7.0 WETLANDS, WILDLIFE, AND FISHERIES

7.1 PROJECT AREA CONTEXT

The Applicant proposes to construct the project, a 22-turbine utility scale wind energy facility in the Towns of Eastbrook and Osborn, and the townships of T22MD and T16MD in Hancock County, Maine. The project will include: upgrades to existing roads and construction of new roads; up to five permanent and up to eight temporary met towers; and a series of 34.5 kV electrical collector lines among the turbines and connecting to an interconnection facility adjacent to an existing substation in T16 MD. The majority of collector lines will be installed underground, though there will be portions of above ground collector lines as well.

The project will be constructed on ridges and hills south of Route 9, including Hardwood Hill, Birch Hill, Een Ridge, Little Bull Hill, and other unnamed hills nearby. Hills within the project area range from 500 to 700 feet in elevation. Surrounding land is primarily managed for commercial timber production, resulting in an extensive network of existing gravel roads throughout the project area.

7.2 AGENCY CONSULTATION

In 2014 and 2018, MNAP, MDIFW, and USFWS were contacted to request information regarding sensitive natural resources, including Essential Habitat, Significant Wildlife Habitat, records of rare, threatened, and endangered wildlife, and rare and exemplary botanical features, that have been documented in the vicinity of the project. MDMR was also consulted to determine the presence of potential habitat for Atlantic salmon (*Salmo salar*) in the project vicinity. The agency response letters and emails are included in Section 9, Exhibit 9-1.

The applicant initially met with MDIFW staff on June 2, 2014, to discuss the scope and methodology for pre-construction wildlife studies and the associated work plan (Exhibit 7-1) for the project. The wildlife surveys performed for the project were approved by the MDIFW, and agency recommendations for survey methods were implemented. At the time, surveys were conducted based on MDIFW's then current Wind Power Pre-construction Study Recommendations dated November 2013 and April 2014.

Bald eagle (*Haliaeetus leucocephalus*) point count locations were based on consultation with the USFWS and were approved by the agency on April 28, 2014. Those eagle point count surveys were conducted in accordance with the USFWS Eagle Conservation Plan Guidance, and the USFWS Maine Field Office was notified prior to initiating these surveys.

MDIFW has expressed concerns with avian impacts from wind energy projects generally and, in particular, risks associated with projects located in the Coastal Plain. In response to those concerns, and with input from MDIFW and Longroad, BRI has generated a draft research outline that includes a proposal to be implemented in connection with the Weaver Wind project that would assess the use of turbine shut-downs to reduce the risk of passerine mortality during spring and fall migration. The proposal includes a combination of research study of a deterrent technology and implementation of operational adjustments or, alternatively, conservation. The research study would assess the effectiveness of shutting down turbines during a portion of the migratory period and determining whether the rate of bird mortality was substantially reduced. If a meaningful reduction is identified, and associated conditions can be predictively used to determine high-risk periods, then an appropriate operational adjustment would be implemented to reduce mortality. Alternatively, if the research concludes that mortality cannot be meaningfully reduced (either because there is insufficient data on which to draw a conclusion or turbine shut-down is not an effective means for reducing mortality), or if conservation is determined to be a preferable means for addressing mortality risk, then a conservation plan for songbirds would be implemented. The conservation effort would target important songbird nesting habitat, disturbed areas that could be enhanced, coastal breeding habitat management practice conversion, or similar measures that would result in concrete and measurable benefits to birds. A conservation analysis is will be conducted to determine the benefit of the conservation measures, to quantify and add specific measurement of the conservation effort. The conservation will be at a comparable level to the anticipated effects of the Project and will benefit a similar guild of bird species as those found at the Project. The proposed study and conservation alternative are still undergoing revision and refinement. It is anticipated that the study plan or conservation alternative would be completed early in MDEP's review of this application and will be implemented as part of the Project. In addition to birds and bats, the Applicant will investigate seed suitability, availability, and species as part of the project's re-vegetation plan to benefit monarch butterfly (*Danaus plexippus*) and yellow-banded bumblebee (*Bombus terricola*) as discussed with MDIFW at a meeting on September 26, 2018.

7.3 DATA COLLECTION

Stantec conducted a variety of natural resource and wildlife field surveys for the project from 2013 through 2016. Some surveys pre-dated the final work plan approved by the agencies, but efforts conformed to the typical standards and practices of pre-construction surveys requested of wind developments in the State at the time. Note that MDIFW's *Maine Wind Power Pre-construction Recommendations and Turbine Curtailment Recommendations to Avoid/Minimize Bat Mortality* (March 2018) (Updated MDIFW Guidance) was not available at the time pre-construction surveys were conducted for the project. The updated MDIFW guidance eliminates the requirement to conduct many of the surveys done for the project and also recommends heightened pre-construction avian surveys for projects located in an area described as the Coastal Plain. All of the survey results conducted for the project are included here in order to provide the most complete information on the project area and potential impacts, including results from surveys that are no longer recommended in the Updated MDIFW Guidance. With respect to avian impacts, the Weaver specific data when combined with data from nearby operating projects provides comprehensive information on avian use and potential impacts. This cumulative data is consistent with the updated MDIFW guidance avian survey recommendations for projects located in the Coastal Plain.

Pre-construction surveys consisted of wetland delineations and wildlife surveys that provided data to assess potential impacts to:

- Wetlands and waterbodies;
- Breeding amphibians;
- Birds and bats ; and
- Rare, threatened, and endangered plants and animals.

7.3.1 Wetlands and Waterbody Delineations

Wetland and waterbody resource delineations were completed in the summer and fall of 2014, and vernal pool survey data from 2009 (Bull Hill Wind Project) was also incorporated into this project for additional reference. Additional vernal pool surveys were conducted in May 2015 to survey potential vernal pools (PVPs) that were identified outside the amphibian breeding season during previous surveys. Delineation for areas adjacent to new or improved access roads that could be impacted by clearing as shown in the project design were re-delineated in 2018. The delineation limits included the following areas associated with the project:

- Summit corridors, generally between 1,000 and 2,000 feet wide, sited for turbines, roads, and electrical collector lines including the hills of Hardwood Hill, Birch Hill, Een Ridge and Little Bull Hill;
- Potential access road corridors, which were approximately 150 feet wide; and
- Electrical collector line corridors between project components and connecting to the existing Bull Hill substation in T16 MD.

Results of the wetland delineation surveys are briefly summarized in Section 7.4 below. Further details of the wetland and waterbody resources identified within the project area, as well as relevant data forms for the project, are provided in Exhibits 7-2-1 through Exhibit 7-2-4. Wetland delineation data were used to modify project designs to minimize resource impacts.

7.3.2 Pre-Construction Wildlife Surveys

Prior to permitting activities for the project, a variety of wildlife surveys were initiated within the project area. Surveys were performed in 2013 and 2014, and eagle point count surveys continued into 2015. Additional nocturnal radar surveys were conducted in fall 2016. Wildlife surveys were conducted to assess the wildlife resources potentially present in the project area.

The scopes of wildlife surveys and analyses were based on several considerations:

- Standard pre-construction survey methods within the wind power industry (i.e., guidelines outlined by the USFWS and MDIFW)'
- Survey efforts within Maine over the past several years that complied with agency requests;
- MDIFW "all-inclusive" protocols (November 2013 and April 2014); and
- MDIFW comments from results of 2013 and 2014 studies.

In addition to pre-construction surveys implemented specifically for the project, results of pre-construction wildlife studies conducted for the nearby Hancock and Bull Hill Wind Projects (2 miles east and 1 mile south, respectively) were also considered. The proximity of these survey efforts to this project provides further insight into wildlife activity within the project area. Table 7-1 summarizes the various pre-construction wildlife surveys conducted for all three wind projects. Combined, there is data available from the project area and immediate vicinity from 8 different years. There are also 2 years of data available from the proposed Downeast Wind Project, located approximately 20 miles southeast of the project, which is not included in Table 7-1.

Table 7-1. Summary of Pre-Construction Wildlife Surveys for Weaver, Hancock, and Bull Hill Wind Projects

Survey	MDIFW 2018 Recommendations	Project			Cummulative Seasons/Years of Onsite and Nearby Studies
		Weaver	Hancock	Bull Hill	
Acoustic Bat Surveys	Only required if talus fields, rocky outcrops, or cliffs are present at the site	· Spring 2014 · Summer 2014 · Fall 2014 * no talus fields, rocky outcrops, or cliffs present at the site	MDIFW deemed this survey unnecessary due to proximity to Bull Hill	· Summer 2009 · Fall 2009 · Spring 2010 · Summer 2010	7 Seasons/ 2.5 yrs
Nocturnal Radar Migration Surveys	For locations in the coastal plain MDIFW recommends a pre-approved, rigorous, independent, and research quality data collection effort consisting of at least 3 years, including at least 6 full seasons (3 spring: April 15-June 1 and 3 summer/fall: July 15-October 31)	· Spring 2014 · Fall 2014 · Fall 2016	MDIFW deemed this survey unnecessary due to proximity to Bull Hill	· Fall 2009 · Spring 2010 · Spring 2011 · Fall 2011	7 Seasons/ 3.5 yrs
Breeding Bird Surveys	typically 1 year, with surveys once in May and twice in June	Spring/Summer 2014	Not conducted	Not conducted	1 breeding season
Raptor Migration Surveys	In mountainous regions, along major river corridors, and in coastal plains, at least 2 years including at least 4 seasons (2 spring and 2 fall): spring (March 1 - June 15) and fall (August 1 - November 30) is recommended	· Fall 2013 · Spring 2014 · Fall 2014	Fall 2012	· Summer 2009 · Fall 2009 · Winter 2010 · Spring 2010	8 seasons/ 4 years
Aerial Eagle Nest Surveys	no longer recommend since not a species of special concern but recommend a spring great blue heron survey which would overlap with eagle nesting period	Spring 2014	· Spring 2012 · Spring 2013	· Spring 2010 · Spring 2011	5 seasons/ 5 years
Eagle Point Count Surveys	2 years recommended by USFWS but not in MDIFW recommendations	· Spring 2014 · Summer 2014 · Fall 2014 · Winter / Spring 2015	Not conducted	Not conducted	4 seasons/ 2 years
Raptor Nest Surveys	not in MDIFW recommendations	- Spring/Summer 2014	Not conducted	Not conducted	1 breeding season
Great Blue Heron Surveys	one spring survey	· Spring/Summer 2014	Not conducted	Not conducted	1

Other site-specific surveys consisted of wetland delineations, vernal pool surveys, and rare, threatened, or endangered species (RTE) surveys. For a complete description of wetland delineation surveys, refer to Exhibits 7-2-1 through Exhibit 7-2-4 of this Section. Details regarding RTE surveys are provided in Section 9, Exhibit 9-2.

Results of the project wildlife surveys are briefly summarized in Section 7.4 below. Additional details of wildlife monitoring studies within the project area are contained in the noted Exhibits.

7.4 SURVEY RESULTS

A brief overview of the natural resources present in the project area is provided below. More detailed information regarding wetland and wildlife surveys performed for the project, wildlife surveys conducted for the nearby Hancock and Bull Hill Wind Projects, as well as other analyses and reports relating relevant information regarding wildlife impacts, is contained in the various exhibits associated with this section:

- Exhibit 7-1: Work Plan for the 2014 Pre-Construction Avian and Bat Survey
- Exhibit 7-2-1: Wetland and Waterbody Delineation and Vernal Pool Report
- Exhibit 7-2-2: Wetland Determination Data Forms

- Exhibit 7-2-3: Photos of Natural Resources Proposed for Impact and/or Adjacent Activity
- Exhibit 7-2-4: Maine State Vernal Pool Results
- Exhibit 7-3: 2014 Preconstruction Avian and Bat Surveys Report
- Exhibit 7-4: Spring 2014 Aerial Bald Eagle Nest Survey Report
- Exhibit 7-5: 2015 Eagle Use Survey Report
- Exhibit 7-6: 2012 Wildlife Habitat Report for the Hancock Wind Project
- Exhibit 7-7-1: Fall 2012 Raptor Survey Results for Hancock Wind Project
- Exhibit 7-7-2: Radar Survey Results for Bull Hill Wind Project (Spring 2010 & 2011 – Fall 2009 & 2011)
- Exhibit 7-7-3: 2012 Re-analysis Results of Radar Surveys for Bull Hill Wind Project
- Exhibit 7-7-4: Bald Eagle Aerial Surveys for Bull Hill Wind Project (2010-2011) and Hancock Wind Project (2012)
- Exhibit 7-7-5: Summer and Fall 2009 and Spring 2010 Avian and Bat Survey Reports for Bull Hill Wind Project
- Exhibit 7-7-6: Fall 2016 Nocturnal Radar Survey Report for Weaver Wind Project
- Exhibit 7- 8: Hancock Post-Construction Monitoring Report
- Exhibit 7- 9: Comparison of Pre-Construction Bird and Bat Activity and Post-Construction Mortality at Commercial Wind Projects in Maine (Revised 2018)
- Exhibit 7- 10: Weaver Wind Project Impacts and Risks to Small Passerine Populations (2018)

7.4.1 Wetlands and Streams

The following is a brief summary of all wetland and waterbody resources identified within the project area:

- A total of 287 wetland resources regulated by the US Army Corps of Engineers (Corps) and Maine Department of Environmental Protection (MDEP).
- A total of 38 wetland resources are considered Wetlands of Special Significance (WSS).
  - 27 of these resources are within 25 feet of a stream
  - 7 of these resources include Significant Wildlife Habitat
  - 4 of the WSS meet both of the above criteria and/or consist of more than 20,000 square feet of open water or emergent vegetation
- A total of 41 streams within the project area.
  - 19 perennial streams
  - 18 intermittent streams
  - 4 ephemeral streams

A complete report of the wetland and stream delineation surveys is provided in Exhibits 7-2-1.

There will be no permanent or temporary fill impacts to wetlands or streams associated with the construction or operation of the project. Construction of the overhead electrical collector lines requires clearing within wetland areas under and directly adjacent to the lines. Following construction, vegetation within the line corridor will be allowed to grow back; however, such vegetation is typically managed/maintained every three to five years to prevent interference with the lines. Maintenance cutting will remove trees and prevent canopy formation, leaving understory vegetation intact, thereby allowing for the development of a stable, dense, shrub-dominated plant community (Section 10.0 and Exhibit 10-1 provide further details regarding vegetation maintenance activities). The total wetland clearing for access roads and collector lines will be approximately 100,037 square feet (or 110,038 square feet with a 10% contingency). Photos of wetlands to be cut are included in Exhibit 7-2-3.

7.4.2 Vernal Pools

Vernal pool surveys were completed in 2014 and 2015, though a subset of vernal pool surveys conducted in 2009 for the Bull Hill Wind Project were incorporated into this project. All naturally occurring pools were surveyed during the appropriate amphibian breeding season in May 2015. Within the project area, 32 vernal pools were identified, 2 of which meet the definition of a Significant Vernal Pool (SVP) under the Natural Resources Protection Act. The significant and non-significant status of these vernal pools were confirmed by the MDIFW in their Vernal Pool Significance Determination letters dated August 3, 2015.

There are 40 PVPs in the project area that are characterized as human-created vernal pools occurring in roadside ditches, roadside borrow pits, or equipment ruts. These pools were identified outside of the peak amphibian breeding period and due to their unnatural origin, were not resurveyed during the amphibian breeding season.

Exhibits 7-2-1 contains a detailed report of the vernal pool surveys conducted in 2009, 2014, and 2015. Table 3: Vernal Pool Summary Table in Exhibit 7-2-1 has been updated based on the 2015 vernal pool surveys. Exhibit 7-2-4 contains the cover letter for the 2015 vernal pool submission to MDIFW and MDIFW's vernal pool significance determinations.

7.4.3 Fisheries

Stream delineation surveys identified 41 streams within the project area, 19 of which are classified as perennial. A complete report of the stream delineation surveys is provided in Exhibit 7-2-1. There is no road crossings proposed for Atlantic salmon habitat streams. Vegetation clearing and maintenance will occur within the buffer of one Atlantic salmon habitat stream, the East Branch of the Union River, in association with the installation and operation of an overhead collector line. The Applicant has detailed the protection measures to be implemented during construction to preserve water quality in compliance with state and federal requirements (Section 10.0 and Exhibit 10-1).

7.4.4 Wildlife Habitat

The project area is primarily dominated by mixed forest including paper birch (*Betula papyrifera*), American beech (*Fagus grandifolia*), balsam fir (*Abies balsamea*), and red spruce (*Picea rubens*). Forested uplands within the project area consist of an even mix of early successional forests, young Beech-Birch-Maple forests, and conifer plantations because of current land use activities related to active timber harvesting. Smaller areas of second growth hardwood forests and second growth red spruce and eastern hemlock (*Tsuga canadensis*) forests are present but less common.

The construction and operation of the project will not impact Deer Wintering Areas, or habitat for state or federally-listed threatened or endangered species.

7.4.5 Wildlife Surveys

Based on MDIFW's current guidance, acoustic bat surveys are required if a project area contains talus field, rocky outcrops, or cliffs that could serve as winter hibernacula or summer roosting habitat for bats. The project does not contain any of these features and therefore acoustic bat surveys would not be recommended at this project under MDIFW's current guidelines. However, at the time surveys were conducted in 2014, MDIFW's guidance recommended acoustic bat surveys and they occurred from April through October using four detectors at two locations within the project area. There were 334 bat call sequences recorded by all detectors, resulting in an overall detection rate of 0.5 bat call sequences per detector-night. Acoustic activity rates peaked in August, with a rate of 1.4 call sequences per detector-night. These results mimic trends observed from acoustic surveys conducted at proposed wind energy projects across the state with detection rates low to zero during the spring, gradually increasing during summer months, and then gradually decreasing into the fall. Overall, a small percentage of identified calls were of the genus *Myotis* (3.6%), which include the species listed as either threatened or endangered in Maine. Data compared to the nearby Bull Hill Wind Project showed similar detection rates with respect to met tower mounted detectors while detection rates at tree detectors at Weaver were significantly lower than Bull Hill. Results from available studies have not shown bat detection rates to correlate to post construction collision risk; however, bat activity has been positively correlated with nightly mean temperatures and negatively correlated with average nightly wind speeds indicating that operational strategies to minimize risk of collision is possible. Approximately 52% (n=173) of bat call sequences were recorded when nightly average temperatures were 16ºC (60.8ºF) or above and 69% (n=232) of call sequences were recorded when average nightly wind speeds were 5 m/s or less. Detailed results of pre-construction bat monitoring efforts are provided in Exhibit 7-3.

During 2013 turbine mortality searches at the nearby Bull Hill Wind Project, there were 19 bats found, 10 of which were little brown bats (*Myotis lucifugus*; not listed at the time but currently state endangered), 3 eastern red bats (*Lasiurus borealis)*, 3 silver-haired bats (*Lasionycteris noctivagans*), 2 hoary bats (*Lasiurus cinereus*), and 1 unidentified bat[1]. During 2014 mortality monitoring at Bull Hill, there were two hoary bats and one silver-haired bat found[2]. In 2017, bats found during mortality searches at the nearby Hancock Wind Project included two silver-haired bats and one eastern red bat (Exhibit 7- 8). All three tree-roosting bat species are considered Special Concern in Maine. Tree-roosting bats represent the majority of bat species found during mortality searches at wind projects in North America and it is tree-roosting bats that are expected to be at risk of collision at the project. Maine has reported among the lowest bat fatality rates at operational projects in the northeast with the highest rates found in southern northeastern states (i.e., Pennsylvania and West Virginia).

MDIFW's recent guidance recommends that a pre-approved, rigorous, independent, and research quality data collection effort is conducted for Projects located in the Coastal Plain. This effort should consist of at least 3 years, including at least 6 full seasons. Nocturnal radar surveys were conducted for a total of 3 seasons at the project and 4 seasons were conducted at the nearby Bull Hill Project. In total, 7 seasons of radar data is available for this part of the state.

Nocturnal radar surveys conducted at the project included 60 nights total, with 20 nights of survey during spring 2014, 20 nights during fall 2014, and 20 nights during fall 2016. Radar surveys documented abundance, flight patterns, and flight altitudes of nocturnal migrants in the project area. The radar unit was centrally located during each survey within the project area on Een Ridge. The overall mean passage rate for the spring 2014 survey period was 806 (±56) targets per kilometer per hour (t/km/hr) and 657 (±29) t/km/hr during the fall 2014 survey period. The overall passage rate for the fall 2016 survey period was 543 ± 28 t/km/hr. The spring passage rate at the project was at the upper range of results observed at proposed wind projects in Maine (147-806 t/km/hr) and within range for the eastern United States (110-1,020 t/km/hr). The average passage rate during the fall seasons were within the range of results observed at proposed wind projects in Maine (201-952 t/km/hr) and in the eastern United States (64-980 t/km/hr).

The overall mean flight heights for the spring 2014 survey period was 365 (±2) m and 412 (±1) m during the fall 2014 survey period. The overall mean flight height for the fall 2016 survey period was 479 ± 1 m. The spring flight height at the project was greater than proposed turbine height of 180 m and at the upper range of results observed at proposed wind projects in Maine (210-384 m) and within range for the eastern United States (210-541 m). The average flight height during the fall seasons were above the proposed turbine height of 180 m and within the upper range of results observed at proposed wind projects in Maine (279-453 m) and in the eastern United States (203 - 644 m). Additional details regarding radar surveys are presented in Exhibit 7-3 and Exhibit 7-7-6. There has been no direct relationship observed between radar flight heights and mortality in the region, even at sites with relatively low flight heights (Exhibit 7- 9).

[1] Bull Hill Wind Project Year 1 Post-Construction Wildlife Monitoring Report, 2013. Stantec, 2014.
[2] Bull Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Stantec, 2015.

Consistent with MDIFW's recent guidelines, breeding bird point count surveys were conducted at the Weaver Wind Project during May and June of 2014 within six different habitat types representative of the project area. A total of 599 individuals representing 52 species were detected during the surveys. Recently-disturbed mixed forest habitats had the greatest number of individuals and highest species richness. No federally or state-threatened or endangered species were detected during the surveys, though several state species of special concern were documented. Species detected were representative of the habitats in which they were observed and were generally regionally common and abundant; therefore, impacts related to habitat loss or edge effects resulting from development of the Project are not expected to impact rare or listed species. Further details of these surveys are contained in Exhibit 7-3.

Based on MDIFW's current guidance, raptor migration surveys are required for at least two years (including at least 4 seasons; two spring seasons and two fall seasons) if a project area is located within a mountainous region, along major river corridors, and in coastal plains. Although these guidelines were not available at the time of surveys, the raptor migration surveys conducted at the project combined with data available from the Bull Hill and Hancock Wind projects totaled 4 years of survey, over the course of 8 different seasons.

Raptor migration surveys were performed in the fall of 2013 and spring and fall of 2014. Ten surveys were conducted in each season. Fall 2013 surveys resulted in 62 raptor observations, with a passage rate of 0.89 raptors per hour. There were 113 raptor observations in the spring of 2014, with a passage rate of 1.61 raptors per hour. Fall 2014 surveys resulted in 88 raptor observations, with a passage rate of 1.26 raptors per hour. Raptor activity and passage rates within the project area were comparable to those documented during raptor migration surveys conducted for the nearby Hancock Wind Project and Bull Hill Wind Project. Detailed results of raptor migration surveys are provided in Exhibit 7-3. There has been no direct relationship observed between raptor passage rates and mortality in the region; low raptor mortality has been observed in Maine, even at sites with relatively high pre-construction raptor activity (Exhibit 7- 9). Raptors represent a small proportion of observed mortality in Maine: there have been 4 raptor fatalities documented in 23 publicly available Maine post-construction studies involving more than 13,000 turbine searches (Exhibit 7- 9).

Aerial eagle surveys for bald eagle nests near the project (within 10 miles) occurred on three days during the spring and summer of 2014. These surveys are not required in MDIFW's recent guidelines due to the delisting of bald eagles in the State of Maine, however they are recommended as part of USFWS's Final Eagle Rule and Eagle Conservation Plan Guidance[3]. Consistent with the Eagle Rule, and within the 10-mile survey area, seven occupied and six unoccupied nests were documented. Six of the occupied nests hatched at least one eaglet. Detailed results of these surveys are presented in Exhibit 7-4. Wind projects in Maine, including the Record Hill Wind Project and Rollins Wind Project, have documented continued nesting success of bald eagles that nest within a few miles of operational turbines, with no eagle fatalities observed[4] [5].

Eagle point count surveys were conducted from April through October of 2014 and November through April of 2015. While these surveys are not required in MDIFW's recent guidelines due to the delisting of bald eagles, they are recommended as part of the USFWS's Final Eagle Rule and Eagle Conservation Plan Guidance. Consistent with the Eagle Rule, point count surveys were conducted for 2 hours per visit to each of 6 800-meter radius points. There were 18 eagles observed: 16 bald eagles and 2 unidentified eagles. Eagles were observed at all 6 points. There were 31 eagle minutes observed within the turbine rotor-sweep zone. Further details of these surveys are contained in Exhibit 7-5. There have been no eagle fatalities documented during mortality monitoring at wind projects in Maine.

---

[3] https://www.fws.gov/birds/management/managed-species/eagle-management.php
[4] *Final Post-Construction Monitoring Report, Year 3, Record Hill Wind Project.* Stantec, 2017.
[5] *Rollins Wind Project Year 3 (2016) Post-Construction Monitoring Report*. Stantec, 2017.

Raptor nesting surveys, although not currently recommended in MDIFW's recent guidelines, were implemented simultaneously with breeding bird surveys, aerial eagle nest surveys, and eagle point count surveys. No active raptor nests were located within one mile of turbine locations, although two species of raptors were suspected to be breeding within the project area. Further details of these surveys are provided in Exhibit 7-5.

Consistent with MDIFW's recent guidelines, Great blue heron surveys were implemented concurrently with raptor migration surveys, aerial eagle nest surveys, and eagle point count surveys. Great blue herons were not observed in the areas of proposed turbines. Additional details regarding these surveys are contained in Exhibit 7-4.

7.5 ALTERNATIVES ANALYSIS

The proposed project is located within an area designated for expedited wind permitting in the State of Maine, 35-A M.S.R.A. Chapter 34-A (State of Maine, 2008). The project is specifically sited to maximize energy generation while minimizing impacts to environmental resources. Selection of a viable wind energy project site is based on a multitude of factors including quality of wind resource, suitable geography, proximity to transmission infrastructure, and compatibility with existing land uses. In determining the location of the project, existing wind data from nearby projects (Bull Hill Wind and Hancock Wind) was advantageous to the siting process. As part of Bull Hill Wind and Hancock Wind, several years of wind data were collected and evaluated. The resulting evaluation concluded that wind resources were well suited for wind energy generation in this area/terrain of Maine. Additional factors favorable for wind development in the area include sparse residential development, proximate access to the electrical grid that avoids the need for new transmission lines, and the relatively large percentage of uplands in the project area.

The overall project design objective was to maximize wind energy generation and minimize environmental impacts. The final project size, design, and layout reflect an iterative process in which multiple hilltops were evaluated for siting the wind generation facilities, and alternative electrical transmission options were considered.

The preliminary project layout (Figure 7-1) was developed using screening level data available in published literature such as: soil survey maps, National Wetland Inventory maps, and Significant Wildlife Habitat maps. Turbines were sited in areas that satisfied the turbine selection criteria and which, based on the available screening level data, had limited potential to impact wetlands and associated regulated resources (e.g., streams, water bodies, and Significant Wildlife Habitats). The preliminary layout consisted of 30 turbines and included consideration for three transmission/substation alternatives. The final project layout (Figure 7-2) was developed in consideration of the previously mentioned studies. Several locations for turbines, collector lines, substations, and roads were reviewed with the goal of identifying a project layout that meets the project purpose with the least environmental impact. The Applicant considered multiple criteria when determining turbine locations for the proposed project. The most important criteria were the presence of a quality wind resource based on existing data from Bull Hill Wind and Hancock Wind. With known wind resources in the area, measures were taken to reduce the impacts of construction and operation of turbines. Proximity of the turbines to existing infrastructure (e.g., roads and electrical substations) was an important factor, as it minimized the number/length of new roads needed for the project and subsequently reduced the amount of disturbance required for cutting and filling. Moderate slopes were preferred and selected to minimize the amount of erosion and runoff potential, as well as to reduce cut and fill impacts. Avoiding wetlands, stream crossings, and other high-value natural resources (i.e., Significant Wildlife Habitat) was also an important consideration in the siting of turbines and locations of electric transmission lines and new roads. Maintaining buffers around natural resources was also factored into the design process.

Further avoidance and minimization efforts included micro-siting or eliminating turbines, using existing roads to the maximum extent practicable, installing most electrical collector lines underground within existing or new roads, adjusting spacing between poles for overhead lines, narrowing access road footprints in some areas, and adjusting turbine grading limits. Turbine pads were sited in upland areas away from wetland boundaries as much as was feasible. Footprints of some turbine pads were reshaped or reduced to avoid impacts to nearby wetlands.

As a result of careful avoidance and minimization during the siting process, there are no impacts to Significant Wildlife Habitat including the Critical Terrestrial Habitat (CTH) of the two Significant Vernal Pools (SVPs) located within proximity to the project area. Soil disturbance will occur in three Inland Waterfowl and Wading Bird Habitats (IWWHs) that straddle Spectacle Pond Road. The disturbance will be trenching within the existing road during installation of the underground collector line system, soil disturbance will not occur in any previously undisturbed areas within the IWWHs. The project will not result in permanent or temporary fill of any regulated wetlands and will not require any in-stream work. Clearing of wetland vegetation will occur, but it is limited to clearing adjacent to existing roads as required to accommodate turbine transport and locations along the above ground portion of the collector line. Using existing roads minimizes overall project impacts and clearing vegetation in adjacent wetlands will result in a minimal loss of functions or values of the wetlands. In addition, roadside clearing for turbine delivery is a one-time occurrence with a de minimis impact on the resource, and collector line clearing converts wetland type, but does not fill in wetlands.

7.6 PROJECT IMPACTS

Based on the information gathered from the surveys identified above, the project layout and footprint was designed to optimize engineering and wind resource conditions while avoiding and/or minimizing environmental impacts. Construction and operation of the project will result in minimal impacts to environmental resources (Table 7-2). As designed, the construction of the project will not result in any soil disturbance or temporary or permanent fill in wetlands. Certain project activities, such as cutting vegetation, filling, disturbing, and installing stormwater controls are proposed adjacent to some regulated natural resources and will require a permit from the MDEP pursuant to the Natural Resources Protection Act (NRPA). To address the proposed impacts, a NRPA Tier 3 application has been completed for the project. The impacts proposed by the project fall into two categories:

- Clearing vegetation in wetlands; and
- Clearing and soil disturbance adjacent to protected natural resources.

A summary of proposed impacts to natural resources is provided in Table 7-3.

Table 7-2. Summary of Environmental Impacts from the Weaver Wind Project

Environmental Resource	Estimated or Potential Impact
Vegetation and Habitat	No RTE species and no unique botanical features identified. Project area is dominated by mixed forest communities.
Wetlands	No permanent or temporary wetland fill. Vegetation clearing within up to 110,038 square feet of wetlands.
Atlantic Salmon	The project is located within designated critical habitat for Atlantic salmon. No direct in-stream work is proposed within the project area. Vegetation clearing and maintenance will only be required within one Atlantic salmon habitat stream buffer.
Significant Vernal Pools	No vegetation clearing within the CTH of SVPs.
Other Significant Wildlife Habitat	Minor disturbance of soil in an existing road that bisects 3 IWWH, no expansion of existing impact footprint. No impacts to other Significant Wildlife Habitat.
Birds	The project area does not contain habitat that supports state or federally listed species. Passage rates and flight heights for diurnally migrating raptors are consistent with other projects in Maine. Nocturnal migrant passage rates are on the higher end, but within range of other studies in Maine and documented mean flight heights are well above the proposed turbine height. The nearest active bald eagle nest was identified 3.2 miles from the nearest proposed turbine. Although correlations between preconstruction survey results and post construction risk have not been found at any project in Maine, or the northeast (Exhibit 7- 9), post construction bird fatality data in Maine overall is low and collectively has not been found to cause population level effects on any bird species (Exhibit 7- 10). No take of any threatened or endangered bird species has been observed in Maine and bird fatalities are largely common species in the State. Bird fatality data from nearby operational projects (Bull Hill and Hancock) do not appear to be greater than operational projects in other parts of the state and similar impacts are expected at Weaver.
Bats	Detection rates consistent with other Maine sites. Turbine curtailment will occur during periods of increased risk of collision.

Table 7-3. Summary of the Proposed Area and Occurrence of Proposed Impacts adjacent to or within Protected Natural Resources

Resource Type	Impact Type	Impact	Number of Occurrence
Direct Wetland Impact			
Non-Wetlands of Special Significance	Vegetation clearing for turbine transport. Additional clearing for one temporary laydown area, one guy wire installation, and the overhead collector line installation[1]	85,188 sq. feet (93,707)	24
Wetlands of Special Significance (WSS)	Vegetation clearing for turbine transport[1]	14,849 sq. feet (16,334)	8
Impacts to Significant Wildlife Habitat			
Significant Wildlife Habitat	Soil disturbances in existing roads within three IWWH areas.	NC[2]	3
Activities Adjacent to Protect Natural Resources			
Streams	Soil disturbance associated with installation of underground collector line within existing gravel road, placement of overhead collector line poles, and placement of rip-rap outside of protected natural resources, located within 75 feet of a river, stream, or brook.	NC[2]	11
	Vegetation cutting to the edge of the stream.	358 linear feet	7
WSS	Soil disturbance associated with installation of underground collector line within existing gravel road, placement of overhead collector line poles, turbine pad grading, met tower laydown area grading, and placement of timber crane mats located within 75 feet of a WSS (not associated with a stream).	NC[2]	0

[1]For direct wetland impacts, the Applicant has applied an additional 10% for vegetation cutting that may occur in tree line to account for vegetation regrowth that may occur between the time survey plans are developed to the time the project is constructed. This total is shown in parentheses.

[2]NC = Not calculated due to variability in impacts caused by the installation of the underground collector. In most cases, a surficial area disturbance of four to ten square feet per linear foot of collector line is expected.

7.6.1 Direct Impacts to Wetlands

Proposed wetland alterations include one-time cutting of vegetation within 32 wetlands to facilitate the transportation of turbine components and construction of overhead electrical lines. In general, vegetation will be cut one to two feet from the ground surface, and low growing herbaceous plants less than one foot tall will remain uncut. The collector has several locations where the existing road narrows through sensitive resource areas; the electrical design goes above ground in some of these areas. Experience during construction of the Bull Hill and Hancock projects demonstrated that the substrate under these log roads through wetlands is stumps and muck, resulting in unstable trenches and installation that destabilizes the roadway. Above ground construction in these areas avoids that disturbance and potential for discharge.

Further discussion of vegetation maintenance and resource buffers is provided in Section 10.0. Temporary and permanent wetland alterations are summarized in Table 7-4. The locations of wetland vegetation cutting proposed for the project are shown on the civil and electrical design plans (Application Exhibits 1 and 2) It should be noted that there is no direct filling, bulldozing, or removing/displacing soil, sands, or other materials proposed within wetlands.

Table 7-4. Summary of Wetlands with Proposed Vegetation Clearing

Wetland Id	WOSS	Wetland Type[1]	Area of Clearing (Square Feet)	Exhibit/Sheet Number
W279	No	PFO	606	Exhibit 1, Sheet 20
W276	No	PFO	3,672	Exhibit 1, Sheets 20 and 21
W277	No	PFO	451	Exhibit 1, Sheets 20 and 21
W278	No	PFO	1,171	Exhibit 1, Sheets 20 and 21
W110	Yes	PSS	936	Exhibit 1, Sheet 35
W164	Yes	PFO	2,185	Exhibit 1, Sheet 36
W166	Yes	PFO	494	Exhibit 1, Sheet 36
W167	Yes	PFO, PSS, PEM	6,796	Exhibit 1, Sheet 36
W172	No	PFO	313	Exhibit 2, Sheet W-E 109
W174	No	PFO, PEM	497	Exhibit 1, Sheet 37
W175	Yes	PFO, PEM	350	Exhibit 1, Sheet 37
W186	No	PFO, PEM	44	Exhibit 1, Sheet 40
W189	Yes	PFO, PSS	90	Exhibit 1, Sheet 40
W211	No	PSS	16	Exhibit 1, Sheet 27
W224	No	PFO, PSS	2,056	Exhibit 1, Sheet 28
W232	No	PFO, PSS, PEM	1,853	Exhibit 1, Sheet 30
W231	No	PFO, PSS, PEM	5,210	Exhibit 1, Sheet 30
W229	No	PFO, PSS, PEM	124	Exhibit 1, Sheet 30
W242	Yes	PFO, PSS, PEM	615	Exhibit 1, Sheet 31
W244	No	PFO, PSS, PEM	9,070	Exhibit 1, Sheet 31
W005	No	PFO	14,105	Exhibit 2, Sheet W-E 119
W011	No	PFO, PSS	78	Exhibit 2, Sheet W-E 120
W021	Yes	PFO	3,383	Exhibit 2, Sheet W-E 121
W020	No	PFO	480	Exhibit 2, Sheet W-E 121
W024	No	PFO, PEM	257	Exhibit 2, Sheet W-E 121
W271	No	PFO	1,119	Exhibit 2, Sheet W-E 102
W270	No	PFO	1,366	Exhibit 2, Sheet W-E 102

Wetland Id	WOSS	Wetland Type[1]	Area of Clearing (Square Feet)	Exhibit/Sheet Number
W273	No	PFO	1,955	Exhibit 2, Sheet W-E 102
W272	No	PFO	1,334	Exhibit 2, Sheet W-E 102
W268	No	PFO	4,049	Exhibit 2, Sheet W-E 102
W267	No	PFO	5,232	Exhibit 2, Sheet W-E 102
W269	No	PFO	30,130	Exhibit 2, Sheet W-E 102
		Subtotal	100,037	
		Total + 10% for vegetation regrowth	10,001	
		Total	110,038	

[1]Wetland type based on Cowardin Classification System (Cowardin et al. 1979)
PFO – Palustrine (Freshwater) Forested Wetland
PSS – Palustrine Scrub-Shrub Wetland
PEM – Palustrine Emergent Wetland

7.6.2 Impacts to Significant Wildlife Habitat

There are no impacts to Significant Wildlife Habitat. No clearing or soil disturbance will occur within the CTH of the two SVPs identified adjacent to the project area (SVP_53KN_N and SVP_63KN_N). Soil disturbance associated with the underground collector line will occur in three locations where Spectacle Pond Road goes through IWWHs (UMO-10168, UMO-13356, and UMO-12420). Soil disturbance will be limited to trenching within the existing gravel road, with no expansion in to the IWWHs.

7.6.3 Activities Adjacent to Protect Natural Resources

Activities adjacent to protected natural resources are regulated under the NRPA. The project proposes the following activities adjacent to protected resources:

- Soil disturbance within 75 feet of 8 WSS;
- Soil disturbance within 75 feet of 11 streams; and
- Vegetation cutting within 25 feet of streams in 7 locations

The soil disturbances listed above will all occur within existing gravel roads and are associated with the installation of the underground collector line system. Vegetation cutting within 25 feet of streams is proposed to allow passage of turbine components on existing roadways. These will be one-time cuts that will be completed as an initial step of project construction. Once turbine components are transported to the site, there will be no need for additional cutting. The locations of vegetation cutting along the edge of streams are shown on the Civil Design Plans (Exhibit 1).

7.6.4 Bat Impacts

Research at operating wind facilities indicates that curtailment of wind turbines has the potential to reduce bat mortality. Curtailment consists of altering (delaying) the operation of a wind turbine so that it begins spinning to generate energy at a wind speed greater than its normal "cut-in" wind speed. For example, the turbine blades will begin spinning and the generator will begin producing electricity once wind speeds reach 5.0 meters per second (m/s) rather than the typical 3.0 or 3.5 m/s. The documented reduction in bat fatality rates at these cut-in speeds reflects data that indicate that activity (foraging, migrating, swarming, etc.) decreases significantly as wind speed increases beyond the 3 to 5 m/s range.

The Applicant will operate with a cut-in wind speed of 6.0 m/s from at least ½ hour before sunset to at least ½ hour after sunrise each night from April 15 to September 30, when the ambient air temperature is at or above 32 degrees Fahrenheit, consistent with MDIFW's Maine Wind Power Pre-construction Recommendations and Turbine Curtailment Recommendations to Avoid/Minimize Bat Mortality (March 2018).

7.6.5 Avian Impacts

Since the late 1990s the wind energy industry has collected extensive pre- and post-construction data across the country regarding impacts to birds and bats as a result of turbine operation. In Maine, there are 10 wind projects for which pre- and post-construction data is available, with studies spanning 10 years (Exhibit 7- 9). An analysis of this data concluded, among other evaluations, that there is no consistent relationship between pre-construction avian passage rates and post-construction mortality. These analyses provide context in evaluating the possible level of impact at the proposed Weaver project. Mean annual bat mortality estimates ranged from 0.12 – 2.95 bats/MW (mean = 0.76) and estimated annual bird mortality ranged from 0.54 – 6.95 birds/MW (mean = 2.78) per site.

Using mortality rates from studies in the region, WEST, Inc. estimated potential impacts to small passerine populations in the Atlantic Northern Forest region which includes Maine, New Brunswick, and Nova Scotia, and parts of New Hampshire, Vermont, and Quebec, and New York. Based on 30 studies, small passerine fatalities consist of 0.44 to 5.75 small passerines/MW/year, with a mean of 2.40 small passerines/MW/year (Exhibit 7- 10) for the low estimator bias adjustment, and 1.70 small passerines/MW/year (Exhibit 7- 10) for the high estimator bias adjustment. For those species most commonly found during turbine mortality searches, red-eyed vireo (*Vireo olivaceus*), golden-crowned kinglet (*Regulus satrapa*), and magnolia warbler (*Setophaga magnolia*) mortality was estimated at 0.19, 0.14, and 0.08 fatalities/MW/year, representing less than 0.015 percent of the Atlantic Northern Forest region populations of each of these species (Exhibit 7- 10). WEST found that avian estimated fatality from the proposed Weaver Project, observed fatality from the operation Bull Hill and Hancock Wind Projects are very small and effectively immeasurable on regional small passerine populations. Additionally, WEST found that the cumulative impacts of all avian fatalities from all operational projects in BCR14 combined also has an effectively immeasurable effect on regional populations (Exhibit 7- 10). West noted that relatively large-scale fatality events that have been documented at wind projects are orders of magnitude lower than those observed at other man-made, lit structures including communication towers and buildings. Annual communication tower mortality is estimated to be 20 times greater than small passerine mortality in the Atlantic Northern Forest region (Exhibit 7- 10).

Although evidence demonstrates that the project will not have an undue adverse impact to individual bird species populations or nocturnal migrants as a whole, the Applicant has worked closely with MDIFW and Biodiversity Research Institute (BRI) to address MDIFW's concern for avian collision risk at the Project and is developing a post-construction plan that addresses potential options for data collection, further minimization and potential mitigation (see sections 7.2 and 7.7 of the application).

7.7 POST-CONSTRUCTION MONITORING

The project will consist of 22 turbines, which makes it similar in size to other wind projects in Maine and it will be located on a previously harvested forested ridge that does not contain habitat for state or federally listed avian species. Therefore, it is expected that avian and bat mortality rates and species composition associated with the project will be relatively similar to mortality documented at these other wind projects, in particular, the adjacent Bull Hill Wind Project and the nearby Hancock Wind Project.

As discussed in Section 7.2 above, through meetings with MDIFW and discussions about potential means for addressing MDIFW's concerns about the risk of bird mortality at the project, BRI was engaged to develop a post-construction plan that addresses potential options for minimization and mitigation. The BRI plan includes a number of options for consideration that are currently being analyzed to determine which measures will be implemented as part of the project. Turbine shut-down and intensive (daily) mortality monitoring with dogs and handlers to assess whether this is one measure to reduce mortality is one option, and conservation commitments to increasing songbird production is another option.

Exhibit 7-1

Work Plan for 2014 Pre-Construction Avian and Bat Surveys

Work Plan for 2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project

Weaver Wind Project
Hancock County, Maine

Prepared for:
First Wind, LLC
129 Middle Street, 3rd Floor
Portland, ME 04101

Prepared by:
Stantec Consulting
30 Park Drive
Topsham, ME 04086

June 18, 2014

Table of Contents

1.0 INTRODUCTION 1

2.0 AVIAN AND BAT SURVEYS 2
2.1 ACOUSTIC BAT MONITORING 2
2.2 NOCTURNAL RADAR MIGRATION SURVEYS 2
2.3 BREEDING BIRD SURVEYS 3
2.4 DIURNAL RAPTOR MIGRATION SURVEYS 3
2.5 EAGLE POINT COUNT SURVEYS 4
2.6 AERIAL EAGLE NEST SURVEYS 4
2.7 RAPTOR NEST SURVEYS 5
2.8 GREAT BLUE HERON SURVEYS 5
2.9 REPORTING 6

3.0 SUMMARY OF SURVEYS CONDUCTED IN THE VICINITY 6

June 18, 2014

1.0 INTRODUCTION

Starting in the fall 2013, Stantec Consulting Services Inc. (Stantec) initiated pre-construction bird and bat surveys to assess bird and bat activity / presence within the project area of First Wind, LLC's proposed Weaver Wind Project in Hancock County, Maine. The proposed project is located in 3 towns and townships in Hancock County, including Eastbrook, Osborn, and T16 MD (Figure 1). The project area is adjacent to the existing operational Bull Hill Wind Farm located near Maine State Route 9 and the permitted but not yet constructed Hancock Wind Project, both owned by First Wind. Turbines at the Weaver Wind Project are proposed on Hardwood Hill, Weaver Ridge, and Een Ridge to the north and Little Bull Hill to the south (Figure 1). The project would include up to 30 turbines with associated collector lines and access roads. The proposed turbines have a maximum height of 145 meters (476').

Stantec has based this work plan on the Maine Department of Inland Fisheries and Wildlife's (MDIFW) two most recent *Wind Power Preconstruction Study Recommendations* dated November 2013 and April 2014 and discussions held with MDIFW during a meeting with First Wind and Stantec on June 2, 2014 at MDIFW's Bangor Office. Surveys were initiated in fall 2013 and will continue through 2014. Pre-construction bird and bat surveys conducted or initiated at the project include:

- Fall 2013 Diurnal Raptor Migration Surveys (Completed)
- Spring, Summer, and Fall Acoustic Bat Monitoring (Initiated)
- Spring and Fall Nocturnal Migration Radar Surveys (Initiated)
- Breeding Bird Surveys (Initiated)
- Diurnal Raptor Migration Surveys (Initiated)[1]
- Eagle Point Count Surveys according to USFWS's Eagle Conservation Plan Guidance (ECP; 2014) (Initiated)
- Aerial Eagle Nest Surveys (Initiated)
- Raptor Nest Surveys (Initiated)
- Great Blue Heron Surveys (Initiated)

The following sections describe in detail the methods of each of the surveys conducted or initiated at the project.

[1] Stantec conducted fall raptor migration surveys at the project in fall 2013; therefore only spring raptor migration surveys will be conducted at the project in 2014.

2.0 AVIAN AND BAT SURVEYS

2.1 ACOUSTIC BAT MONITORING

Consistent with MDIFW's 2014 Wind Power Pre-construction Recommendations, which call for a high (20 meters) and low (5-8 meters) detector at each of the onsite met towers, 4 acoustic bat detectors were deployed in the project area; two detectors in each of the two met towers onsite (Figure 1). Acoustic bat detectors were deployed in mid-April, 2014 and will operate through mid-October, 2014. The timing of the bat acoustic surveys coincides with the spring migration, summer residency, and fall migration activity periods for bats and is consistent with MDIFW recommendations. The purpose of this passive acoustic bat survey will be to sample and document the level and timing of bat activity at the project area.

Anabat detectors (Titley Electronics Pty Ltd.) will be used for data collection due to their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, allowing for detection of all species of bats known to occur in Maine. The detectors will sample from approximately ½ hour before sunset until ½ hour after sunrise on a nightly basis throughout the survey period. Detectors will be visited approximately every 2 weeks to download data and check the condition of the detectors.

Once all data are downloaded, each data file will be visually inspected to screen out bat calls, and each call file will be qualitatively identified to guild and to species, when possible. A "pass," or call, will be defined as any file with ≥2 echolocation pulses. Biologists experienced in qualitative analysis of acoustic bat data will conduct the analysis, and a second experienced biologist will conduct a QAQC review of analyzed calls. Bat call sequences will be identified to guild and species when possible. Once all call files are identified and categorized into appropriate guilds, nightly tallies of detected calls will be compiled to provide an index of bat activity. To describe bat activity levels in relation to weather variables, Stantec will obtain weather data from the onsite met towers. Weather data will include average nightly wind speed and average nightly temperature.

2.2 NOCTURNAL RADAR MIGRATION SURVEYS

Stantec initiated nocturnal radar surveys at the project in spring 2014 using an X-band marine radar unit. Surveys will follow MDIFW recommendations and will be conducted in the spring and fall 2014 to document the abundance, timing, and flight altitudes of night-migrating species. Surveys will be conducted from the fall 2013/spring 2014 raptor survey location on the summit of Een Ridge (Figure 1). Topography and surrounding tree height provide a nearly unobstructed view with less than 30% ground clutter as called for in MDIFW recommendations.

Stantec conducted surveys on 20 nights in spring (between April 15 and May 31) and will conduct 20 nights in fall (between August 15 and October 15), 2014. Radar surveys will include up to 12 hours of data collection per night of both vertical and horizontal data. Vertical data will be used to calculate flight heights and percent of migrants flying below proposed turbine height; horizontal data will be used to calculate passage rates and flight direction. Because radar systems cannot detect birds in heavy or consistent rain, sampling will focus on nights with generally clear weather within the sampling periods. On nights when only showers are forecasted, surveys will occur between passing showers to collect information on migration activity during inclement weather.

Radar data will be post-processed using analysis software and methods developed by Stantec which is consistent with most radar surveys conducted in the state. Digital image data will be converted to numerical data for the calculation of migration statistics. Insect data will be separated from other target data based on target flight speed. Stantec will calculate and report the average hourly and nightly traffic rate (targets/kilometer/hour), seasonal traffic rate, nightly and seasonal flight direction, and nightly and seasonal flight height. The percentage of targets flying below the height of the proposed turbines will be calculated.

2.3 BREEDING BIRD SURVEYS

Stantec will conduct breeding bird surveys (BBS) in spring/summer 2014 to characterize presence of breeding birds heard or visually identified in the project area. Surveys will be conducted in accordance with United States Geological Survey (USGS) BBS techniques, which are consistent with those conducted at other proposed wind power projects in Maine and MDIFW 2014 recommendations.

Stantec biologists will conduct 1 breeding bird field survey in May and 2 in June. BBS surveys will consist of point count surveys to count singing male birds or birds seen during a 10-minute sampling period. BBS surveys will occur at approximately 20 survey points spread throughout the project area (one point spaced approximately every 250 meters as per the USGS BBS techniques) in representative habitats and proposed turbine locations (Figure 1). Point counts will be marked with a GPS unit. Breeding birds observed incidentally between points or outside the 10-minute surveys also will be recorded. Surveys will occur on fair-weather days, when weather variables (e.g. wind and rain) do not hinder the observer's ability to detect singing birds. Data will be recorded on standardized datasheets and will be summarized to determine species richness, relative abundance, species frequency, and community diversity.

2.4 DIURNAL RAPTOR MIGRATION SURVEYS

Stantec conducted diurnal raptor surveys at the project in fall 2013 and spring (mid-April to late May) 2014 to document the species composition and flight patterns of migrating raptors in the vicinity of the project. Survey methods are consistent with MDIFW's recommendations and those typically conducted for proposed wind power projects in Maine. Raptor surveys were conducted at the same location each season from Een Ridge (Figure1). Surveys occurred during 10 days in fall and 10 days in spring. Surveys were conducted on days with optimal migration weather, which typically includes fair days with thermal development and winds generally from a southerly direction. Raptor surveys were conducted from 9 am to 4 pm. Binoculars and spotting scopes were used to aid in identification. Data was documented on Stantec raptor datasheets and included flight pattern and location, flight behavior, flight height, flight time, as well as weather conditions. Data will be analyzed and summarized by hour, day, and for the season, and average passage rate, species composition, and average flight height will be calculated. Figures showing the viewshed from the survey location will be included in the final report.

2.5 EAGLE POINT COUNT SURVEYS

Stantec will conduct point count surveys at the project area for eagles for one full year, consistent with the ECP Guidance. Point count surveys will consist of 2-hour visual surveys at 6 plots within the Project area, each with an 800-meter radius and covering an area of 2 square kilometers. Stantec will survey 6 points[2] each cycle (once approximately every 3 weeks) totaling 18 point count surveys in 1 year; point count locations will be surveyed within a 2-day period. Point count locations are distributed throughout the Project area where the observer has a suitable (or clear?) view of the sky; points will not be conducted in forested areas unless suitable vantage points exist. Proposed point count locations are based on consultation with USFWS (on April 16, 2014) and approved by USFWS on April 28, 2014 (Figure 1). Point count locations will be mapped using a Global Positioning Systems (GPS) unit. Surveys will occur in all weather conditions except when visibility is very poor. Survey efforts will target all hours of daylight. The starting point count location will change each survey cycle to enable sampling of each plot during a range of daylight hours. Though the species targeted during point count surveys are bald eagles, all raptors observed will be recorded. In addition, Stantec will record incidental observations of other species (i.e., waterbirds and songbirds) observed during surveys. Data will be summarized in a memo report with an associated map.

2.6 AERIAL EAGLE NEST SURVEYS

Stantec will assess the nesting eagle population in the vicinity of the project by conducting aerial eagle nest surveys. The survey area includes the project area plus a 10-mile buffer, as recommended by the ECP Guidance (Figure 1). Prior to the first survey, Stantec reviewed information provided by MDIFW regarding known active and historic eagle nest locations near the project area. Known eagle nest locations will be surveyed as well as waterbodies and other potentially suitable habitat within the 10-mile buffer. The aerial surveys involve 2 separate flights consisting of low altitude passes, approximately 500 to 1,000 ft agl. The first flight was conducted over two days on April 28 and May 9, 2014 to be timed to coincide with egg laying/initial incubation (early May) and the second flight will target the time period when eaglets have hatched but prior to their first flight (i.e., June, when they are visible in the nest or adjacent branches to determine hatching success). Flights will occur on days with visibility greater than ½ mile, and winds are suitable for flying. Stantec will notify USFWS per the National Bald Eagle

[2] Per the April 2013 ECP Guidelines, the number of proposed point count locations was determined by calculating the entire turbine area including a 1-km buffer around turbines, calculating 30% of the area, and dividing by 2 (to account for the 2 square-kilometer plots).

Management Guidelines (USFWS 2007) before flights are conducted in accordance with the ECP Guidance. During eagle nest surveys out to a distance of 4 miles from the proposed turbines, Stantec will document any observations of nesting habitat known to support great blue heron (*Ardea herodias*) (i.e., wetland habitat with snags). In addition, out to a distance of 1 mile from proposed turbines, Stantec will document any osprey (*Pandion haliaetus*) nests or nests of other species of raptor.

Results will be discussed in a memo report with an associated map.

2.7 RAPTOR NEST SURVEYS

Stantec will document the presence of raptor nests within 1 mile of the proposed turbine locations using a variety of targeted and opportunistic methods. These methods will be conducted, or applied, during the course of other on-site survey efforts described in this work plan.

Initially, any raptor nests observed within 1 mile of the proposed turbine locations during the aerial eagle nests surveys and during breeding bird surveys conducted in May and June, 2014 will be documented. If any raptor nests are observed during the aerial eagle surveys, a GPS point will be taken from the air, and Stantec will ground-truth the location and assess occupancy as possible. In addition, any incidental observations of raptors will be recorded during all avian and bat surveys conducted at the project and while travelling between survey points within the project area. If any of these incidental observations are of territorial behavior or are repeatedly observed, then biologists will conduct a meandering survey of the area to determine if a nest is nearby or to illicit further territorial defense behavior of the observed species. If any raptor nests are observed incidentally through this process, a GPS point will be taken at the nest site and occupancy will be assessed as possible.

The final method used to survey for the presence of raptor nests in proximity to the project will include a call response effort associated with the two BBS point count surveys to be conducted in June, 2014. During these BBS point counts, Stantec will also broadcast calls of Great Horned Owl (*Bubo virginianus*) for 5 minutes after each of the10 minute BBS point counts is completed. These call back surveys are aimed at identifying potential raptor nests through direct responses of raptors to the Great Horned Owl call backs. This method was recommended by MDIFW at a meeting with Stantec, and First Wind on June 2, 2014.

2.8 GREAT BLUE HERON SURVEYS

Stantec will search for active great blue heron rookeries or potential rookery habitat within 4 miles of the proposed turbine locations during the aerial eagle nests surveys. If stick nests are identified within 4 miles of the project, ground surveys will be conducted to determine the number of nests present, and whether or not the nests are active. Stantec will take photos and GPS locations of any nests found. To assess the presence and/or movement of great blue herons at the project, Stantec will search for great blue herons in addition to raptors and eagles during the spring raptor migration surveys conducted in April and May and the eagle point count surveys conducted every 3 weeks until next spring 2015.

2.9 REPORTING

Stantec will draft a single comprehensive report discussing results of the avian and bat surveys described above. Stantec will draft a separate memo report providing results of the aerial eagle nest surveys upon their completion. Stantec will draft a separate memo report discussing results of the eagle point count surveys upon their completion in 2015. Results of all other avian and bat surveys will be provided in a comprehensive report in early 2015. Reports will follow typical scientific reporting standards and will include Introduction, Methods, Results, and Discussion sections. Reports will include appropriate photographs, tables, and figures. Draft reports will be submitted to First Wind and to MDIFWS and USFWS for review and comment.

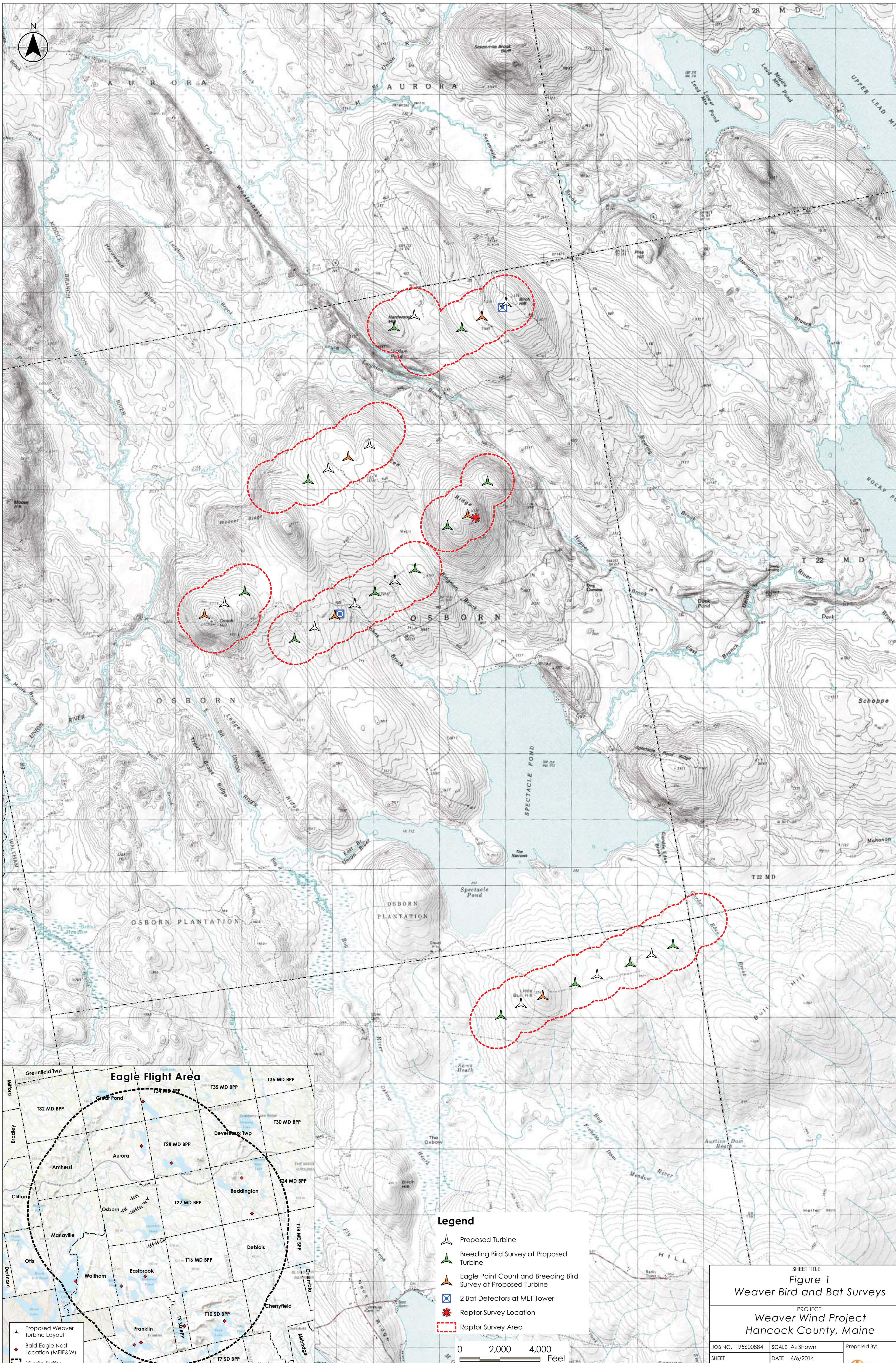
3.0 SUMMARY OF SURVEYS CONDUCTED IN THE VICINITY

As discussed during a meeting with MDIFW, Stantec, and First Wind on June 2, 2014, the Weaver project site benefits from the fact that a number of avian and bat resource surveys were conducted at the nearby, operating, Bull Hill site to the south and the permitted Hancock site to the east. While those survey efforts were conducted in previous years and in slightly different locations than the Weaver site, their proximity to Weaver does provide additional insight into the wildlife communities occurring at the site. The data from those surveys, therefore, can be used to supplement the existing or planned data collection at the Weaver site, resulting in an overall greater knowledge of the wildlife assemblage, and potential impacts, at the site.

The following table summarizes the number of similar studies that have been conducted as part of the permitting process for the operational Bull Hill Wind Project and permitted Hancock Wind Project (Figure 2). These surveys combined with on-site surveys at the Weaver Project may fulfill the multiple year recommendation from MDIFW for diurnal raptor migration surveys (at least 2 years), radar migration surveys (1-2 years), and eagle surveys (at least 2 years) as described in their *Wind Power Preconstruction Study Recommendations* dated April 2014.

Table 1. Similar studies conducted at Bull Hill Wind Project and Hancock Wind Project.

Project	Survey	Years	Dates	Season	Effort
Bull Hill	Radar	2009	9/1-10/15	fall	20 nights
		2010	4/20-5/24	spring	20 nights
		2011	4/26-5/22	spring	10 nights
		2011	9/6-9/27	fall	10 nights
	Raptor	2009	8/1-8/27	summer	6 days
		2009	9/2-10/14	fall	12 days
		2010	3/14-4/6	winter	3 days
		2010	4/21-5/23	spring	12 days
	Acoustic	2009	7/14-11/4	summer/fall	Continuous
		2010	4/15-7/14	spring	Continuous
	Aerial Eagle	2010	4/13 and 5/28	spring	2 days
	Aerial Eagle	2011	4/14-4/15 and 5/25	spring	3 days
Hancock	Raptor	2012	9/27-10/17	fall	10 days
	Aerial Eagle	2013	4/10 and 6/10, 6/28, and 7/3	spring/summer	4 days

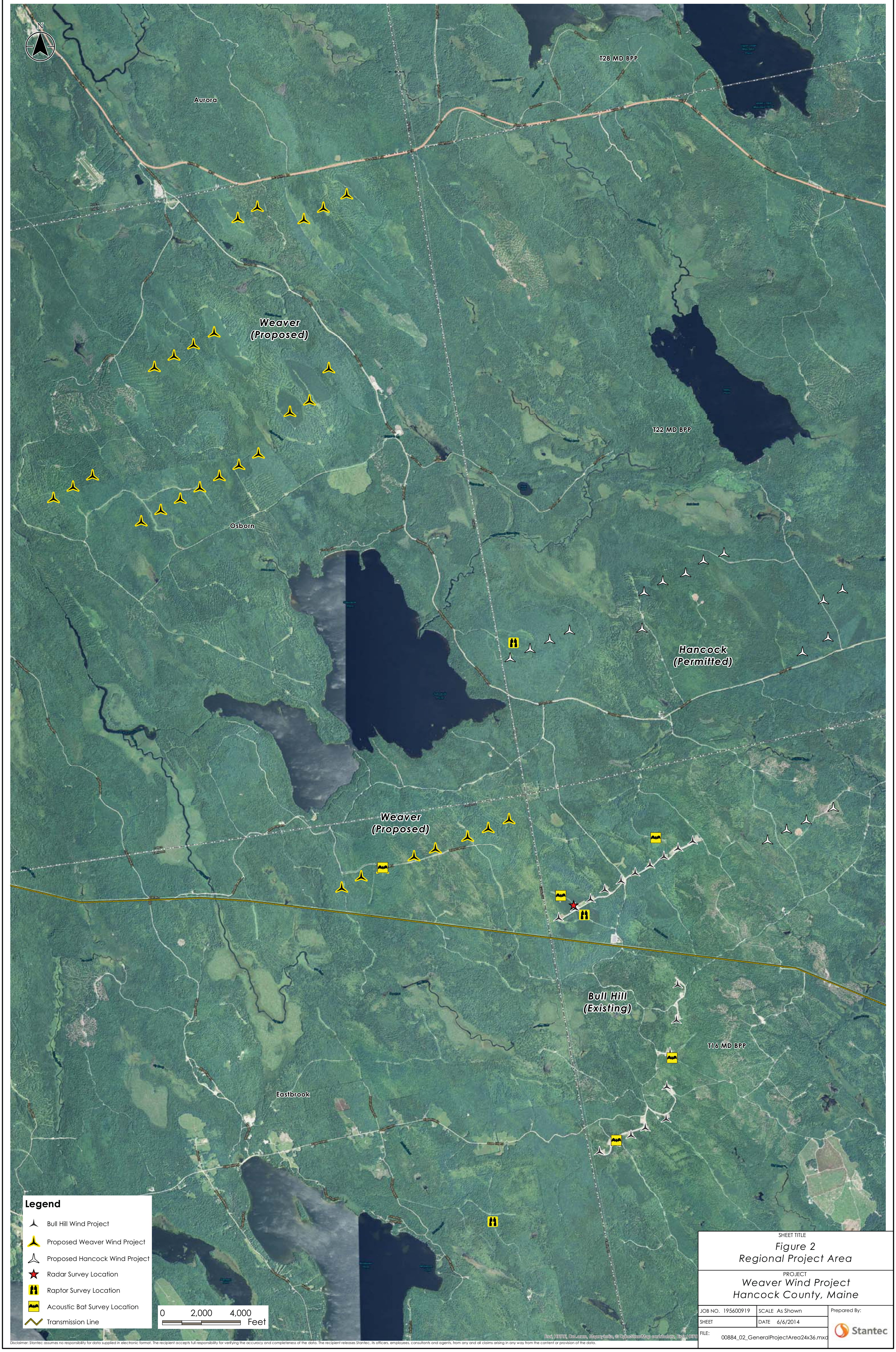


SHEET TITLE
Figure 1
Weaver Bird and Bat Surveys

PROJECT
Weaver Wind Project
Hancock County, Maine

JOB NO. 195600884 | SCALE As Shown | Prepared By:
SHEET | DATE 6/6/2014
FILE: 00884_01_SurveyLocations201424x36.mxd

Stantec



Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

SHEET TITLE

Figure 2
Regional Project Area

PROJECT

Weaver Wind Project
Hancock County, Maine

JOB NO. 195600919 | SCALE As Shown | SHEET | DATE 6/6/2014

FILE: 00884_02_GeneralProjectArea24x36.mxd

Prepared By: Stantec

Exhibit 7-2-1

Wetland and Waterbody Delineation and Vernal Pool Report

Wetland and Stream Delineation and Vernal Pool Survey Report

Weaver Wind Project, Hancock County, Maine

August 9, 2018

Prepared for:

Weaver Wind LLC

Prepared by:

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Table of Contents

1.0 INTRODUCTION **1**

2.0 SITE DESCRIPTION **1**

3.0 FIELD SURVEY METHODS **1**

4.0 FIELD SURVEY RESULTS **2**
4.1 WETLAND AND STREAM DELINEATION RESULTS 2
4.2 VERNAL POOL SURVEY RESULTS 3
4.3 WETLANDS OF SPECIAL SIGNIFICANCE 4

5.0 CONCLUSION **4**

LIST OF TABLES

Table 1 Wetland Summary Table 2
Table 2 Stream Summary Table 2
Table 3 Vernal Pool Summary Table 2

LIST OF FIGURES

Figure 1 Project/Delineation Limits 1

1.0 INTRODUCTION

During the summer and fall of 2014, Stantec Consulting Services Inc. (Stantec) completed wetland and stream delineations for the design and siting phase of the proposed Weaver Wind Project (project) located in Hancock County, Maine. These delineations were completed to facilitate project planning and to allow incorporation of avoidance and minimization of natural resource impacts into the final project design. During the delineations, Stantec also identified vernal pools and potential vernal pools (PVP), as appropriate.

This report provides a brief discussion of the methodologies we employed and the delineation results. Summary tables of the results have been included in this report and Wetland Determination Data Forms, Maine State Vernal Pool Assessment Forms, and shapefiles of the delineation results have been provided separately. Representative site photographs are available on request.

2.0 SITE DESCRIPTION

The project area is centrally located in Hancock County in Osborn, T22 MD, T16 MD, and Eastbrook (Figure 7B, Delineated Natural Resources). It is located south of Route 9 and north of the existing Bull Hill Wind Project. Ridges within the project area range from about 500 to 700 feet in elevation and include Little Bull Hill, Een Ridge, Hardwood Hill, and Birch Hill. General site topography is nearly flat to gently sloping with narrow valleys between these small hills and low ridges. An esker that runs northwest to southeast and is known as the Whalesback intersects the northern part of the project area. Soils in this area are generally derived from glacial till, consisting of loam and sandy loam with boulders occurring at or near the soil surface. A number of large glacial erratics are present throughout the area. Spectacle Pond is centrally located within the project area. The East Branch Union River, Colson Branch, Leighton Brook, Garden Eden Brook, and Hopper Brook transect the project at various points.

Much of the area is managed for commercial timber production and there are many existing gravel roads that provide access throughout the area. Forested uplands within the project area are dominated by an even mix of early successional forests, young Beech-Birch-Maple forests, and conifer plantations. Smaller areas of second growth hardwood forests and second growth red spruce (*Picea rubens*) and eastern hemlock (*Tsuga canadensis)* forests are less common. The area includes beaver impoundments, and forested scrub-shrub, and emergent wetlands. Many wetlands have been altered by recent and historic timber harvesting.

3.0 FIELD SURVEY METHODS

Stantec completed field delineations for much of the project area between July and October 2014. Additionally, delineations along approximately 3,800 linear feet of existing access road were completed in 2009 as part of the Bull Hill Wind Project. In 2014, Stantec delineated wetlands within the project area in accordance with the *Corps of Engineers Wetlands Delineation Manual*[1] and the *Regional Supplement to the Corps of Engineers Wetland*

[1] Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual.* Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Delineation Manual: Northcentral and Northeast Region (Version 2.0)[2]. Wetland boundaries and stream centerlines or banks were marked with pink flagging and flags were located using Trimble® Global Positioning System (GPS) receivers. Within the town of Eastbrook, Maine Department of Environmental Protection (MDEP) jurisdictional stream and Wetland of Special Significance (WSS) determinations were based on the criteria in the Maine Natural Resources Protection Act (NRPA). The remainder of the project area is located within the Land Use Planning Commission (LUPC) jurisdiction and identification of streams and P-WL1, WSS, was based on the LUPC *Chapter 10 Land Use Districts and Standards*. Throughout the project area, identification of streams and WSS was limited to observable conditions and available background information.

For a portion of the project area, identification of vernal pools and PVPs were completed in 2009 as part of the original Bull Hill Wind Project. For the remainder of the project area, vernal pools and PVPs were identified in 2014 concurrent with wetland delineations. Identified vernal pools and PVPs were located with the GPS. Because 2014 field delineations were conducted outside of the amphibian breeding period, vernal pool identification was based on the observed presence of remnant egg masses and larval amphibians or. PVPs were identified based upon wetland characteristics such as the presence of surface water that suggested these areas could provide habitat for breeding amphibians or habitat for other vernal pool associated species. In May of 2015, Stantec returned to the project area to survey PVPs that were naturally occurring and identified during previous surveys as potentially significant vernal pools (PSVPs). Unnatural PVPs, occurring in roadside ditches, excavations, and equipment ruts that do not meet the significance criteria as defined in the NRPA were not surveyed in 2015 and remain as PVPs. Maine State Vernal Pool Assessment Forms were completed for all naturally occurring vernal pools identified within the project area. These forms were submitted to the Maine Department of Inland Fisheries and Wildlife for their vernal pool significance determinations.

During the course of field work, Stantec also documented incidental observations of invasive plant species including Japanese knotweed (*Fallopia japonica*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*). Each incidental observation was located with the GPS receiver. These observations do not represent a complete survey for invasive plant species but can be incorporated into a post-construction invasive management plan for the project.

4.0 FIELD SURVEY RESULTS

4.1 WETLAND AND STREAM DELINEATION RESULTS

Stantec delineated 287 wetlands within the project area (Table 1). Most of the wetlands are identified as palustrine forested (PFO) followed by an equal number of palustrine scrub-shrub (PSS) and palustrine emergent (PEM), and only a few wetlands were dominated by palustrine unconsolidated bottom (PUB). Many of the wetlands include two or more of these community types.

[2] U.S. Army Corps of Engineers. 2012. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)*, ed. J. S. Wakeley, R. W. Lichvar, C. V. Noble, and J. F. Berkowitz. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Forested wetlands within the project area are dominated by northern white cedar (*Thuja occidentalis),* black ash *(Fraxinus nigra), green ash (Fraxinus pennsylvanica*), red maple *(Acer rubrum),* balsam fir *(Abies balsamea)* gray birch *(Betula populifolia),* and yellow birch (*Betula alleghaniensis*). Eastern hemlock and quaking aspen (*Populus tremuloides*) are also present and have adapted to wetland conditions by growing on mounds or developing shallow root systems.

In general, the scrub-shrub wetlands occur in areas with deeper organic soils or are associated with a water body or beaver impoundment. Typical shrubs found in these areas include common winterberry (*Ilex verticillata*), catberry (*Nemopanthus mucronatus*), speckled alder (*Alnus incana*), leatherleaf (*Chamaedaphne calyculata*), possumhaw (*Viburnum nudum*), broad-leaf meadowsweet (*Spiraea latifolia*), and steeplebush (*Spiraea tomentosa*). Emergent plants present in these wetlands include broad-leaf cat-tail (*Typha latifolia*), bluejoint (*Calamagrostis canadensis*), rattlesnake manna grass (*Glyceria canadensis*), American burr-reed (*Sparganium americanum*), three-way sedge (*Dulichium arundinaceum*), and northern water-horehound (*Lycopus uniflorus*).

Similar to the scrub-shrub wetlands described above, some emergent wetlands are naturally occurring and are found on deeper organic soils or in association with an open water area. More commonly the emergent wetlands within the project area are the result of timber harvesting. These altered wetlands include recently harvested forested wetlands and skidder trails. These areas are typically dominated by nodding sedge (*Carex gynandra*), cottongrass bulrush (*Scirpus cyperinus*), interrupted fern (*Osmunda claytoniana*), sensitive fern (*Onoclea sensibilis*), fowl manna grass (*Glyceria striata*), pointed broom sedge (*Carex scoparia*), and wrinkle-leaf goldenrod (*Solidago rugosa*).

Many wetlands in the project area contain dense glacial till or large boulders and rocks close to the ground surface. Groundwater is close to the surface and influences the vegetation, soils and hydrology. Shallow soils (10” to 15” deep) with a thick organic horizon and thin layer of reduced sandy or gravelly loam are common. There are also a number of wetlands that contain deep organic layer over a reduced clay loam. These wetlands tend to be larger but are less common.

Stantec delineated 41 streams within the project area (Table 2). The delineated streams vary in characteristics ranging from small ephemeral channels that flow only following snow melt or precipitation events to large perennial channels such as the East Branch of the Union River. Most of these streams either flowing through a wetland or flow out of a headwater wetland. In addition, there are several streams within the project area that are not associated with a wetland. Many of the streams occur along access roads where there are existing crossings. Of the 41 delineated streams:

- 19 are characterized as perennial
- 18 are characterized as intermittent
- 4 are characterized as ephemeral

4.2 VERNAL POOL SURVEY RESULTS

Stantec identified 32 vernal pools within the project area including vernal pools identified in 2009, 2014, and 2015 (Table 3). Fifteen of these identified vernal pools were characterized as naturally occurring and 2 meet the definition of an SVP under the NRPA. The 17 man-made vernal pools were located in roadside ditches, roadside borrow pits or occurred in equipment ruts. Stantec also located 40 PVPs in the project area all of which are man-made and located in roadside ditches/excavations and equipment ruts.Due to their unnatural original, these PVPs do not meet the definition of a vernal pool as defined in the NRPA.

4.3 WETLANDS OF SPECIAL SIGNIFICANCE

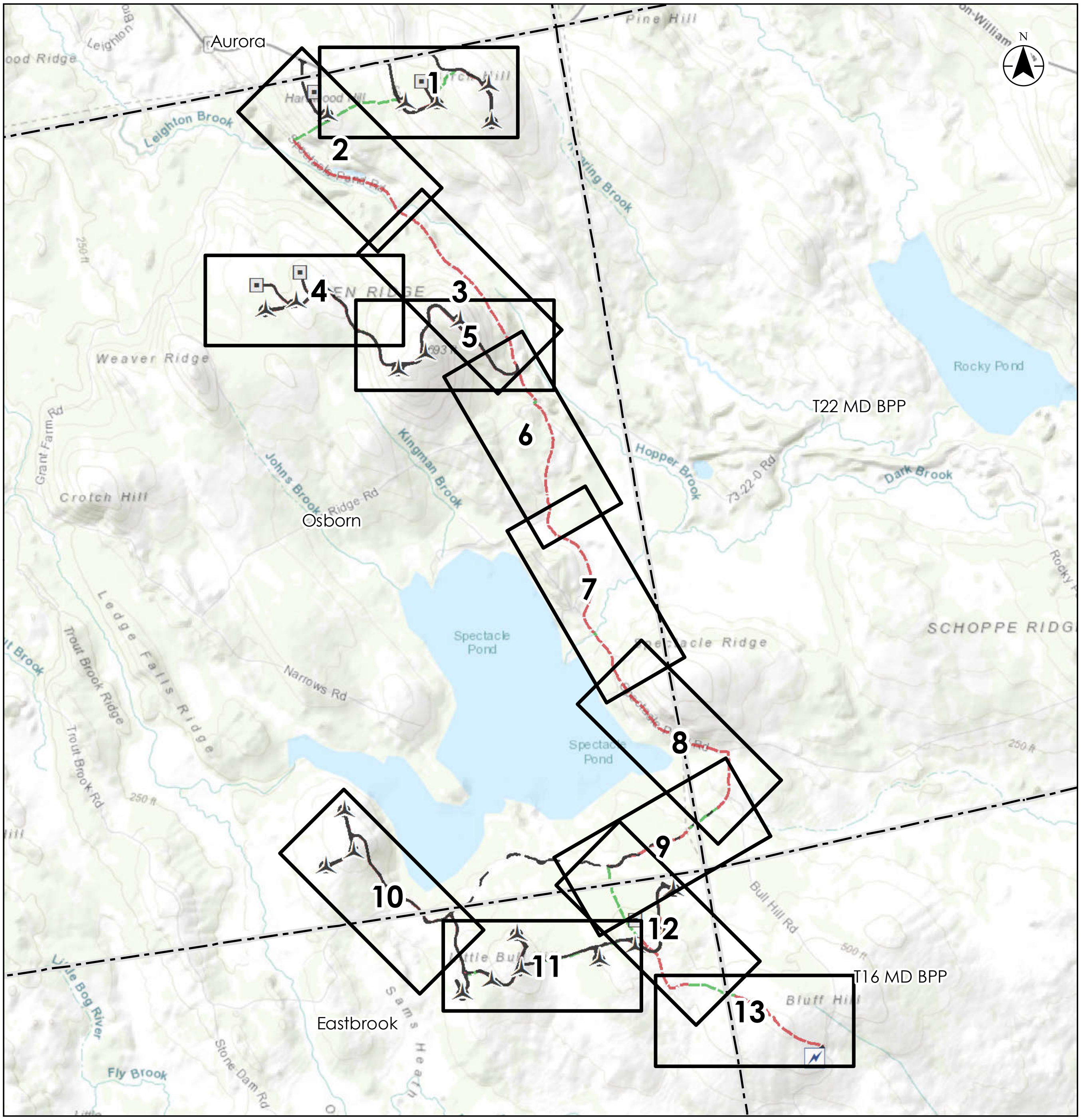
As noted in Table 1, of the 287 identified wetlands, 38 are classified as WSS either under the NRPA or as P-WL1's.

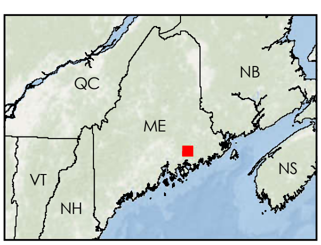
- 27 are significant due to their association with a river stream or brook
- 7 are significant due to the presence of significant wildlife habitat including Inland Waterfowl and Wading bird Habitat (IWWH) or a SVP;
- 4 meet both of the above criteria and/or have 20,000 square feet or more of open water or emergent marsh vegetation

5.0 CONCLUSION

This report summarizes the results of Stantec's field delineation for the proposed project layout as of the date of this report. Subsequent changes to the project footprint or alignment may necessitate further field surveys. Impacts to 32 of the 287 wetlands are proposed as part of the project and further described in the MDEP Site Location of Development/NRPA combined application. Clearing will occur along the banks of 7 stream. No direct impacts to the channel or banks of any streams are proposed.

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation Index.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Substation
- Major Overhead Collector Line
- Underground Collector Line
- Access Road

0 6,000 Feet

1:72,000 (at original document size of 8.5x11)

Stantec

Project Location
Hancock County, Maine

195601223
Prepared by GAC on 2018-08-14
Reviewed by BRB on 2018-08-14

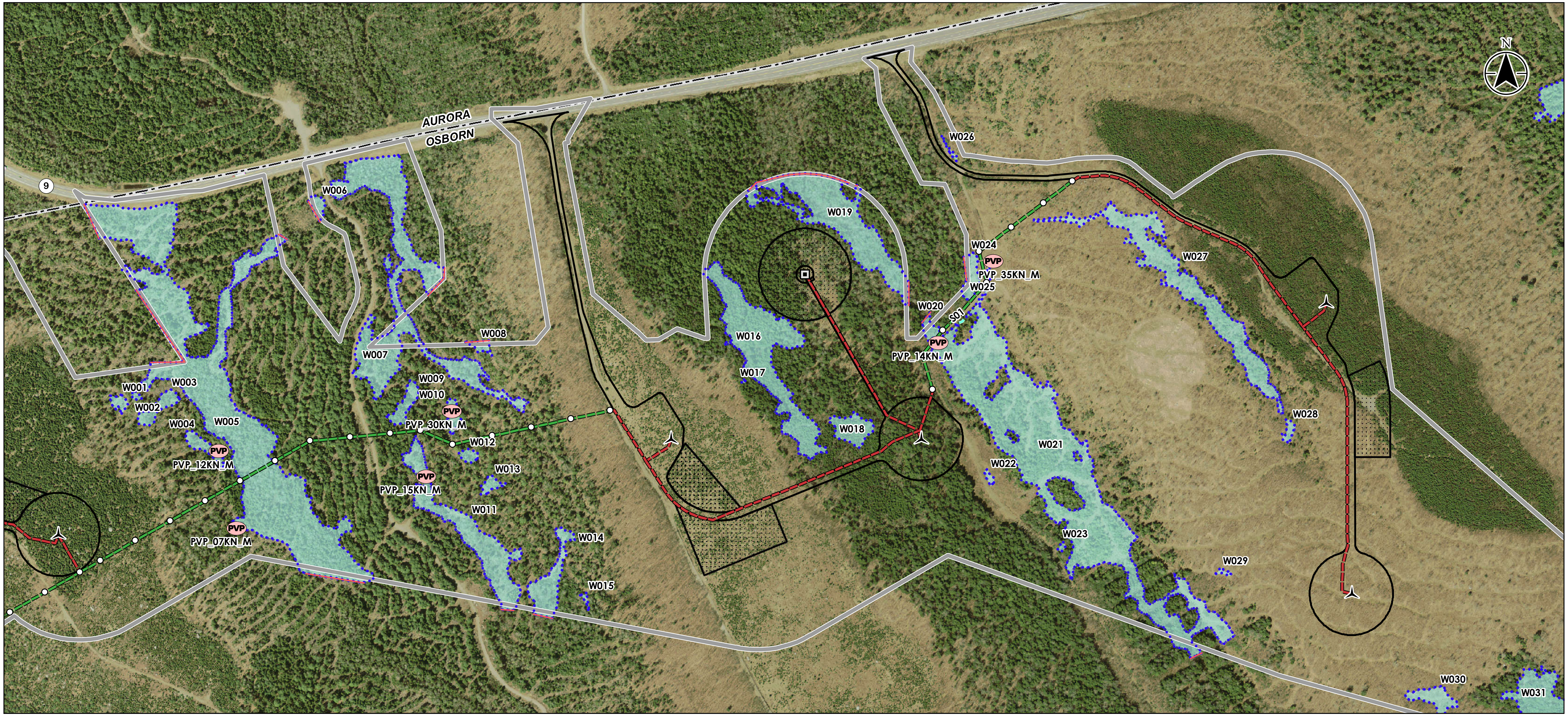
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

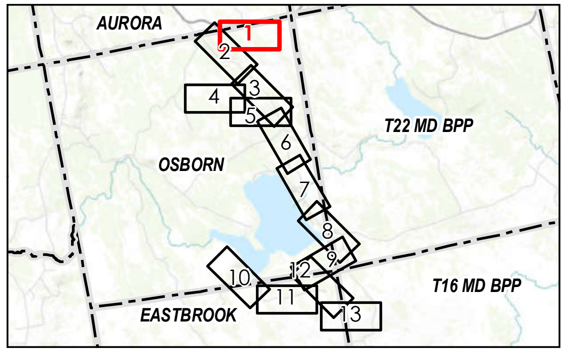
Figure No.
Key

Title
Delineated Natural Resources Index Map

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Base map: ESRI Wowrld Topographic Map





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Stantec

Project Location: Hancock County, Maine

195601223

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

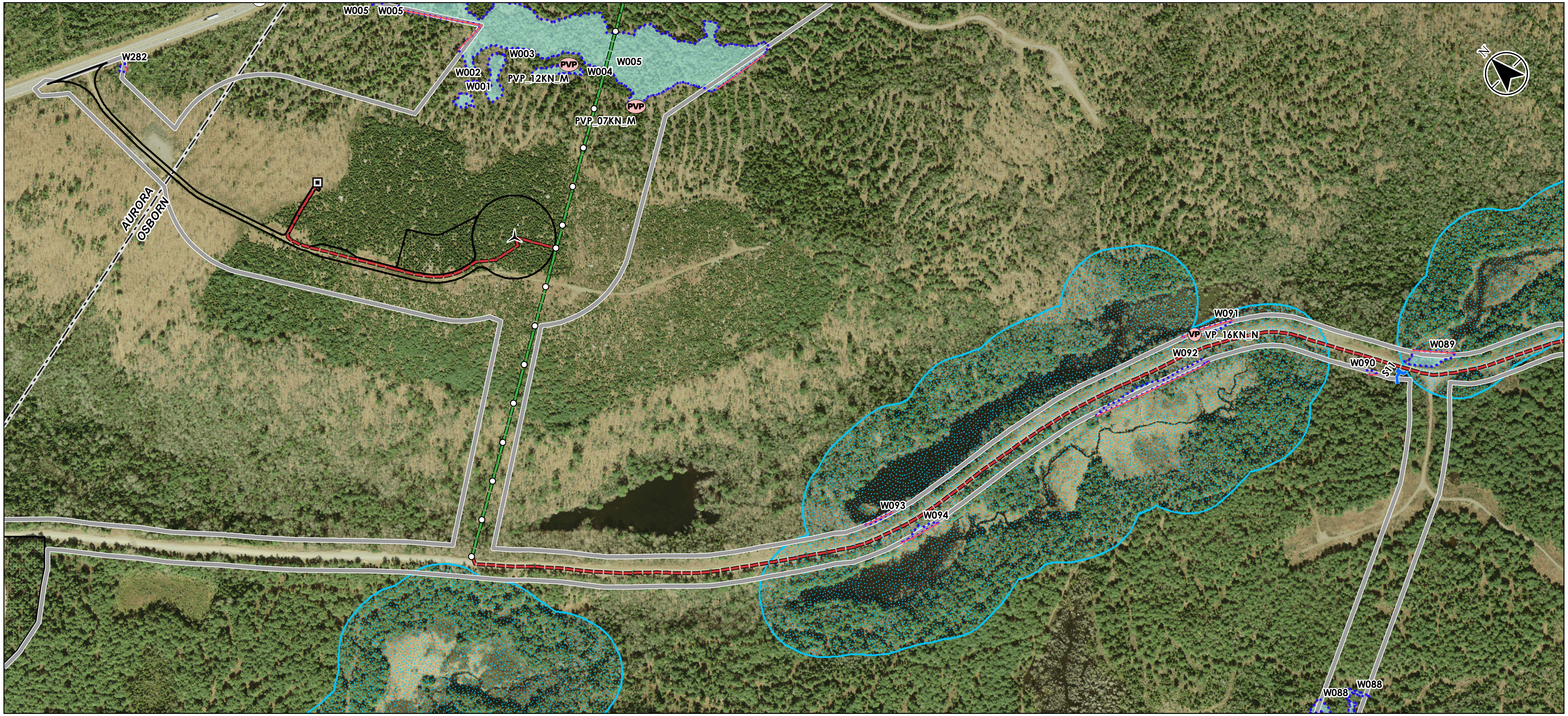
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

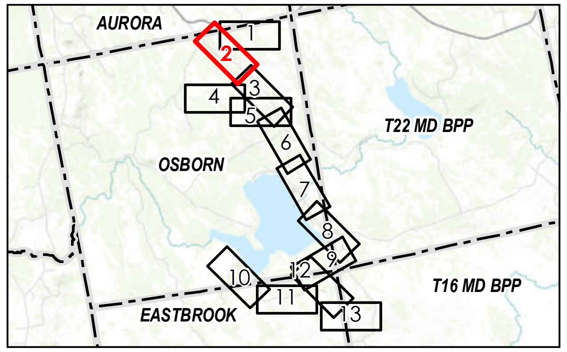
Figure No.
1 of 13

Title
Delineated Natural Resources

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location: Hancock County, Maine

195601223

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

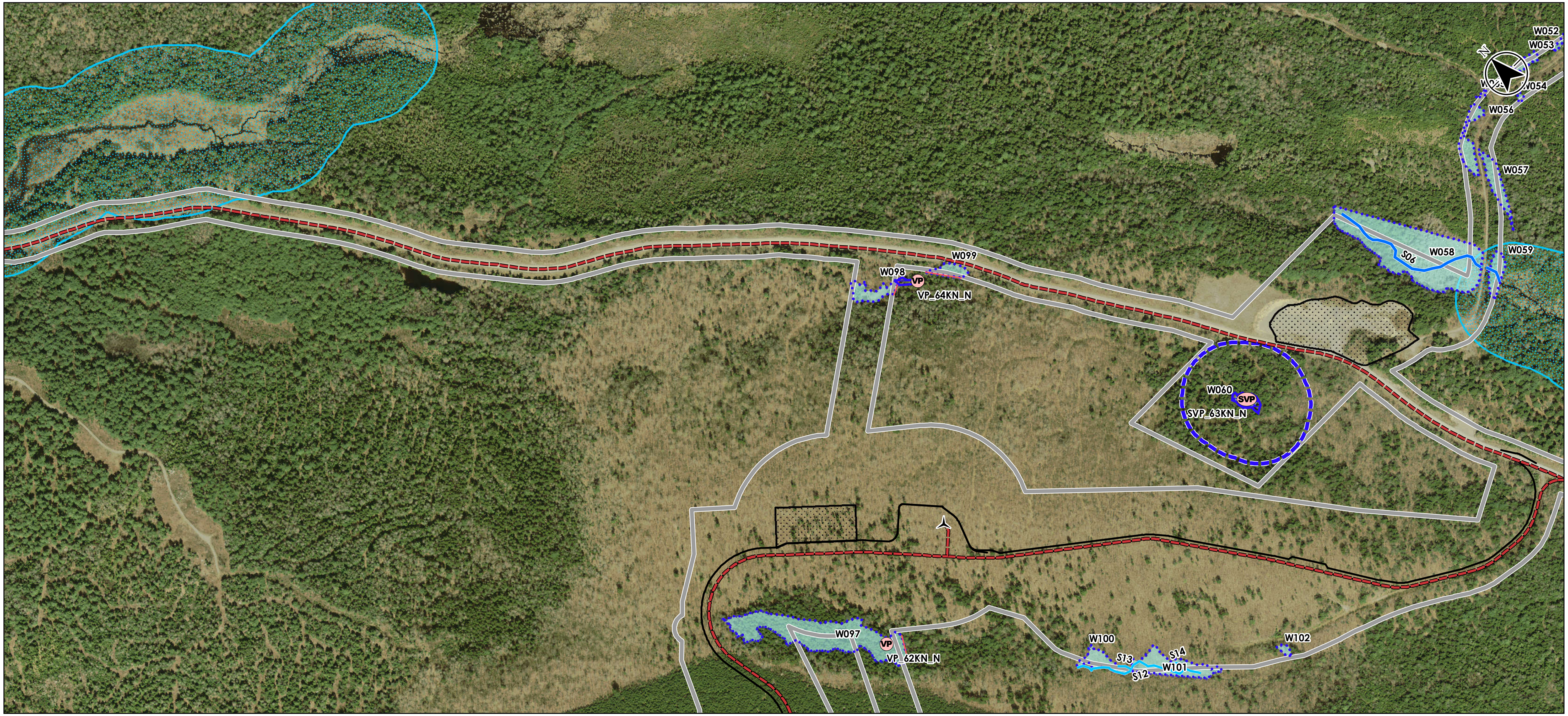
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

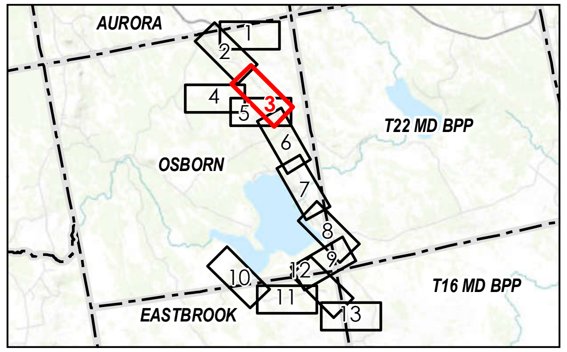
Figure No.
2 of 13

Title
Delineated Natural Resources

Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location 195601223

Hancock County, Maine

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project

Weaver Wind Project
Longroad Energy Partners LLC

Figure No.

3 of 13

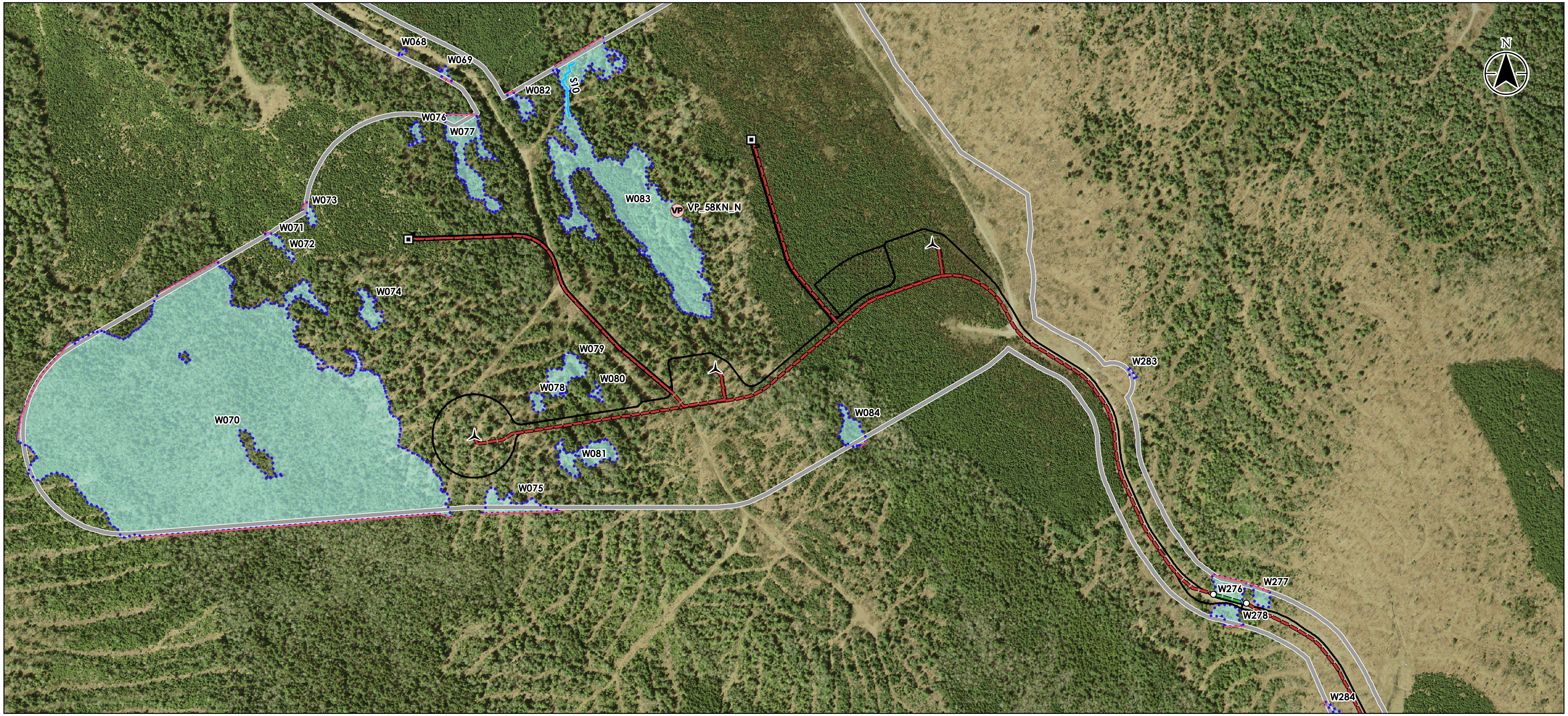
Title

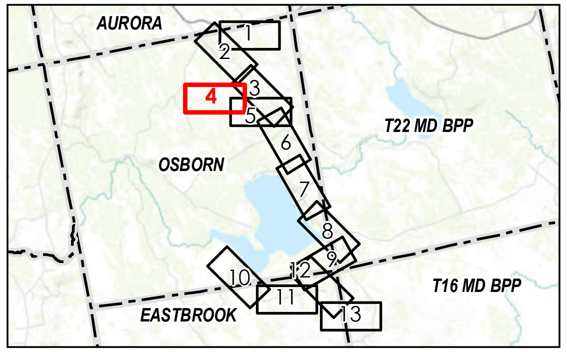
Delineated Natural Resources

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location 195601223

Hancock County, Maine

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project

Weaver Wind Project
Longroad Energy Partners LLC

Figure No.

4 of 13

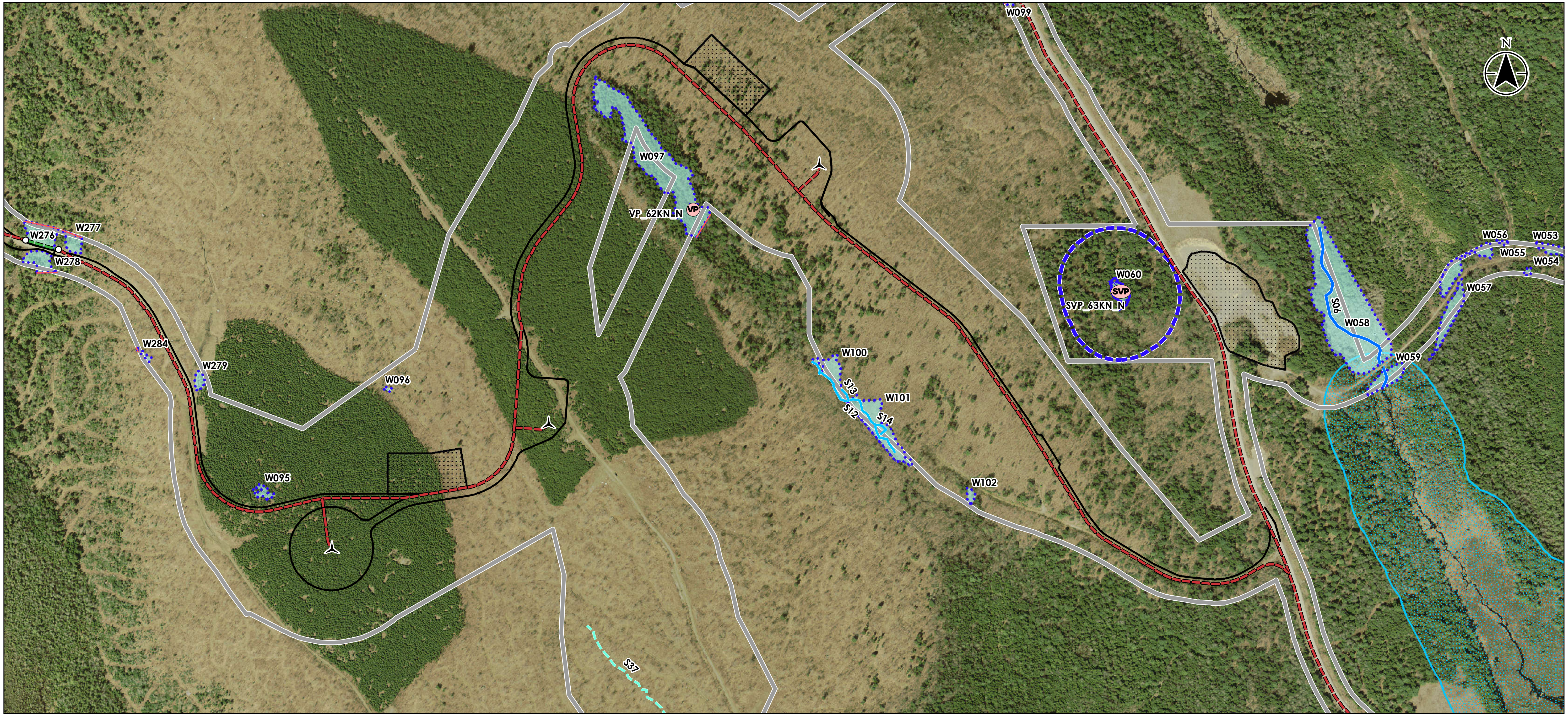
Title

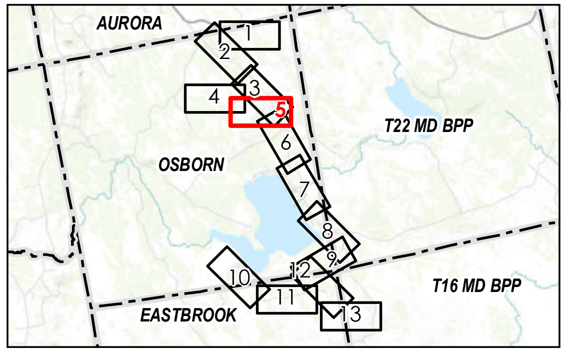
Delineated Natural Resources

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location: Hancock County, Maine — 195601223

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

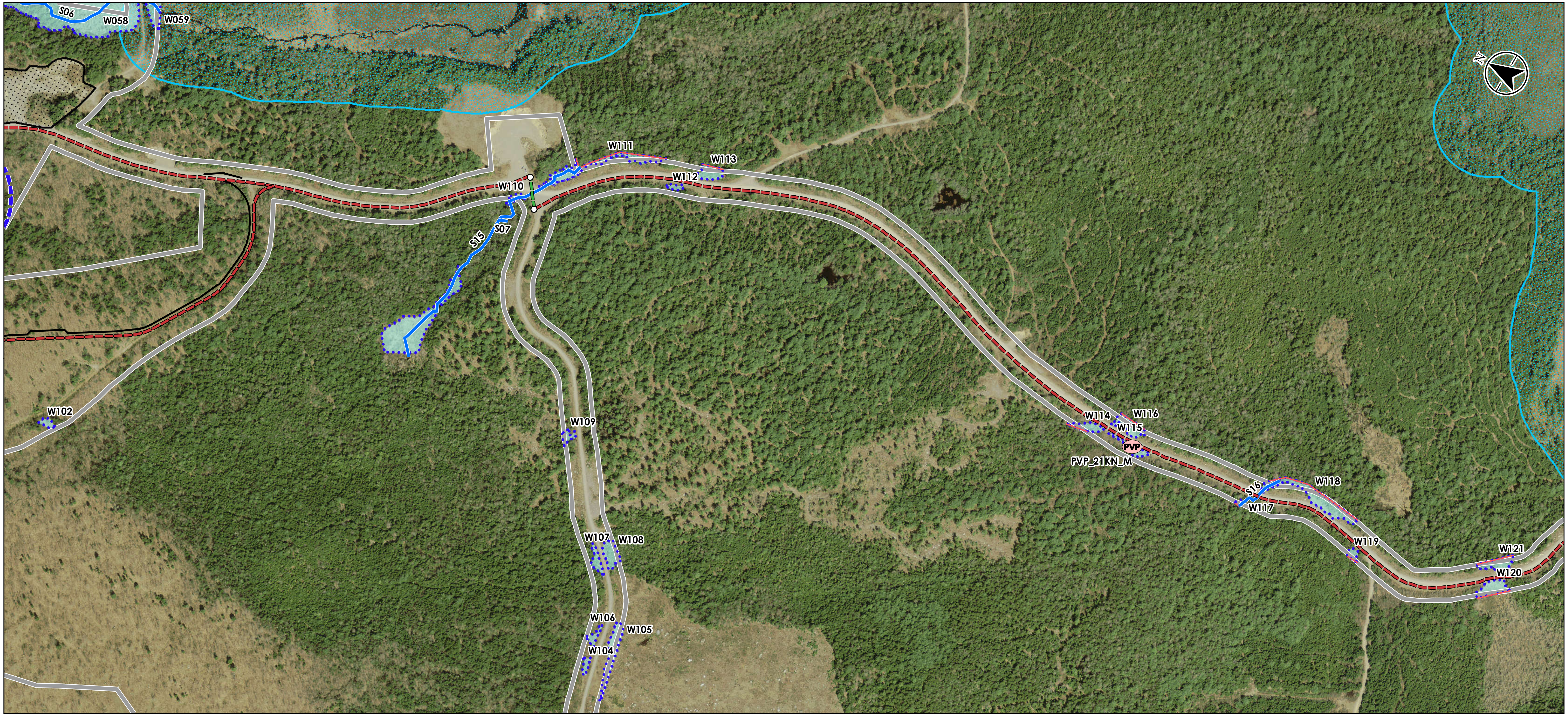
Figure No.
5 of 13

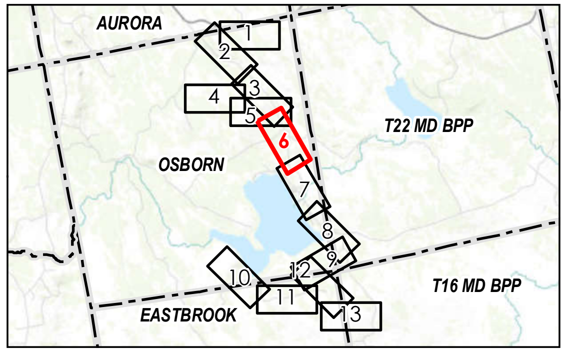
Title
Delineated Natural Resources

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

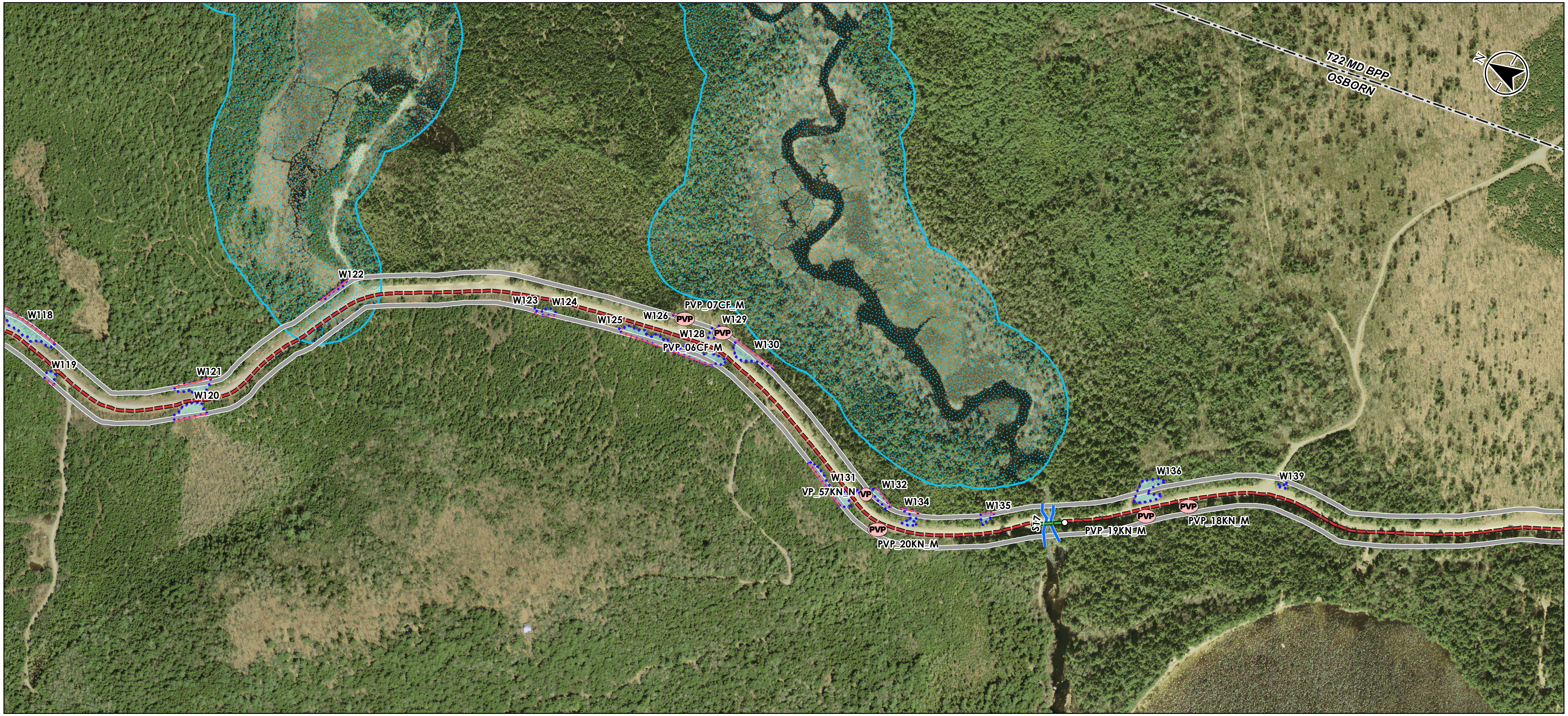
Project Location 195601223
Hancock County, Maine
Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

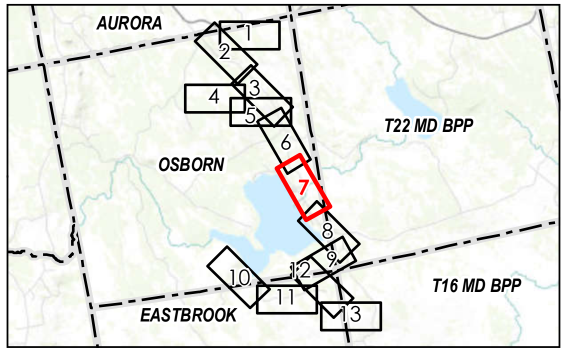
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
6 of 13

Title
Delineated Natural Resources

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location: Hancock County, Maine

195601223

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

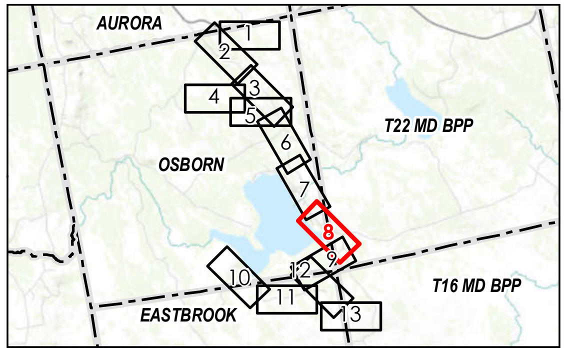
Figure No.
7 of 13

Title
Delineated Natural Resources

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpenter



Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location 195601223
Hancock County, Maine

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
8 of 13

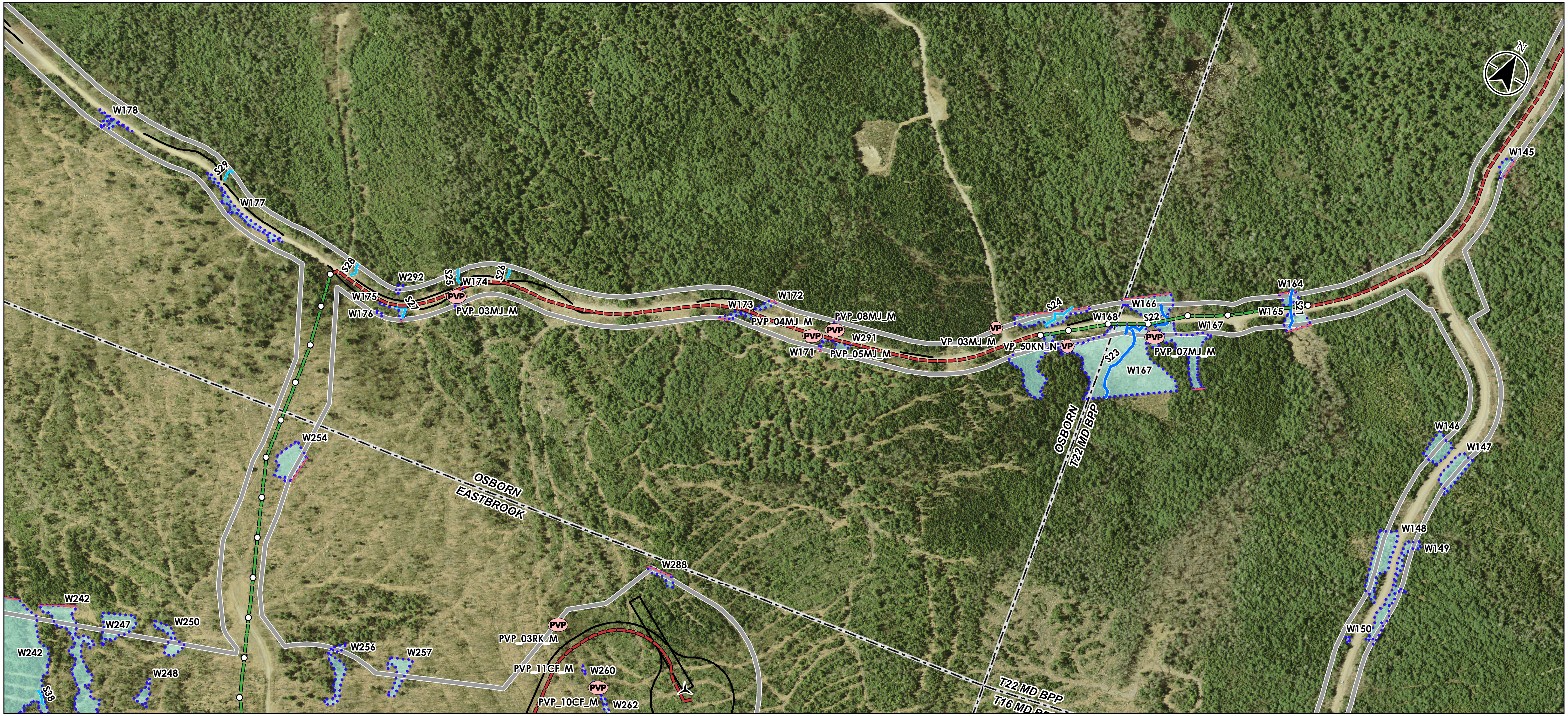
Title
Delineated Natural Resources

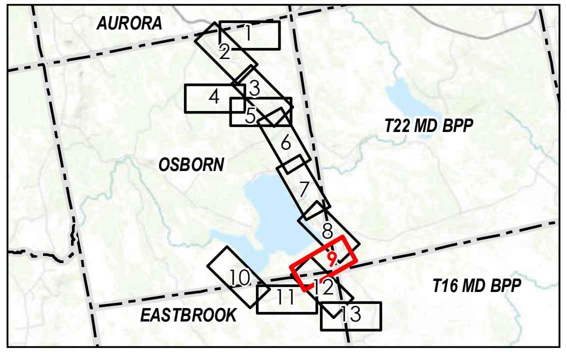
Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_7B_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location: Hancock County, Maine

195601223

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

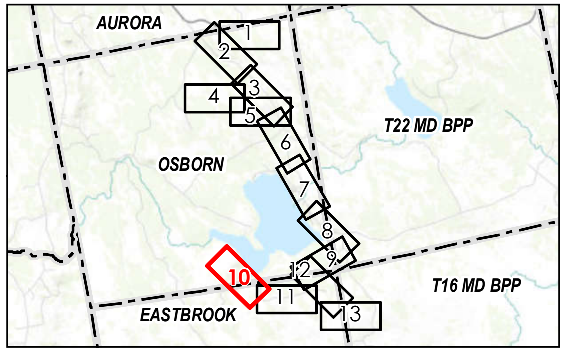
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
9 of 13

Title
Delineated Natural Resources

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014



Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP — VP
- SVP — SVP
- PVP — PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Stantec

Project Location 195601223

Hancock County, Maine

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project

Weaver Wind Project
Longroad Energy Partners LLC

Figure No.

10 of 13

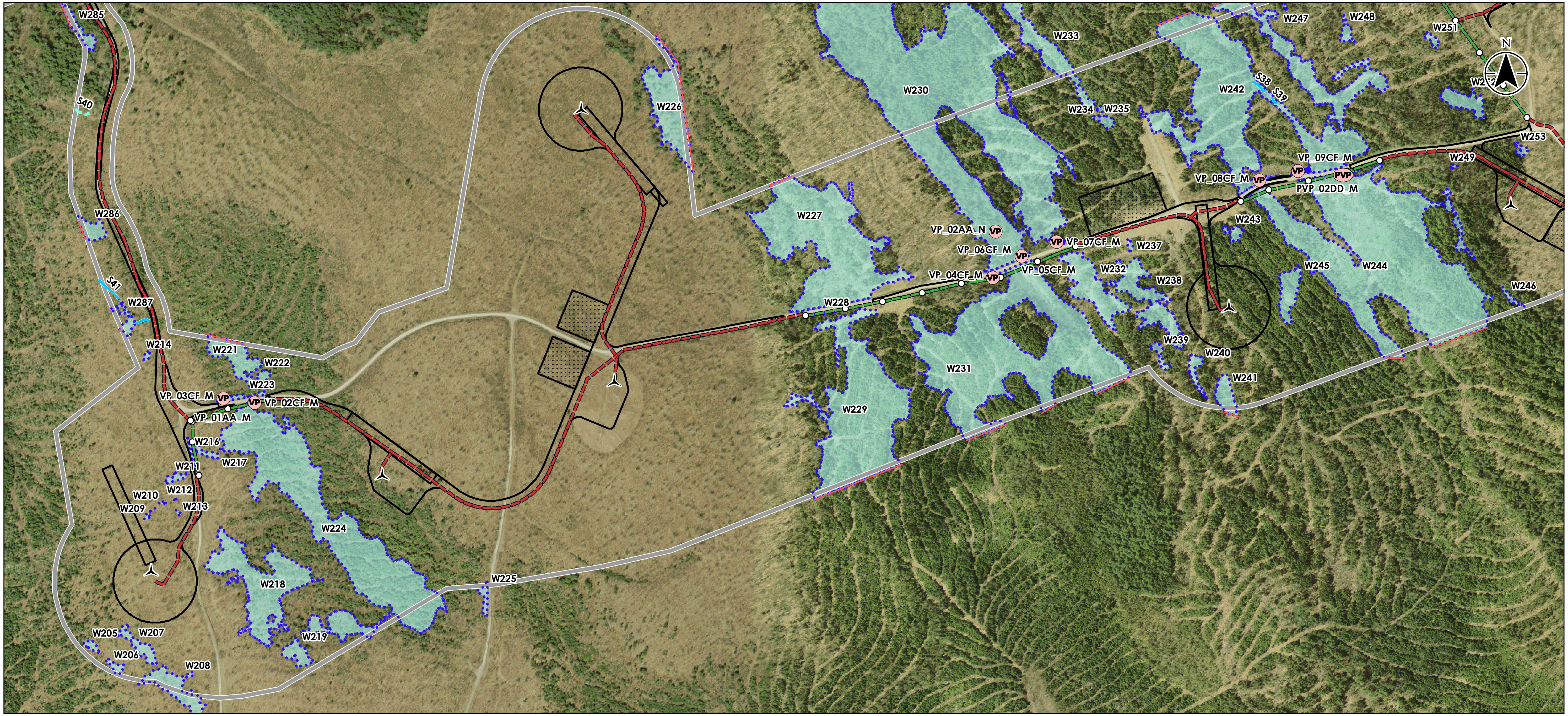
Title

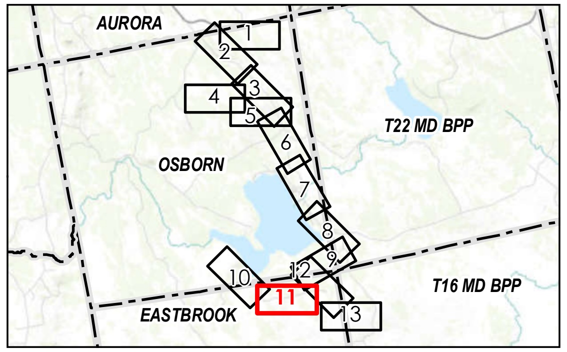
Delineated Natural Resources

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_78_Delineation.mxd Revised: 2018-10-26 By: gcarpentier





Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet

1:6,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Stantec

Project Location: Hancock County, Maine

195601223

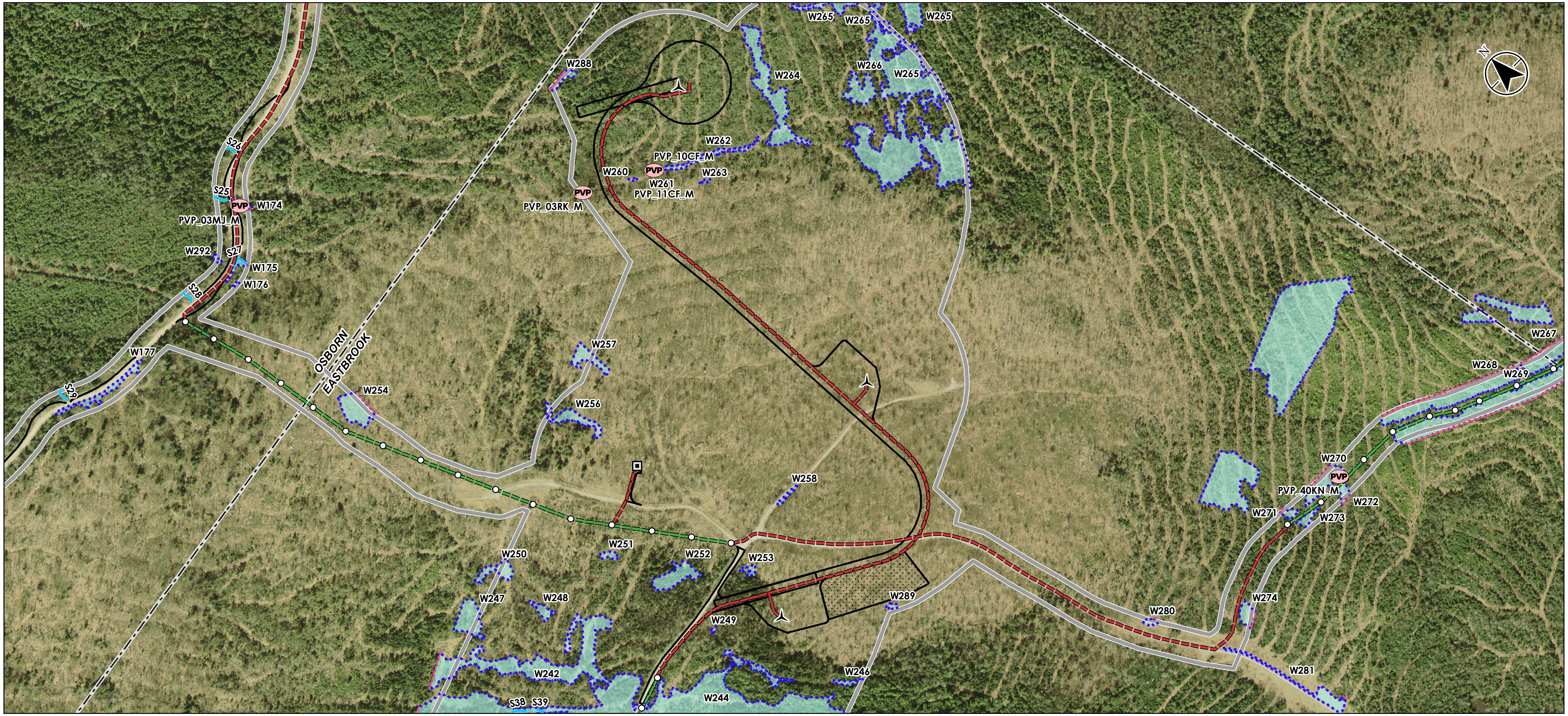
Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

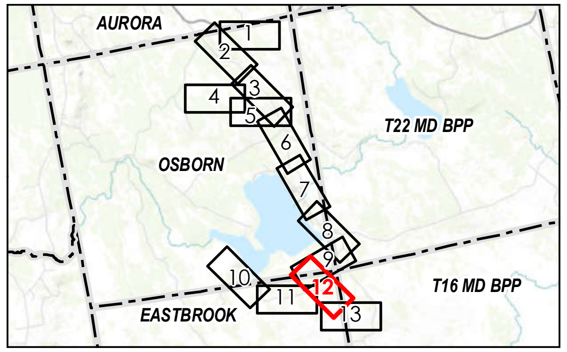
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
11 of 13

Title
Delineated Natural Resources

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit2018\01223_78_Delineation.mxd Revised: 2018-10-26 By: pcarpentier





Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Legend
- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point
- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet
1:6,000 (At original document size of 11x17)

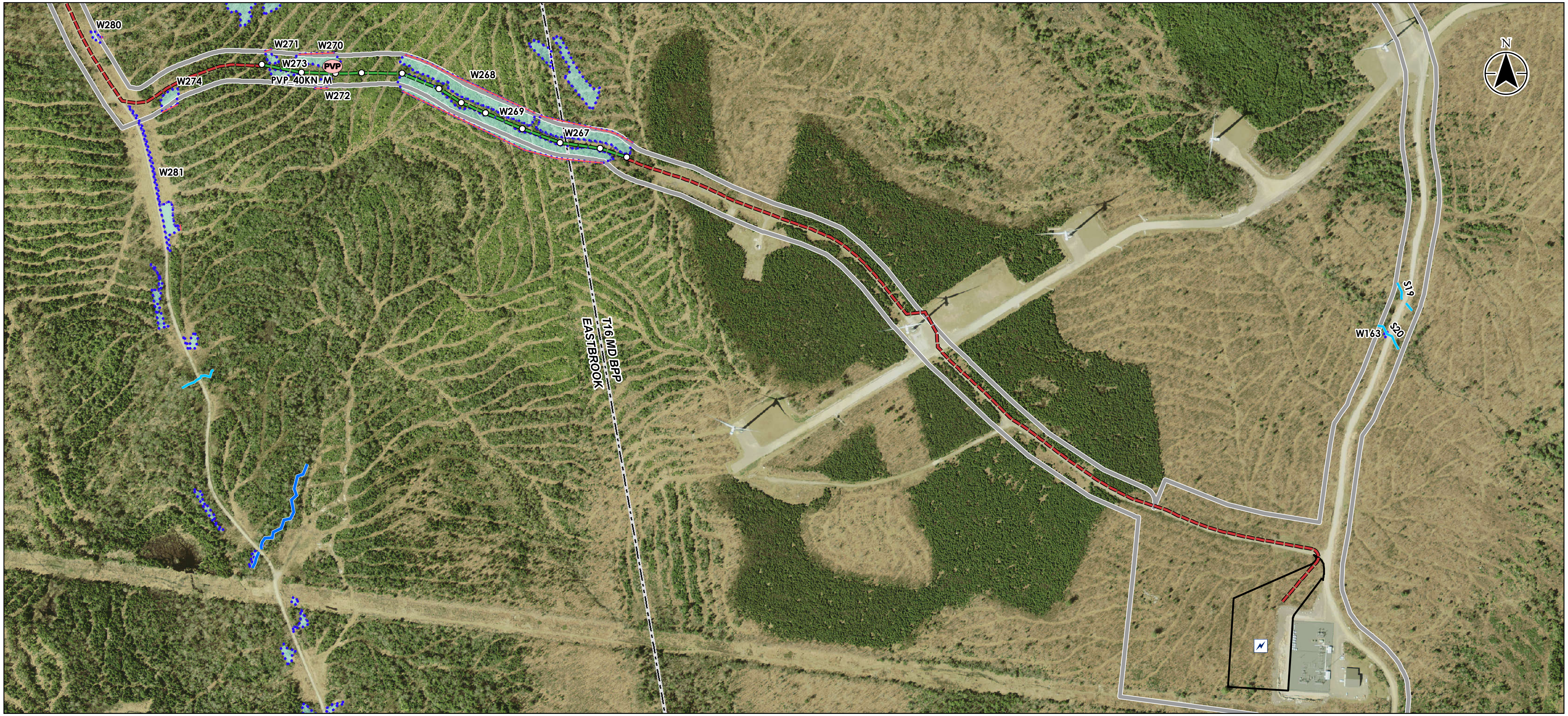
Stantec

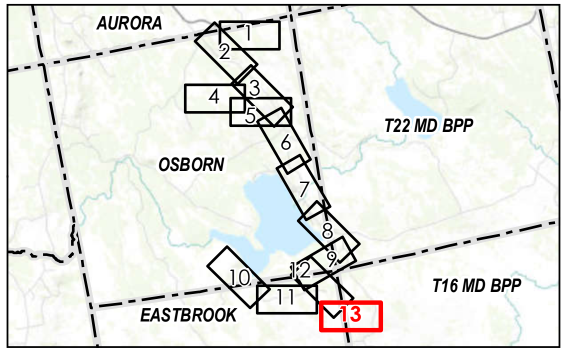
Project Location: Hancock County, Maine
195601223
Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
12 of 13

Title
Delineated Natural Resources





Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Orthoimagery: Maine Orthoimagery 2014

Legend

- Turbine Layout
- MET Tower
- Overhead Collector Pole
- Overhead Collector Line
- Underground Collector Line
- Access Road
- Laydown Area
- Town Boundary

Vernal Pool Center Point

- VP
- SVP
- PVP
- Vernal Pool Boundary
- Significant Vernal Pool Critical Terrestrial Habitat
- Inland Waterfowl / Wading Bird Habitat

Delineated Stream

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Delineated Wetland
- Open Wetland Line
- Delineation Limit

0 500 1,000 Feet
1:6,000 (At original document size of 11x17)

Stantec

Project Location: Hancock County, Maine

195601223

Prepared by GC on 2018-10-25
Reviewed by TT on 2018-10-25

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
13 of 13

Title
Delineated Natural Resources

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\Permit\2018\01223_78_Delineation.mxd Revised: 2018-10-26 By: gcarpentier

Table 1: Wetland summary table. Weaver Wind Project. Hancock County, Maine.

Wetland ID	PFO	PSS	PEM	PUB	Stream ID	P	I	E	VP/ABA ID	P-WL1	WSS	Notes
W001		X										
W002	X											
W003	D		X						VP_52KN_N			
									PVP_02RK_M			
W004	D		X						PVP_12KN_M			
W005	X								PVP_01JL_M			
									PVP_01RK_M			
									PVP_07KN_M			
									PVP_31KN_M			
									PVP_32KN_M			
W006		X							SVP_53KN_N	H		
W007	D		X									
W008	X											
W009	D	X	X									
W010	X								PVP_30KN_M			
W011	D	X							PVP_15KN_M			
W012	D	X										
W013	X											
W014	X											
W015		X										
W016	X											
W017			X									
W018	X											
W019	X											
W020	X											
W021	D		X		S01			X	PVP_33KN_M	R		
W022			X									
W023			X						PVP_34KN_M			
W024	D		X									
W025			X						PVP_35KN_M			
W026		X										
W027	D		X									
W028	X											
W029			X									
W030	X											
W031	X				S02		X			R		
W032		X										
W033			X									
W034		X										
W035		X							PVP_07JL_M			
W036		X							PVP_08JL_M			
W037			X									
W038	X											
W039	X											
W040		X										
W041	X								PVP_24KN_M			
W042			X									
W043			X									
W044	X											
W045	X				S03	X				R		
W046	D	X										
W047	X											
W048	X				S05	X				R		
W049	X				S05	X				R		
W050	X											
W051	X											
W052	D	X										
W053	X	D										
W054		X										
W055			X									
W056	D	X										
W057	X											
W058	X				S06	X				R, H		IWWH
W059	D	X			S06	X				R, H		IWWH
W060			X						SVP_63KN_N	H		
W061		D	X		S08	X				R, H, E		IWWH
					S09			X				
W062			D	X						H, E		IWWH
W063	X											
W064	X											
W065			X						PVP_22KN_M			
W066	X											
W067	X											
W068			X						PVP_23KN_M			
W069	X											
W070	X								VP_59KN_N			
									VP_60KN_N			
									VP_61KN_N			
W071			X									
W072		X										
W073	X		D									
W074	X											
W075	X											
W076	X											
W077	X											

Wetland ID	PFO	PSS	PEM	PUB	Stream ID	P	I	E	VP/ABA ID	P-WL1	WSS	Notes
W078	X											
W079	D	X										
W080		X										
W081	D	X										
W082	X											
W083	X				S10		X		VP_58KN_N	R		
W084	X											
W085	X								PVP_03CF_M			
									VP_65KN_N			
W086	X											
W087	X											
W088	X											
W089			X							H		IWWH
W090	X											
W091	X			D								IWWH
W092	X	D	D							H		IWWH
W093	X			D						H		IWWH
W094	X	D	D							H		IWWH
W095			X									
W096			X									
W097	X								VP_62KN_N			
W098		X							VP_64KN_N			
W099	X											
W100	X				S13		X			R		
					S14		X					
W101	X				S12		X			R		
					S13		X					
					S14		X					
W102	X											
W103	X											
W104		X										
W105			X						PVP_09KN_M			
W106		X										
W107	D	X										
W108	X											
W109	X	D										
W110		X			S15	X				R		
W111		X			S15	X				R		
W112		X										
W113	X											
W114	X											
W115	D		X						PVP_21KN_M			
W116	X											
W117	X				S16	X				R		
W118	X				S16	X				R		
W119	X											
W120	X											
W121	X											
W122	X									H		
W123	X											
W124	X											
W125	X											
W126			X									
W127		X		D					PVP_07CF_M			
W128		X										
W129		X							PVP_06CF_M			
W130	X											
W131	X											
W132	X								VP_57KN_N			
W133		X							PVP_20KN_M			
W134	X											
W135	X											
W136		X										
W137		X							PVP_19KN_M			
W138		X							PVP_18KN_M			
W139		X										
W140	X											
W141	X				S18	X				R		
W142		X										
W143		X	D									
W144		X										
W145	D	X										
W146	D	X										
W147	X											
W148	D	X	X						VP_51KN_M			
W149	D	X							VP_02AA_M			
W150		X							VP_03AA_M			
W151	X											
W152	X		D									
W153	X		D									
W154	X											
W155	X	D	D									
W156	X											
W157			D	X					PVP_04AA_M			
W158	X	D										

Wetland ID	PFO	PSS	PEM	PUB	Stream ID	P	I	E	VP/ABA ID	P-WL1	WSS	Notes
W159	D	X										
W160		X	D									
W161	D	X										
W162			X									
W163					S20		X			R		
W164	X				S21	X				R		
W165	D		X		S21	X				R		
W166	X				S22	X				R		
W167	X	X	X		S22	X			VP_50KN_N	R		
					S23	X			PVP_07MJ_M			
W168	X				S24		X			R		
W169		D	D						VP_03MJ_M			
W170			X						PVP_08MJ_M			
W171		D	D						PVP_04MJ_M			
									PVP_05MJ_M			
W172	X											
W173	D		X									
W174	D		X						PVP_03MJ_M			
W175	D		X		S27		X		PVP_01MJ_M	R		
W176			X									
W177		X	D									
W178		X	D									
W179	X											
W180		D	D						PVP_02MJ_M			
W181			X									
W182	D		X									
W183	D		X									
W184	X				S34		X			R		
W185	D		X		S34		X				R	
W186	D		X									
W187		X										
W188	X				S35	X					R	
W189	D	X			S35	X					R	
W190	X				S36	X					R	
W191		X										
W192		D	X									
W193		X										
W194	D	X										
W195	D	X										
W196	X								VP_55KN_N			
									VP_56KN_N			
W197	X											
W198	X											
W199	X											
W200	X											
W201	X											
W202	X											
W203	X								PVP_10JL_M			
W204	X											
W205		X										
W206		X										
W207	X											
W208	X											
W209	X											
W210		X										
W211		X										
W212			X									
W213		X										
W214			X									
W215			X						VP_01MJ_M			
W216			X									
W217			X									
W218	D	D										
W219	X											
W220		X							03CF			Man-made vernal pool identified in 2009
W221	X											
W222	X											
W223		X	D									
W224	D	X							01AA			Man-made vernal pool identified in 2009
									02CF			Man-made vernal pool identified in 2009
W225			X						02TT			Man-made PVP identified in 2009
W226	D	X										
W227	X											
W228			X									
W229	D	X	D									
W230	D	D	X						05CF			Man-made vernal pool identified in 2009
									06CF			Man-made vernal pool identified in 2009
									02AA			Natural vernal pool identified in 2009

Wetland ID	PFO	PSS	PEM	PUB	Stream ID	P	I	E	VP/ABA ID	P-WL1	WSS	Notes
									07CF			Man-made vernal pool identified in 2009
W231	D	X	X						04CF			Man-made vernal pool identified in 2009
W232	D	D	X									
W233			X									
W234	X											
W235*	X											
W237		X	D									
W238	D	D	X									
W239	D	X	X									
W240			X									
W241	D		X									
W242	D	X	X		S38		X		08CF		R	Man-made vernal pool identified in 2009
					S39		X		09CF			Man-made vernal pool identified in 2009
									01MG			Man-made vernal pool identified in 2009
W243	D	X	X									
W244	D	X	X						02DD			Man-made PVP identified in 2009
W245	D	X	X									
W246		X										
W247	X	D										
W248	D		X									
W249	X											
W250		X										
W251	X											
W252	X											
W253		X										
W254*	X											
W256		X	D									
W257		X	D									
W258			X									
W259			X						PVP_03RK_M			
W260			X						PVP_11CF_M			
W261			X						PVP_10CF_M			
W262			X									
W263			X									
W264	X											
W265	D	X	X						11CF			Man-made vernal pool identified in 2009
									02MG			Man-made vernal pool identified in 2009
W266	X											
W267	X											
W268	X											
W269	X											
W270	X								PVP_40KN_M			new, manmade roadside ditch
W271	X											
W272	X											
W273	X											
W274	X											
W275	D	X										
W276	X											
W277	X											
W278	X											
W279	X											
W280			X									
W281			X									
W282	X											
W283	X											
W284	X											
W285	X											
W286	X											
W287	X				S41		X				R	
W288	X											
W289		X										

*Wetland ID numbers W236 and W255 are skipped by intention

P-WL1 and Wetland of Special Significance (WSS) designations:

R	Located within 25 feet of a river, stream or brook
H	Wetland includes a mapped significant wildlife habitat or potential significant wildlife habitat
E	Wetland includes 20,000 square feet or more of open water or emergent marsh vegetation
	Note some wetlands include one or more of the above criteria

Table 2: Stream summary table. Weaver Wind Project. Hancock County, Maine.

Stream ID	Associated Wetland ID	Flow Regime P	I	E	Top of Bank Width (Ft.)	Ordinary Highwater Mark Width (Ft.)	Water Depth at Survey (Ft.)	Substrate	Additional Notes
S01	W021			X	2.5	1.5	0.1	cobble, gravel, mud	
S02	W031		X		3	2	0.2	cobble, gravel, mud	
S03	W045	X			6	4	0.3	gravel, boulder	
S04	No associated wetland	X			6	4	0.3	gravel, boulder	
S05	W048, W049	X			8	4	0.3	gravel, boulder	
S06	W058, W059	X			10-25	4-8	0.4-2.5	silt, gravel, boulder	Hopper Brook
S07	No associated wetland	X			8	4	0.5	silt, cobble, boulder	
S08	W061	X			12	8	0.25	gravel, cobble, mud	Leighton Brook
S09	W061			X	4	3	0	gravel, cobble, mud	
S10	W083		X		1-6	1-3	0.1-0.5	silt, cobble, gravel, organic	
S11	No associated wetland	X			10	6	0.5	cobble, gravel	Leighton Brook
S12	W100, W101		X		2	2	0.2	gravel, cobble, boulders	
S13	W100, W101		X		2	2	0.3	gravel, cobble, boulders	
S14	W101		X		1	1	0.3	gravel, cobble, boulders	
S15	W110, W111	X			3.5	1.5	0.25	cobble, gravel	
S16	W117, W118	X			6	4	0.25	silt, detritus, boulder	
S17	No associated wetland	X			30	25	2	boulder, cobble, gravel	East Branch Union River
S18	W141	X			1	1	0.25	silt, gravel	
S19	No associated wetland		X		—	—	—	—	Not all stream characteristics available
S20	W163		X		—	—	—	—	Colson Branch. Not all stream characteristics available
S21	W164, W165	X			12	11	2.5	gravel, silt, detritus	
S22	W166, W167	X			5	4	1	gravel, silt	
S23	W167	X			6	5	0.75	gravel, silt	Garden Eden Brook
S24	W168		X		4	2	0.1	gravel	
S25	No associated wetland		X		5	5	0.5	boulder, gravel	
S26	No associated wetland		X		1	1	0.25	boulder, sand	
S27	W175		X		1	1	0.1	silt, cobble	
S28	No associated wetland		X		5	5	1	gravel, cobble	
S29	No associated wetland		X		3	3	0.25	gravel, cobble	
S30	No associated wetland	X			7	4	0.5	gravel, cobble	
S31	No associated wetland		X		3	1	0.25	silt ,detritus	
S32	No associated wetland	X			6	3	0.75	gravel, cobble	
S33	No associated wetland	X			8	3	0.25	cobble, gravel	
S34	W184, W185		X		6	2	0.5	gravel, cobble	
S35	W188, W189	X			6	5	0.5	cobble, gravel, sand	
S36	W190	X			2.5	2.5	0.25	cobble, silt	
S37	No associated wetland			X	4-6	2-3	0	gravel, cobble, boulder	
S38	W242		X		4	1.5	0.5	cobble	
S39	W242		X		1	1	0.5	cobble	
S40	No associated wetland			X	2	2	0.25	sand	
S41	W287		X		2	2	0.5	gravel, sand, cobble	

Table 3: Vernal pool summary table. 2009 vernal pools listed at the bottom of table. Weaver Wind Project. Hancock County, Maine.

PoolID	Type	Descriptor	Observation Date	Wood Frog	Spotted Salamander	Blue-spotted salamander	Fairy Shrimp	Notes
VP_01MJ_M	VP	Man-made	7/8/2014	?	0	0	No	Borrow pit. Wood frog tadpoles observed.
PVP_01MJ_M	PVP	Man-made	7/9/2014	0	0	0	No	
PVP_02MJ_M	PVP	Man-made	7/10/2014	0	0	0	No	
PVP_03MJ_M	PVP	Man-made	7/10/2014	0	0	0	No	
PVP_04MJ_M	PVP	Man-made	7/10/2014	0	0	0	No	
PVP_05MJ_M	PVP	Man-made	7/10/2014	0	0	0	No	
VP_50KN_N	VP	Natural	5/1/2015	43	53	0	No	Additional visit on 5/13/15, IFW determined not significant: permanent inlet/outlet, permanent hydroperiod
PVP_07MJ_M	PVP	Man-made	7/10/2014	0	0	0	No	
VP_03MJ_M	VP	Man-made	7/11/2014	?	0	0	No	Borrow pit. Wood frog tadpoles observed.
PVP_08MJ_M	PVP	Man-made	7/11/2014	0	0	0	No	
VP_55KN_N	VP	Natural	5/5/2015	0	15	0	No	Additional visit on 5/14/15
VP_56KN_N	VP	Natural	5/5/2015	0	7	0	No	Additional visit on 5/14/15
VP_51KN_M	VP	Man-made	5/1/2015	116	14	1	No	Impoundment adjacent to road. Outlet from pool under road. Additional visit on 5/13/15
VP_02AA_M	VP	Man-made	7/18/2014	?	0	0	No	Wood frog tadpoles observed
VP_03AA_M	VP	Man-made	7/28/2014	?	0	0	No	Wood frog tadpoles observed
PVP_04AA_M	PVP	Man-made	7/28/2014	0	0	0	No	
VP_58KN_N	VP	Natural-Modified	5/6/2015	0	14	0	No	Additional visit on 5/14/15
PVP_07KN_M	PVP	Man-made	8/7/2014	0	0	0	No	
PVP_01JL_M	PVP	Man-made	8/7/2014	0	0	0	No	
PVP_01RK_M	PVP	Man-made	8/7/2014	0	0	0	No	
PVP_02RK_M	PVP	Man-made	8/7/2014	0	0	0	No	
PVP_09KN_M	PVP	Man-made	8/13/2014	0	0	0	No	
VP_59KN_N	VP	Natural	5/6/2015	0	7	0	No	Additional visit on 5/14/15
VP_60KN_N	VP	Natural	5/6/2015	0	7	0	No	Additional visit on 5/14/15
VP_61KN_N	VP	Natural	5/6/2015	0	11	0	No	Additional visit on 5/14/15
PVP_12KN_M	PVP	Man-made	8/14/2014	0	0	0	No	
VP_52KN_N	VP	Natural-Modified	5/5/2015	0	2	0	No	Additional visit on 5/14/15
PVP_14KN_M	PVP	Man-made	8/15/2014	0	0	0	No	
VP_64KN_N	VP	Natural	5/6/2015	0	14	0	No	Additional visit on 5/14/15
VP_62KN_N	VP	Natural	5/6/2015	0	12	0	No	Additional visit on 5/13/15
PVP_03CF_M	PVP	Man-made	8/19/2014	0	0	0	No	
VP_65KN_N	VP	Natural	5/6/2015	0	17	0	No	Additional visit on 5/14/15
SVP_53KN_N	SVP	Natural	5/5/2015	104	2	0	No	Additional visit on 5/13/15
VP_57KN_N	VP	Natural-Modified	5/5/2015	0	8	0	No	Additional visit on 5/13/15
PVP_06CF_M	PVP	Man-made	8/25/2014	0	0	0	No	
PVP_07CF_M	PVP	Man-made	8/25/2014	0	0	0	No	
PVP_18KN_M	PVP	Man-made	8/25/2014	0	0	0	No	
PVP_19KN_M	PVP	Man-made	8/25/2014	0	0	0	No	
PVP_20KN_M	PVP	Man-made	8/25/2014	0	0	0	No	
PVP_21KN_M	PVP	Man-made	8/26/2014	0	0	0	No	
PVP_22KN_M	PVP	Man-made	8/27/2014	0	0	0	No	
PVP_23KN_M	PVP	Man-made	8/27/2014	0	0	0	No	
PVP_24KN_M	PVP	Man-made	8/27/2014	0	0	0	No	
PVP_07JL_M	PVP	Man-made	8/28/2014	0	0	0	No	
PVP_08JL_M	PVP	Man-made	8/28/2014	0	0	0	No	
PVP_30KN_M	PVP	Man-made	9/23/2014	0	0	0	No	
PVP_31KN_M	PVP	Man-made	9/23/2014	0	0	0	No	
PVP_32KN_M	PVP	Man-made	9/23/2014	0	0	0	No	
PVP_33KN_M	PVP	Man-made	9/25/2014	0	0	0	No	
PVP_34KN_M	PVP	Man-made	9/25/2014	0	0	0	No	
PVP_35KN_M	PVP	Man-made	9/29/2014	0	0	0	No	
PVP_10CF_M	PVP	Man-made	10/2/2014	0	0	0	No	
PVP_11CF_M	PVP	Man-made	10/2/2014	0	0	0	No	
PVP_10JL_M	PVP	Man-made	10/7/2014	0	0	0	No	
PVP_03RK_M	PVP	Man-made	10/16/2014	0	0	0	No	
SVP_63KN_N	SVP	Natural	5/6/2015	146	98	13	Yes	Additional visit on 5/14/15
PVP_40KN_M	PVP	Man-made	11/21/2014	0	0	0	No	
01AA	VP	Man-made	5/12/2009	0	6	0	No	Green frog tadpoles observed
02AA	VP	Natural	5/12/2009	2	3	0	No	
02CF	VP	Man-made	5/12/2009	0	5	0	No	
03CF	VP	Man-made	5/12/2009	3	0	0	No	
04CF	VP	Man-made	5/12/2009	1	5	0	No	Wood frog tadpoles observed
05CF	VP	Man-made	5/12/2009	7	0	0	No	
06CF	VP	Man-made	5/12/2009	7	34	0	No	
07CF	VP	Man-made	5/12/2009	8	7	0	No	
08CF	VP	Man-made	5/12/2009	30	0	0	No	
09CF	VP	Man-made	5/12/2009	24	10	0	No	
11CF	VP	Man-made	5/12/2009	1	13	0	No	
01MG	VP	Man-made	5/12/2009	0	5	0	No	
02MG	VP	Man-made	5/12/2009	7	0	0	No	
02DD	PVP	Man-made	11/19/2009	0	0	0	No	
02TT	PVP	Man-made	11/18/2009	0	0	0	No	

Exhibit 7-2-2

Wetland Determination Data Forms

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 10/15/14
Applicant: First Wind | County: Hancock
Investigator #1: Rod Kelshaw | Investigator #2: Jeanna Leclerc | State: Maine
Soil Unit: Brayton-Colonel 0-8%slopes | NWI/WWI Classification: Upland | Wetland ID: W005_1
Landform: Depression | Local Relief: Linear | Sample Point: Upland
Slope (%): 5 | Latitude: 44.825773 | Longitude: -68.233056 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:		(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	0	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	0	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
1	0	1	--	NR	--	--	--	--	--	--	Oi - organic/duff
0	2	2	10YR	6/2	100	--	--	--	--	--	Stony fine sandy loam
2	11	3	7.5YR	4/4	100	--	--	--	--	--	Stony fine sandy loam
11	15	4	10YR	4/6	100	--	--	--	--	--	fine sandy loam
15	17	5	2.5Y	5/4	80	--	NR	<20	D	M	very fine sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: None Depth:

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Second horizon is an albic E-horizon.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W005_1 | Sample Point: Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	70	Y	FACU
2.	*Abies balsamea*	10	Y	FAC
3.	*Thuja occidentalis*	3	N	FACW
4.	*Acer rubrum*	2	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	85		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	25	Y	FACU
2.	*Abies balsamea*	10	N	FAC
3.	*Thuja occidentalis*	3	N	FACW
4.	*Betula populifolia*	2	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	40		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	0		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks: No vegetation observed in herb stratum.

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *33.3%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	6	x 2 =	12
FAC spp.	24	x 3 =	72
FACU spp.	95	x 4 =	380
UPL spp.	0	x 5 =	0
Total	125 (A)		464 (B)

Prevalence Index = B/A = *3.712*

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 10/15/14
Applicant: First Wind — County: Hancock
Investigator #1: Rod Kelshaw — Investigator #2: Jeanna Leclerc — State: Maine
Soil Unit: Marlow Dixfield 3-15% slopes — NWI/WWI Classification: PFO — Wetland ID: W005_1
Landform: Depression — Local Relief: Linear — Sample Point: Wetland
Slope (%): 0-3 — Latitude: 44.825773 — Longitude: -68.233056 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No — Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No — Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:

- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:

- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☑ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☑ Yes	☐ No	Depth: 0	(in.)
Saturation Present?	☑ Yes	☐ No	Depth: 0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	22	1	--	NR	--	--	--	--	--	--	Oa muck
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☑ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]

- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: None — Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W005_1 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	50	Y	FAC
2.	*Acer rubrum*	20	Y	FAC
3.	*Thuja occidentalis*	3	N	FACW
4.	*Fraxinus nigra*	2	N	FACW
5.	--	--	--	--
6.	--	--	--	--
7.		--	--	
8.		--	--	
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	75		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Alnus incana*	15	Y	FACW
2.	*Abies balsamea*	8	N	FAC
3.	*Picea rubens*	3	N	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	26		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Osmunda claytoniana*	15	Y	FAC
2.	*Mianthemum canadense*	10	Y	FACU
3.	*Oxalis montana*	2	N	FACU
4.	*Carex trisperma*	3	N	OBL
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	30		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***80.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	3	x 1 =	3
FACW spp.	20	x 2 =	40
FAC spp.	93	x 3 =	279
FACU spp.	15	x 4 =	60
UPL spp.	0	x 5 =	0
Total	131 (A)		382 (B)

Prevalence Index = B/A = ***2.916***

Hydrophytic Vegetation Indicators:

Yes	No	Indicator
☐ Yes	☑ No	Rapid Test for Hydrophytic Vegetation
☑ Yes	☐ No	Dominance Test is > 50%
☑ Yes	☐ No	Prevalence Index is ≤ 3.0 *
☐ Yes	☑ No	Morphological Adaptations (Explain) *
☐ Yes	☑ No	Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 08/07/14
Applicant: First Wind | County: Hancock
Investigator #1: Katelin Nickerson | Investigator #2: Jeanna Leclerc | State: Maine
Soil Unit: Brayton-Colonel association, 0-8% slopes, v. stony | NWI/WWI Classification: Upland | Wetland ID: W005_2
Landform: Side slope | Local Relief: Concave | Sample Point: Upland
Slope (%): 0-3 | Latitude: 44.825798 | Longitude: -68.232824 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑ **):**

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
3	0	1	--	NR	--	--	--	--	--	--	fibric organic
0	7	2	5Y	6/1	100	--	--	--	--	--	sandy loam
7	10	3	7.5YR	3/4	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑ **):**

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Rock Depth: 13"

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Second horizon an albic E-horizon.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W005_2 | Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	30	Y	FACU
2.	*Abies balsamea*	20	Y	FAC
3.	*Pinus strobus*	15	Y	FACU
4.	*Thuja occidentalis*	5	N	FACW
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	70		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	30	Y	FACU
2.	*Abies balsamea*	10	Y	FAC
3.	*Thuja occidentalis*	10	Y	FACW
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	50		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Vaccinium angustifolium*	3	Y	FACU
2.	*Maianthemum canadense*	2	Y	FACU
3.	*Acer rubrum*	Y	Y	FAC
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	5		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *37.5%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	15	x 2 =	30
FAC spp.	30	x 3 =	90
FACU spp.	80	x 4 =	320
UPL spp.	0	x 5 =	0
Total	125 (A)		440 (B)

Prevalence Index = B/A = ***3.520***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 08/07/14
Applicant: First Wind | County: Hancock
Investigator #1: Katelin Nickerson | Investigator #2: Jeanna Leclerc | State: Maine
Soil Unit: Brayton-Colonel association, 0-8% slopes, v. stony | NWI/WWI Classification: PFO | Wetland ID: W005_2
Landform: Depression | Local Relief: Concave | Sample Point: Wetland
Slope (%): 0-3 | Latitude: 44.825223 | Longitude: -68.233072 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- | Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ **Yes** ☐ **No**

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐ **):**

Primary:

- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:

- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☑ Yes	☐ No	Depth: 0	(in.)
Saturation Present?	☑ Yes	☐ No	Depth: 0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
36	0	1	--	NR	--	--	--	--	--	--	mucky peat
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐ **):**

- ☑ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]

- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (**LRR K, L, R**)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (**LRR K, L**)
- ☐ S9 - Thin Dark Surface (**LRR K, L**)
- ☐ F12 - Iron-Manganese Masses (**LRR K, L, R**)
- ☐ F19 - Piedmont Floodplain Soils (**MLRA 149B**)
- ☐ TA6 - Mesic Spodic (**MLRA 144A, 145, 149B**)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W005_2 | Sample Point Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	25	Y	FAC
2.	*Acer rubrum*	15	Y	FAC
3.	*Betula alleghaniensis*	15	Y	FAC
4.	*Fraxinus pennsylvanica*	5	N	FACW
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Alnus incana*	50	Y	FACW
2.	*Abies balsamea*	10	N	FAC
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Osmunda claytoniana*	10	Y	FAC
2.	*Acer rubrum*	5	Y	FAC
3.	*Linnaea borealis*	5	Y	FAC
4.	*Carex trisperma*	5	Y	OBL
5.	*Trientalis borealis*	3	N	FAC
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	28		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 8 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	5	x 1 =	5
FACW spp.	55	x 2 =	110
FAC spp.	88	x 3 =	264
FACU spp.	0	x 4 =	0
UPL spp.	0	x 5 =	0
Total	148 (A)		379 (B)

Prevalence Index = B/A = ***2.561***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 08/27/14
Applicant: First Wind — County: Hancock
Investigator #1: Katelin Nickerson — Investigator #2: — State: Maine
Soil Unit: Colton-Hermon Association, 5-15% slopes — NWI/WWI Classification: Upland — Wetland ID: W047
Landform: Side slope — Local Relief: Linear — Sample Point: Upland
Slope (%): 5-10 — Latitude: 44.805456 — Longitude: -68.19204 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐naturally problematic? ☑ Yes ☐No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No — Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No — Is This Sampling Point Within A Wetland? ☐ Yes ☑ No
Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A
Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	5	1	10YR	4/6	100	--	--	--	--	--	sandy loam
5	8	2	10YR	5/8	100	--	--	--	--	--	sandy loam
	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Compaction — Depth: 8"

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Soils contain 10% coarse fragments.

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Wetland ID: W047 — Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Betula papyrifera*	40	Y	FACU
2.	*Populus tremuloides*	15	N	FACU
3.	*Picea rubens*	15	N	FACU
4.	*Acer rubrum*	5	N	FAC
5.	*Abies balsamea*	5	N	FAC
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	80		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Thuja occidentalis*	10	Y	FACW
2.	*Picea rubens*	10	Y	FACU
3.	*Nemopanthus mucronatus*	5	N	OBL
4.	*Acer rubrum*	5	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	30		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Cornus canadensis*	30	Y	FAC
2.	*Pteridium aquilinum*	10	Y	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	40		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *40.0%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	5	x 1 =	5
FACW spp.	10	x 2 =	20
FAC spp.	45	x 3 =	135
FACU spp.	90	x 4 =	360
UPL spp.	0	x 5 =	0
Total	150 (A)		520 (B)

Prevalence Index = B/A = ***3.467***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 08/27/14
Applicant: First Wind — County: Hancock
Investigator #1: Katelin Nickerson — Investigator #2: — State: Maine
Soil Unit: Colton-Hermon Association, 5-15% slopes — NWI/WWI Classification: PFO — Wetland ID: W047
Landform: Depression — Local Relief: Concave — Sample Point: **Wetland**
Slope (%): 0-5 — Latitude: 44.805173 — Longitude: -68.19211 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐ or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐ or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No — Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No — Is This Sampling Point Within A Wetland? ☑ **Yes** ☐ **No**

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes ☐ No	Depth:	1	(in.)
Water Table Present?	☑ Yes ☐ No	Depth:	0	(in.)
Saturation Present?	☑ Yes ☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
38	30	1	--	NR	--	--	--	--	--	--	peat
30	0	2	--	NR	--	--	--	--	--	--	mucky peat
0	2	3	2.5Y	4/1	60	2.5Y	6/2	40	D	M	silty clay loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☑ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks: Sand fragments mixted in horizon 2.

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W047 | Sample Point Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	25	Y	FAC
2.	*Thuja occidentalis*	15	Y	FACW
3.	*Picea rubens*	5	N	FACU
4.	*Betula alleghaniensis*	5	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	50		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Alnus incana*	40	Y	FACW
2.	*Thuja occidentalis*	10	Y	FACW
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	50		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Rubus hispidus*	40	Y	FACW
2.	*Glyceria melicaria*	20	Y	OBL
3.	*Osmunda claytoniana*	15	N	FAC
4.	*Acer rubrum*	5	N	FAC
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	80		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	20	x 1 =	20
FACW spp.	105	x 2 =	210
FAC spp.	50	x 3 =	150
FACU spp.	5	x 4 =	20
UPL spp.	0	x 5 =	0
Total	180 (A)		400 (B)

Prevalence Index = B/A = ***2.222***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks: Sphagnum sp. mat throughout.

Additional Remarks: 100% Sphagnum cover

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 08/14/14
Applicant: First Wind | County: Hancock
Investigator #1: Jeanna Leclerc | Investigator #2: Katelin Nickerson | State: Maine
Soil Unit: Colonel-Brayton-Dixfield association, 1-8% slopes, v. stony | NWI/WWI Classification: Upland | Wetland ID: W070
Landform: Rise | Local Relief: Convex | Sample Point: Upland
Slope (%): 3-8 | Latitude: 44.804659 | Longitude: -68.213882 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present? ☐ Yes ☑ No Depth: (in.)
Water Table Present? ☐ Yes ☑ No Depth: (in.)
Saturation Present? ☐ Yes ☑ No Depth: (in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	5	1	--	NR	100	--	--	--	--	--	fibric organic
	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Boulder/Bedrock Depth: 5"

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Horizon 1 is very dry.

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W070 | Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Pinus strobus*	20	Y	FACU
2.	*Picea rubens*	20	Y	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	40		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	20	Y	FACU
2.	*Acer rubrum*	10	Y	FAC
3.	*Pinus strobus*	5	N	FACU
4.	*Thuja occidentalis*	5	N	FACW
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	40		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Maianthemum canadense*	40	Y	FACU
2.	*Gaultheria procumbens*	25	Y	FACU
3.	*Vaccinium angustifolium*	20	Y	FACU
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	85		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***14.3%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	5	x 2 =	10
FAC spp.	10	x 3 =	30
FACU spp.	150	x 4 =	600
UPL spp.	0	x 5 =	0
Total	165 (A)		640 (B)

Prevalence Index = B/A = ***3.879***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No — Dominance Test is > 50%
- ☐ Yes ☑ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project	Stantec Project #: 195600884	Date:	08/14/14
Applicant: First Wind		County:	Hancock
Investigator #1: Jeanna Leclerc	Investigator #2: Katelin Nickerson	State:	Maine
Soil Unit: Brayton-Colonel association, 0-8% slopes, very stony	NWI/WWI Classification: PFO	Wetland ID:	W070
Landform: Depression	Local Relief: Concave	Sample Point:	Wetland
Slope (%): 0-3 Latitude: 44.802552	Longitude: -68.253659 Datum: --	Community ID:	--
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks)	☑ Yes ☐ No	Section:	--
Are Vegetation ☐, Soil ☐ or Hydrology ☐ significantly disturbed?	Are normal circumstances present?	Township:	--
Are Vegetation ☐, Soil ☐ or Hydrology ☐ naturally problematic?	☑ Yes ☐ No	Range: --	Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present?	☑ Yes ☐ No	Hydric Soils Present?	☑ Yes ☐ No
Wetland Hydrology Present?	☑ Yes ☐ No	Is This Sampling Point Within A Wetland?	☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☑ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☑ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☑ D4 - Microtopographic Relief
- ☑ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes ☐ No	Depth:	1	(in.)
Water Table Present?	☑ Yes ☐ No	Depth:	6	(in.)
Saturation Present?	☑ Yes ☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks: Pockets of surface water in pit and mound microtopography.

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
3	0	1	--	NR	100	--	--	--	--	--	muck
0	8	2	2.5Y	5/1	40	2.5Y	7/1	40	D	M	silt loam
--	--	--	--	--	--	--	NR	20	C	M	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☑ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Compaction Depth: 11"

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W070 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	30	Y	FAC
2.	*Acer rubrum*	30	Y	FAC
3.	*Picea rubens*	15	Y	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	75		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Alnus incana*	20	Y	FACW
2.	*Abies balsamea*	15	Y	FAC
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	35		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Maianthemum canadense*	5	Y	FACU
2.	*Trientalis borealis*	5	Y	FAC
3.	*Osmunda claytoniana*	5	Y	FAC
4.	*Parathelypteris noveboracensis*	5	Y	FAC
5.	*Linnaea borealis*	2	N	FAC
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	22		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 7 (A)

Total Number of Dominant Species Across All Strata: 9 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***77.8%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	20	x 2 =	40
FAC spp.	92	x 3 =	276
FACU spp.	20	x 4 =	80
UPL spp.	0	x 5 =	0
Total	132 (A)		396 (B)

Prevalence Index = B/A = ***3.000***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 08/08/14
Applicant: First Wind | County: Hancock
Investigator #1: Jeanna Leclerc | Investigator #2: | State: Maine
Soil Unit: Colton-Adams complex, 3-15% slopes | NWI/WWI Classification: Upland | Wetland ID: W083
Landform: Rise | Local Relief: Convex | Sample Point: **Upland**
Slope (%): 3-8 | Latitude: 44.804659 | Longitude: -68.213882 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No
Is This Sampling Point Within A Wetland? ☐ **Yes** ☑ **No**

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
2	0	1	--	NR	--	--	--	--	--	--	fibric organic
0	1	2	7.5YR	5/2	100	--	--	--	--	--	sandy loam
1	2	3	5YR	3/3	100	--	--	--	--	--	sandy loam
2	5	4	7.5YR	3/4	100	--	--	--	--	--	sandy loam
5	11	5	10YR	4/6	100	--	--	--	--	--	sandy loam
11	12	6	10YR	5/6	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR Depth: 12"

Hydric Soil Present? ☐ Yes ☑ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W083 | Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	25	Y	FACU
2.	*Picea rubens*	15	Y	FACU
3.	*Acer rubrum*	10	N	FAC
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	50		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	15	Y	FACU
2.	*Abies balsamea*	15	Y	FAC
3.	*Picea rubens*	15	Y	FACU
4.	*Acer pensylvanicum*	5	N	FACU
5.	*Betula alleghaniensis*	5	N	FAC
6.	*Viburnum nudum*	5	N	FACW
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Maianthemum canadense*	5	Y	FACU
2.	*Coptis trifolia*	5	Y	FACW
3.	*Acer rubrum*	5	Y	FAC
4.	*Picea rubens*	5	Y	FACU
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	20		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 9 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***33.3%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	10	x 2 =	20
FAC spp.	35	x 3 =	105
FACU spp.	85	x 4 =	340
UPL spp.	0	x 5 =	0
Total	130 (A)		465 (B)

Prevalence Index = B/A = ***3.577***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 08/06/14
Applicant: First Wind — County: Hancock
Investigator #1: Jeanna Leclerc — Investigator #2: — State: Maine
Soil Unit: Dixfield-Colonel Complex, 0-8% slope, very stony — NWI/WWI Classification: PFO — Wetland ID: W083
Landform: Depression — Local Relief: Concave — Sample Point: Wetland
Slope (%): 0-3 — Latitude: 44.807389 — Longitude: -68.244437 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present?	☑ Yes ☐ No	Hydric Soils Present?	☑ Yes ☐ No
Wetland Hydrology Present?	☑ Yes ☐ No	Is This Sampling Point Within A Wetland?	☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☑ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☑ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☑ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☑ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☑ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes ☐ No	Depth: 0	(in.)
Water Table Present?	☑ Yes ☐ No	Depth: 0	(in.)
Saturation Present?	☑ Yes ☐ No	Depth: 0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
5	0	1	5Y	3/2	100	--	--	--	--	--	mucky peat
0	7	2	5Y	3/1	100	--	--	--	--	--	silt loam
7	11	3	Gley 1	5/10Y	100	--	--	--	--	--	loamy sand
11	13	4	Gley 2	6/5G	100	--	--	--	--	--	loamy sand
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☑ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Rock — Depth: 13 in.

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W083 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	40	Y	FAC
2.	*Betula alleghaniensis*	15	N	FAC
3.	*Picea rubens*	10	N	FACU
4.	*Tsuga canadensis*	10	N	FACU
5.	*Acer rubrum*	5	N	FAC
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	80		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	10	Y	FAC
2.	*Picea rubens*	10	Y	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	20		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Onoclea sensibilis*	20	Y	FACW
2.	*Osmunda spectabilis*	20	Y	OBL
3.	*Unknown grass*	20	Y	NL
4.	*Osmunda claytoniana*	10	N	FAC
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	70		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***66.7%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	20	x 1 =	20
FACW spp.	20	x 2 =	40
FAC spp.	80	x 3 =	240
FACU spp.	30	x 4 =	120
UPL spp.	0	x 5 =	0
Total	150 (A)		420 (B)

Prevalence Index = B/A = ***2.800***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 08/19/14
Applicant: First Wind — County: Hancock
Investigator #1: Katelin Nickerson — Investigator #2: — State: Maine
Soil Unit: Dixfield-Turnbridge-Colonel complex, 3-15% slopes, v. stony — NWI/WWI Classification: Upland — Wetland ID: W097
Landform: Side slope — Local Relief: Concave — Sample Point: Upland
Slope (%): 0-5 — Latitude: 44.801654 — Longitude: -68.21951 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No
Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	1	1	10YR	3/1	100	--	--	--	--	--	silt loam
1	1.5	2	10YR	5/1	100	--	--	--	--	--	silt loam
1.5	16.5	3	10YR	5/6	100	--	--	--	--	--	silt loam
16.5	21.5	4	10YR	6/2	90	5YR	5/6	10	C	M	silt loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Second horizon is an albic E-horizon.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project   Wetland ID: W097   Sample Point: Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	55	Y	FACU
2.	*Tsuga canadensis*	30	Y	FACU
3.	*Acer saccharum*	5	N	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	90		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	15	Y	FACU
2.	*Abies balsamea*	5	Y	FAC
3.	*Tsuga canadensis*	5	Y	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	25		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Coptis trifolia*	30	Y	FACW
2.	*Picea rubens*	10	Y	FACU
3.	*Tsuga canadensis*	5	N	FACU
4.	*Trientalis borealis*	2	N	FAC
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	47		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***28.6%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	30	x 2 =	60
FAC spp.	7	x 3 =	21
FACU spp.	125	x 4 =	500
UPL spp.	0	x 5 =	0
Total	162 (A)		581 (B)

Prevalence Index = B/A = ***3.586***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project	Stantec Project #: 195600884	Date:	08/19/14
Applicant: First Wind		County:	Hancock
Investigator #1: Katelin Nickerson	Investigator #2:	State:	Maine
Soil Unit: Dixfield-Turnbridge-Colonel complex, 3-15% slope, v. stony	NWI/WWI Classification: PFO	Wetland ID:	W097
Landform: Depression	Local Relief: Concave	Sample Point:	Wetland
Slope (%): 0-5 Latitude: 44.801501	Longitude: -68.219627 Datum: --	Community ID:	--
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks)	☑ Yes ☐ No	Section:	--
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?	Are normal circumstances present?	Township:	--
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?	☑ Yes ☐ No	Range:	-- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present?	☑ Yes ☐ No	Hydric Soils Present?	☑ Yes ☐ No
Wetland Hydrology Present?	☑ Yes ☐ No	Is This Sampling Point Within A Wetland?	☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes ☐ No	Depth:	NR	(in.)
Water Table Present?	☑ Yes ☐ No	Depth:	6	(in.)
Saturation Present?	☑ Yes ☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks: Pockets of surface water around boulders

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
3	0	1	--	NR	--	--	--	--	--	--	peat
0	4	2	2.5Y	5/1	85	10YR	4/4	15	C	M	coarse sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☑ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR Depth: 7"

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W097 | Sample Point Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	20	Y	FAC
2.	*Betula alleghaniensis*	20	Y	FAC
3.	*Fraxinus pennsylvanica*	10	N	FACW
4.	*Picea rubens*	5	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	55		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	10	Y	FACU
2.	*Betula alleghaniensis*	10	Y	FAC
3.	*Tsuga canadensis*	5	Y	FACU
4.	*Fraxinus pennsylvanica*	5	Y	FACW
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	30		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Acer rubrum*	5	Y	FAC
2.	*Picea rubens*	5	Y	FACU
3.	*Aralia nudicaulis*	5	Y	FACU
4.	*Ribes lacustre*	2	N	FACW
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	17		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 9 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *55.6%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	17	x 2 =	34
FAC spp.	60	x 3 =	180
FACU spp.	25	x 4 =	100
UPL spp.	0	x 5 =	0
Total	102 (A)		314 (B)

Prevalence Index = B/A = *3.078*

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☑ Yes ☐ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks: Tsuga canadensis and Picea rubens shallow rooting and growing on boulders assigned FAC rating for tree stratum.

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 08/21/14
Applicant: First Wind | County: Hancock
Investigator #1: Jeanna Leclerc | Investigator #2: Katelin Nickerson | State: Maine
Soil Unit: Colton-Adams complex, 3-15% slopes | NWI/WWI Classification: Upland | Wetland ID: W099
Landform: Side slope | Local Relief: Convex | Sample Point: Upland
Slope (%): 3-9 | Latitude: 44.804659 | Longitude: -68.213882 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present? ☐ Yes ☑ No Depth: (in.)
Water Table Present? ☐ Yes ☑ No Depth: (in.)
Saturation Present? ☐ Yes ☑ No Depth: (in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	12	1	7.5YR	2.5/1	100	--	--	--	--	--	loam
12	18	2	2.5Y	5/2	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR Depth: 18"

Hydric Soil Present? ☐ Yes ☑ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W099 | Sample Point: Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	50	Y	FACU
2.	*Betula alleghaniensis*	10	N	FAC
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Fagus grandifolia*	15	Y	FACU
2.	*Acer pensylvanicum*	15	Y	FACU
3.	*Acer saccharum*	15	Y	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	45		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Dennstaedtia punctilobula*	30	Y	UPL
2.	*Aralia nudicaulis*	20	Y	FACU
3.	*Rubus idaeus*	10	N	FACU
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	60		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***0.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	0	x 2 =	0
FAC spp.	10	x 3 =	30
FACU spp.	125	x 4 =	500
UPL spp.	30	x 5 =	150
Total	165 (A)		680 (B)

Prevalence Index = B/A = ***4.121***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project   Stantec Project #: 195600884   Date: 08/21/14
Applicant: First Wind   County: Hancock
Investigator #1: Nickerson, Katelin   Investigator #2: Jeanna Leclerc   State: Maine
Soil Unit: Colton-Adams complex, 3-15% slopes   NWI/WWI Classification: PFO   Wetland ID: W099
Landform: Depression   Local Relief: Concave   Sample Point: Wetland
Slope (%): 0-5   Latitude: 44.804507   Longitude: -68.213764   Datum: --   Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No   Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?   Are normal circumstances present?   Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?   ☑ Yes ☐ No   Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No   Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No   Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:		(in.)
Water Table Present?	☑ Yes	☐ No	Depth:	0	(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	12	1	--	--	--	--	--	--	--	--	mucky peat
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☐ A1- Histosol
- ☑ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Rock   Depth: 12"

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W099 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	30	Y	FAC
2.	*Acer rubrum*	15	Y	FAC
3.	*Thuja occidentalis*	5	N	FACW
4.	*Picea rubens*	5	N	FACU
5.	*Fraxinus pennsylvanica*	5	N	FACW
6.	*Ulmus americana*	5	N	FACW
7.	*Betula alleghaniensis*	5	N	FAC
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	70		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Nemopanthus mucronatus*	10	Y	OBL
2.	*Ulmus americana*	5	Y	FACW
3.	*Acer spicatum*	5	Y	FACU
4.	*Abies balsamea*	5	Y	FAC
5.	*Betula alleghaniensis*	5	Y	FAC
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	30		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tiarella cordifolia*	15	Y	FACU
2.	*Osmundastrum cinnamomeum*	15	Y	FACW
3.	*Rubus pubescens*	10	Y	FACW
4.	*Viola sp.*	10	Y	NL
5.	*Carex disperma*	10	Y	OBL
6	*Onoclea sensibilis*	5	N	FACW
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	65		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 9 (A)

Total Number of Dominant Species Across All Strata: 12 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *75.0%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	20	x 1 =	20
FACW spp.	50	x 2 =	100
FAC spp.	60	x 3 =	180
FACU spp.	25	x 4 =	100
UPL spp.	0	x 5 =	0
Total	155 (A)		400 (B)

Prevalence Index = B/A = *2.581*

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 10/16/14
Applicant: First Wind — County: Hancock
Investigator #1: Charles Ferris — Investigator #2: -- — State: Maine
Soil Unit: Hermon-Monadnock-Dixfield Complex 3-15% slopes — NWI/WWI Classification: Upland — Wetland ID: W107
Landform: Depression — Local Relief: Concave — Sample Point: Upland
Slope (%): 0-3 — Latitude: 44.79005 — Longitude: -68.2211733 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No — Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No — **Is This Sampling Point Within A Wetland?** ☐ **Yes** ☑ **No**

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
1	0	1	--	NR	--	--	--	--	--	--	organic/duff
0	1	2	2.5Y	3/1	100	--					silt loam
1	2	3	2.5Y	7/1	100	--	--	--	--	--	silt loam
2	14	4	10YR	5/6	100	--	--	--	--	--	silt loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Till — Depth: 14"

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Third horizon is an albic E-horizon.

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W107 | Sample Point Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Thuja occidentalis*	20	Y	FACW
2.	*Tsuga canadensis*	15	Y	FACU
3.	*Abies balsamea*	10	Y	FAC
4.	*Pinus strobus*	5	N	FACU
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	50		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	55	Y	FACU
2.	*Abies balsamea*	30	Y	FAC
3.	*Acer pensylvanicum*	5	N	FACU
4.		--	--	--
5.		--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	90		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Osmundastrum cinnamomeum*	25	Y	FACW
2.	*Thuja occidentalis*	25	Y	FACU
3.	*Carex crinita*	5	N	OBL
4.	*Equisetum sylvaticum*	2	N	FACW
5.	*Solidago rugosa*	3	N	FAC
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	60		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***57.1%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	5	x 1 =	5
FACW spp.	47	x 2 =	94
FAC spp.	43	x 3 =	129
FACU spp.	105	x 4 =	420
UPL spp.	0	x 5 =	0
Total	200 (A)		648 (B)

Prevalence Index = B/A = ***3.240***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project	Stantec Project #: 195600884
Applicant: First Wind	Date: 10/16/14
Investigator #1: Charles Ferris	Investigator #2: --
County: Hancock	State: Maine
Soil Unit: Hermon-Monadnock-Dixfield Complex 3-15% slopes	NWI/WWI Classification: PFO
Wetland ID: W107	Sample Point: Wetland
Landform: Depression	Local Relief: Concave
Slope (%): 0-3	Latitude: 44.790059
Longitude: -68.2211593	Datum: --
Community ID: --	Section: --
Township: --	Range: -- Dir: --

Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed?

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic?

Are normal circumstances present? ☑ Yes ☐ No

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No	Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No	Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:		(in.)
Water Table Present?	☑ Yes	☐ No	Depth:	0	(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
2	0	1	--	NR	--	--	--	--	--	--	organic
0	5	2	2.5Y	3/1	90	--	NR	10	D	M	loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☑ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Till Depth: 7"

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W107 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	15	Y	FAC
2.	*Populus tremuloides*	10	Y	FACU
3.	*Tsuga canadensis*	5	N	FACU
4.	*Acer rubrum*	5	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.		--	--	
8.		--	--	
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	35		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Thuja occidentalis*	20	Y	FACW
2.	*Abies balsamea*	15	Y	FAC
3.	*Tsuga canadensis*	10	Y	FACU
4.	*Betula populifolia*	8	N	FAC
5.	*Acer rubrum*	5	N	FAC
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	58		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Osmundastrum cinnamomeum*	25	Y	FACW
2.	*Thuja occidentalis*	25	Y	FACW
3.	*Carex crinita*	5	N	OBL
4.	*Solidago rugosa*	3	N	FAC
5.	*Equisetum sylvaticum*	2	N	FACW
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	60		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *71.4%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	5	x 1 =	5
FACW spp.	72	x 2 =	144
FAC spp.	51	x 3 =	153
FACU spp.	25	x 4 =	100
UPL spp.	0	x 5 =	0
Total	153 (A)		402 (B)

Prevalence Index = B/A = *2.627*

Hydrophytic Vegetation Indicators:

Yes	No	Indicator
☐ Yes	☑ No	Rapid Test for Hydrophytic Vegetation
☑ Yes	☐ No	Dominance Test is > 50%
☑ Yes	☐ No	Prevalence Index is ≤ 3.0 *
☐ Yes	☑ No	Morphological Adaptations (Explain) *
☐ Yes	☑ No	Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 08/26/14
Applicant: First Wind — County: Hancock
Investigator #1: Charles Ferris — Investigator #2: Jeanna Leclerc — State: Maine
Soil Unit: Colton-Hermon association, 5-15% slopes — NWI/WWI Classification: Upland — Wetland ID: W113
Landform: Side slope — Local Relief: Convex — Sample Point: Upland
Slope (%): 5-10 — Latitude: 44.791551 — Longitude: -68.203982 — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐naturally problematic? — ☑ Yes ☐No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No — Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No — Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top	Bottom		Matrix			Mottles					Texture
Depth	Depth	Horizon	Color (Moist)		%	Color (Moist)		%	Type	Location	(e.g. clay, sand, loam)
0	1	1	2.5Y	3/1	100	--	--	--	--	--	sandy loam
1	2	2	10YR	6/2	100	--	--	--	--	--	sandy loam
2	16	3	10YR	4/4	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR — Depth: 16"

Hydric Soil Present? ☐ Yes ☑ No

Remarks: 6" duff at surface. Second horizon is shallow E-horizon. Lowest horizon contains 60% coarse fragments.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W113 | Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Pinus strobus*	35	Y	FACU
2.	*Tsuga canadensis*	25	Y	FACU
3.	*Picea rubens*	15	N	FACU
4.	*Thuja occidentalis*	10	N	FACW
5.	*Betula alleghaniensis*	5	N	FAC
6.	*Betula papyrifera*	5	N	FACU
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	95		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	15	Y	FAC
2.	*Tsuga canadensis*	10	Y	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	25		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	0		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks: No vegetation present in the herbaceous layer.

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***25.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	10	x 2 =	20
FAC spp.	20	x 3 =	60
FACU spp.	90	x 4 =	360
UPL spp.	0	x 5 =	0
Total	120 (A)		440 (B)

Prevalence Index = B/A = ***3.667***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 08/26/14
Applicant: First Wind — County: Hancock
Investigator #1: Charles Ferris — Investigator #2: Jeanna Leclerc — State: Maine
Soil Unit: Colton-Hermon association, 5-15% slopes — NWI/WWI Classification: PFO — Wetland ID: W113
Landform: Depression — Local Relief: Concave — Sample Point: Wetland
Slope (%): 0-5 — Latitude: — Longitude: — Datum: -- — Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No — Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No — Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:		(in.)
Water Table Present?	☑ Yes	☐ No	Depth:	0	(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	18	1	--	--	100	--	--	--	--	--	mucky peat
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☑ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Rock — Depth: 18"

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W113 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Thuja occidentalis*	50	Y	FACW
2.	*Pinus strobus*	15	N	FAC
3.	*Tsuga canadensis*	10	N	FAC
4.	*Betula alleghaniensis*	5	N	FAC
5.	*Picea rubens*	5	N	FACU
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	85		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	40	Y	FAC
2.	*Thuja occidentalis*	5	N	FACW
3.	*Betula alleghaniensis*	5	N	FAC
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	50		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	0		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	55	x 2 =	110
FAC spp.	75	x 3 =	225
FACU spp.	5	x 4 =	20
UPL spp.	0	x 5 =	0
Total	135 (A)		355 (B)

Prevalence Index = B/A = ***2.630***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☑ No — Dominance Test is > 50%
- ☑ Yes ☑ No — Prevalence Index is ≤ 3.0 *
- ☑ Yes ☐ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Tsuga canadensis and Pinus strobus growing on mounds or on top of rocks and reassinged FAC rating for this plot. No vegegation present in herbacous layer.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project
Stantec Project #: 195600884
Date: 07/18/14
Applicant: First Wind
County: Hancock
Investigator #1: Audie Arbo
Investigator #2: Jeanna Leclerc
State: Maine
Soil Unit: Colonel-Brayton-Dixfield association, 1-8% slope, v. stony
NWI/WWI Classification: Upland
Wetland ID: W148
Landform: Backslope
Local Relief: Linear
Sample Point: Upland
Slope (%): 0-2
Latitude: NR
Longitude: NR
Datum: --
Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No
Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐significantly disturbed?
Are normal circumstances present? ☐ Yes ☑ No
Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐naturally problematic?
Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No
Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☐ Yes ☑ No

Remarks: Heavy rain in the previous 3 days.

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:		(in.)
Water Table Present?	☐ Yes	☑ No	Depth:		(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	6	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks: Heavy rain for the previous 3 days.

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
2	0	1	--	NR	--	--	--	--	--	--	hemic organic
0	2	2	10YR	5/1.5	100	--	--	--	--	--	sand
2	6	3	7.5YR	3/4	100	--	--	--	--	--	sandy loam
6	11	4	10YR	3/3	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Till Depth: 11 in.

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Coarse fragments present in Horizon 4.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W148 | Sample Point: Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Pinus strobus*	35	Y	FACU
2.	*Picea rubens*	25	Y	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	75	Y	FACU
2.	*Pinus strobus*	15	N	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	90		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	0		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks: No herb layer under dense canopy

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *0.0%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	0	x 2 =	0
FAC spp.	0	x 3 =	0
FACU spp.	150	x 4 =	600
UPL spp.	0	x 5 =	0
Total	150 (A)		600 (B)

Prevalence Index = B/A = *4.000*

Hydrophytic Vegetation Indicators:

☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
☐ Yes ☑ No Dominance Test is > 50%
☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
☐ Yes ☑ No Morphological Adaptations (Explain) *
☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Stantec Project #: 195600884 — Date: 07/18/14
Applicant: First Wind — County: Hancock
Investigator #1: Audie Arbo — Investigator #2: Jeanna Leclerc — State: Maine
Soil Unit: Colonel-Brayton-Dixfield association, 1-8% slope, v. stony — NWI/WWI Classification: PEM — Wetland ID: W148
Landform: Backslope — Local Relief: Linear — Sample Point: Wetland
Slope (%): 1-8% — Latitude: 44.747038 — Longitude: -68.17557 — Datum: -- — Community ID:
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☐ Yes ☑ No — Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? — Are normal circumstances present? — Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? — ☑ Yes ☐ No — Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes ☐ No	Depth:	6	(in.)
Water Table Present?	☑ Yes ☐ No	Depth:	0	(in.)
Saturation Present?	☑ Yes ☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks: Heavy rains for previous 3 days. 6 inches of standing water.

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
6	2	1	--	NR	--	--	--	--	--	--	peat
2	0	2	--	NR	--	--	--	--	--	--	peaty muck
0	2	3	5Y	2.5/1	100	--	--	--	--	--	mucky loam
2	9	4	2.5Y	6/1	100	--	--	--	--	--	sand
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☑ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☑ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Basal Till — Depth: 9 in.

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W148 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	0		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Acer rubrum*	5	Y	FAC
2.	*Spiraea tomentosa*	5	Y	FACW
3.	*Spiraea alba*	2	N	FACW
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	12		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Scirpus cyperinus*	75	Y	OBL
2.	*Carex echinata*	5	N	OBL
3.	*Carex stipata*	5	N	OBL
4.	*Hypericum fraseri*	5	N	OBL
5.	*Carex trisperma*	5	N	OBL
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	95		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	95	x 1 =	95
FACW spp.	7	x 2 =	14
FAC spp.	5	x 3 =	15
FACU spp.	0	x 4 =	0
UPL spp.	0	x 5 =	0
Total	107 (A)		124 (B)

Prevalence Index = B/A = ***1.159***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Additional Remarks:

Standing dead trees, approximately 2% cover.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project	Stantec Project #: 195600884	Date:	07/11/14
Applicant: First Wind		County:	Aroostook
Investigator #1: Michael Johnson	Investigator #2: Jeanna Leclerc	State:	Maine
Soil Unit: Brayton-Peacham Association, 0-3% slope, ex. stony	NWI/WWI Classification: Upland	Wetland ID:	W168
Landform: Footslope	Local Relief: Concave	Sample Point:	Upland
Slope (%): 0-3% Latitude: 44.747928	Longitude: -68.182788 Datum: --	Community ID:	--
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks)	☑ Yes ☐ No	Section:	--
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?	Are normal circumstances present?	Township:	--
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?	☑ Yes ☐ No	Range: --	Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present?	☐ Yes ☑ No	Hydric Soils Present?	☐ Yes ☑ No
Wetland Hydrology Present?	☐ Yes ☑ No	Is This Sampling Point Within A Wetland?	☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑ **):**

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes ☑ No	Depth:	(in.)
Water Table Present?	☐ Yes ☑ No	Depth:	(in.)
Saturation Present?	☐ Yes ☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top	Bottom		Matrix			Mottles					Texture
Depth	Depth	Horizon	Color (Moist)		%	Color (Moist)		%	Type	Location	(e.g. clay, sand, loam)
0	2	1	7.5YR	2.5/2	100	--	--	--	--	--	sandy loam
2	12	2	2.5YR	4/6	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑ **):**

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed)	Type: NR	Depth: 12 in.	**Hydric Soil Present?** ☐ Yes ☑ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W168 | Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	50	Y	FACU
2.	*Pinus strobus*	30	Y	FACU
3.	*Abies balsamea*	10	N	FAC
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	90		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Picea rubens*	5	Y	FACU
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	5		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	1	N	FAC
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	1		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***0.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	0	x 2 =	0
FAC spp.	11	x 3 =	33
FACU spp.	85	x 4 =	340
UPL spp.	0	x 5 =	0
Total	96 (A)		373 (B)

Prevalence Index = B/A = ***3.885***

Hydrophytic Vegetation Indicators:

☐ Yes	☑ No	Rapid Test for Hydrophytic Vegetation
☐ Yes	☑ No	Dominance Test is > 50%
☐ Yes	☑ No	Prevalence Index is ≤ 3.0 *
☐ Yes	☑ No	Morphological Adaptations (Explain) *
☐ Yes	☑ No	Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks: Herb stratum cover was less than 5 percent and was not included in the dominance calculation.

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 07/09/14
Applicant: First Wind | County: Hancock
Investigator #1: Michael Johnson | Investigator #2: Jeanna Leclerc | State: Maine
Soil Unit: Brayton-Peacham Association, 0-3% slopes, ex. stony | NWI/WWI Classification: PFO | Wetland ID: W168
Landform: Footslope | Local Relief: Concave | Sample Point: Wetland
Slope (%): 0-3% | Latitude: 44.748051 | Longitude: -68.18284 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No | Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No | Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☑ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:		(in.)
Water Table Present?	☐ Yes	☑ No	Depth:		(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
18	0	1	10YR	2/1	100	--	--	--	--	--	peaty muck
0	2	2	10YR	5/1	95	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☑ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W168 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Thuja occidentalis*	30	Y	FACW
2.	*Abies balsamea*	20	Y	FAC
3.	*Acer rubrum*	10	N	FAC
4.	*Betula alleghaniensis*	10	N	FAC
5.	*Picea rubens*	10	N	FACU
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	80		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	10	Y	FAC
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	10		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Acer rubrum*	1	N	FAC
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	1		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	30	x 2 =	60
FAC spp.	51	x 3 =	153
FACU spp.	10	x 4 =	40
UPL spp.	0	x 5 =	0
Total	91 (A)		253 (B)

Prevalence Index = B/A = ***2.780***

Hydrophytic Vegetation Indicators:

Yes	No	Indicator
☐ Yes	☑ No	Rapid Test for Hydrophytic Vegetation
☑ Yes	☐ No	Dominance Test is > 50%
☑ Yes	☐ No	Prevalence Index is ≤ 3.0 *
☐ Yes	☑ No	Morphological Adaptations (Explain) *
☐ Yes	☑ No	Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks: Herb stratum cover was less than 5 percent so was not included in the dominance calculation.

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 07/09/14
Applicant: First Wind | County: Hancock
Investigator #1: Michael Johnson | Investigator #2: Jeanna Leclerc | State: Maine
Soil Unit: Brayton-Colonel association, gently sloping, v. stony | NWI/WWI Classification: Upland | Wetland ID: W185
Landform: Talf | Local Relief: Linear | Sample Point: Upland
Slope (%): 0-8% | Latitude: 44.738997 | Longitude: 68.217325 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No | Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No | **Is This Sampling Point Within A Wetland? ☐ Yes ☑ No**

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present? ☐ Yes ☑ No Depth: (in.)
Water Table Present? ☐ Yes ☑ No Depth: (in.)
Saturation Present? ☐ Yes ☑ No Depth: (in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	4	1	10YR	2/2	100	--	--	--	--	--	sandy loam
4	8	2	10YR	5/4	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR Depth: 8 in.

Hydric Soil Present? ☐ Yes ☑ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W185 | Sample Point Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	60	Y	FACU
2.	*Abies balsamea*	20	Y	FAC
3.	*Betula alleghaniensis*	10	N	FAC
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	90		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Tsuga canadensis*	5	Y	FACU
2.	*Acer pensylvanicum*	5	Y	FACU
3.	*Abies balsamea*	5	Y	FAC
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	15		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Acer rubrum*	1	N	FAC
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	1		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***40.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	0	x 2 =	0
FAC spp.	36	x 3 =	108
FACU spp.	70	x 4 =	280
UPL spp.	0	x 5 =	0
Total	106 (A)		388 (B)

Prevalence Index = B/A = ***3.660***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks: Herb stratum had less than 5% cover and was not included in the dominance calculation.

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project
Stantec Project #: 195600884
Date: 07/09/14
Applicant: First wind
County: Hancock
Investigator #1: Michael Johnson
Investigator #2: Jeanna Leclerc
State: Maine
Soil Unit: Brayton-Colonel Association, gently sloping, v. stony
NWI/WWI Classification: PFO
Wetland ID: W185
Landform: Talf
Local Relief: Linear
Sample Point: Wetland
Slope (%): 0-8%
Latitude: 44.738926
Longitude: 68.217475
Datum: --
Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No
Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are normal circumstances present?
Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?
☑ Yes ☐ No
Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☐ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☑ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes ☐ No	Depth:	1	(in.)
Water Table Present?	☐ Yes ☑ No	Depth:		(in.)
Saturation Present?	☑ Yes ☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks: Surface water localized to topographic pits.

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	2	1	10YR	3/2	100	--	--	--	--	--	sandy loam
2	12	2	10YR	6/1	95	10YR	4/6	5	C	M	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☑ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR Depth: 12 in.

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project   Wetland ID: W185   Sample Point Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	30	Y	FAC
2.	*Thuja occidentalis*	20	Y	FACW
3.	*Acer rubrum*	10	N	FAC
4.	*Betula alleghaniensis*	10	N	FAC
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	70		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	20	Y	FAC
2.	*Betula alleghaniensis*	10	Y	FAC
3.	*Tsuga canadensis*	5	N	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	35		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Carex lacustris*	30	Y	OBL
2.	*Rubus pubescens*	20	Y	FACW
3.	*Cornus canadensis*	10	N	FAC
4.	*Onoclea sensibilis*	5	N	FACW
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	65		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	30	x 1 =	30
FACW spp.	45	x 2 =	90
FAC spp.	90	x 3 =	270
FACU spp.	5	x 4 =	20
UPL spp.	0	x 5 =	0
Total	170 (A)		410 (B)

Prevalence Index = B/A = ***2.412***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☑ Yes ☐ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project   Stantec Project #: 195600884   Date: 10/16/14
Applicant: First Wind   County: Hancock
Investigator #1: Charles Ferris   Investigator #2: Jeanna Leclerc   State: Maine
Soil Unit: Marlow-Dixfield association   NWI/WWI Classification: Upland   Wetland ID: W194
Landform: Depression   Local Relief: Concave   Sample Point: Upland
Slope (%): 0-3   Latitude: 44.73894   Longitude: -68.190897   Datum: --   Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No   Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?   Are normal circumstances present?   Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?   ☑ Yes ☐ No   Range: --   Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☐ Yes ☑ No   Hydric Soils Present? ☐ Yes ☑ No
Wetland Hydrology Present? ☐ Yes ☑ No   **Is This Sampling Point Within A Wetland? ☐ Yes ☑ No**

Remarks: Plot taken adjacent to old skidder trail.

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix C		Matrix %	Mottles Color (Moist)		Mottles %	Mottles Type	Mottles Location	Texture (e.g. clay, sand, loam)
1	0	1	--	NR	100	--	--	--	--	--	duff/organic
0	1	2	10YR	5/3	100	--	--	--	--	--	silt loam
1	16	3	2.5Y	4/3	100	--	--	--	--	--	silt loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed)   Type: None   Depth:

Hydric Soil Present? ☐ Yes ☑ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project Wetland ID: W194 Sample Point Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Betula alleghaniensis*	35	Y	FAC
2.	*Acer saccharum*	20	Y	FACU
3.	*Fraxinus nigra*	5	N	FACW
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Fagus grandifolia*	45	Y	FACU
2.	*Betula alleghaniensis*	35	Y	FAC
3.	*Acer pensylvanicum*	5	N	FACU
4.	*Acer saccharum*	5	N	FACU
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	90		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Dennstaedtia punctilobula*	2	N	UPL
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	2		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***50.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	5	x 2 =	10
FAC spp.	70	x 3 =	210
FACU spp.	75	x 4 =	300
UPL spp.	2	x 5 =	10
Total	152 (A)		530 (B)

Prevalence Index = B/A = ***3.487***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Remarks: The herb stratum includes less than 5 percent cover and was not inlcuded in the dominance calculation.

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 10/16/14
Applicant: First Wind | County: Hancock
Investigator #1: Charles Ferris | Investigator #2: Jeanna Leclerc | State: Maine
Soil Unit: Marlow-Dixfield association | NWI/WWI Classification: PSS | Wetland ID: W194
Landform: Depression | Local Relief: Concave | Sample Point: Wetland
Slope (%): 0-3 | Latitude: 44.738969 | Longitude: -68.190783 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☑ , Soil ☑ , or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? | ☐ Yes ☑ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No | Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No | Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks: Plot taken in old skidder trail. Wetland has been impacted by timber harvesting activity.

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☑ Yes	☐ No	Depth: NR	(in.)
Saturation Present?	☑ Yes	☐ No	Depth: 0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix C		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
0	14	1	2.5Y	3/2	85	5Y	5/6	15	C	M	silt loam with 5% CF
14	18	2	2.5Y	5/2	95	5Y	5/6	5	D	M	silt loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☑ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: None Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Wetland ID: W194 — Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	0		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Betula alleghaniensis*	25	Y	FAC
2.	*Rubus idaeus*	10	N	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	35		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Scirpus cyperinus*	30	Y	OBL
2.	*Rubus hispidus*	20	Y	FACU
3.	*Solidago canadensis*	5	N	FACU
4.	*Onoclea sensibilis*	2	N	FACW
5.	*Parathelypteris noveboracensis*	2	N	FAC
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	59		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: *66.7%* (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	30	x 1 =	30
FACW spp.	2	x 2 =	4
FAC spp.	27	x 3 =	81
FACU spp.	35	x 4 =	140
UPL spp.	0	x 5 =	0
Total	94 (A)		255 (B)

Prevalence Index = B/A = *2.713*

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Additional Remarks:

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project	Stantec Project #: 195600884	Date:	07/15/14
Applicant: First Wind		County:	Hancock
Investigator #1: Katelin Nickerson	Investigator #2: Jeanna Leclerc	State:	Maine
Soil Unit: Marlow-Dixfield association, strongly sloping, v. stony	NWI/WWI Classification: Upland	Wetland ID:	W218
Landform: Talf	Local Relief: Linear	Sample Point:	Upland
Slope (%): 3-6% Latitude: 44.730333	Longitude: -68.216006 Datum: --	Community ID:	--
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks)	☑ Yes ☐ No	Section:	--
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?	Are normal circumstances present?	Township:	--
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?	☑ Yes ☐ No	Range: --	Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present?	☑ Yes ☐ No	Hydric Soils Present?	☐ Yes ☑ No
Wetland Hydrology Present?	☐ Yes ☑ No	Is This Sampling Point Within A Wetland?	☐ Yes ☑ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
2	0	1	--	NR	--	--	--	--	--	--	fibirc organic
0	2	2	10YR	3/1	100	--	--	--	--	--	loam
2	11	3	10YR	4/2	98	--	--	--	--	--	loam
11	16	4	10YR	4/3	90	10YR	5/6	10	C	M	loam
--	--	--	--	--	--	--	--	--	--	--	loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):

- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Rock Depth: 18 in.

Hydric Soil Present? ☐ Yes ☑ No

Remarks: Coarse fragments throughout the mineral soil.

Stantec

WETLAND DETERMINATION DATA FORM

Northeast and Northcentral Region

Project/Site: Weaver Wind Project — Wetland ID: W218 — Sample Point **Upland**

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Abies balsamea*	20	Y	FAC
2.	*Betula alleghaniensis*	20	Y	FAC
3.	*Betula populifolia*	10	N	FAC
4.	*Betula papyrifera*	5	N	FACU
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	55		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Betula alleghaniensis*	15	Y	FAC
2.	*Abies balsamea*	10	Y	FAC
3.	*Acer pensylvanicum*	5	N	FACU
4.	*Tsuga canadensis*	5	N	FACU
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	35		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Maianthemum canadense*	20	Y	FACU
2.	*Aralia nudicaulis*	15	Y	FACU
3.	*Abies balsamea*	5	N	FAC
4.	*Rubus pubescens*	5	N	FACW
5.	*Acer rubrum*	5	N	FAC
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	50		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***66.7%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	5	x 2 =	10
FAC spp.	85	x 3 =	255
FACU spp.	50	x 4 =	200
UPL spp.	0	x 5 =	0
Total	140 (A)		465 (B)

Prevalence Index = B/A = ***3.321***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☐ Yes ☑ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Additional Remarks:

No hydric soils or wetland hydrology indicators.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Stantec Project #: 195600884 | Date: 07/15/14
Applicant: First Wind | County: Hancock
Investigator #1: Jeanna Leclerc | Investigator #2: Katelin Nickerson | State: Maine
Soil Unit: Marlow-Dixfield association, strongly sloping, very stony | NWI/WWI Classification: PSS | Wetland ID: W218
Landform: Terrace | Local Relief: Concave | Sample Point: Wetland
Slope (%): 0-3 | Latitude: 44.730327 | Longitude: -68.216287 | Datum: -- | Community ID: --
Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No | Section: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? | Are normal circumstances present? | Township: --
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? | ☑ Yes ☐ No | Range: -- Dir: --

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No | Hydric Soils Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No | Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes ☑ No	Depth:		(in.)
Water Table Present?	☑ Yes ☐ No	Depth:	12	(in.)
Saturation Present?	☑ Yes ☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Type	Location	Texture (e.g. clay, sand, loam)
2	0	1	--	NR	--	--	--	--	--	--	mucky peat
0	3	2	2.5Y	4/1	98	--	--	2	C	M	sandy loam
3	16	3	5Y	5/2	90	7.5YR	5/6	10	C	M	clay loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☑ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (LRR K, L, R)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (LRR K, L)
- ☐ S9 - Thin Dark Surface (LRR K, L)
- ☐ F12 - Iron-Manganese Masses (LRR K, L, R)
- ☐ F19 - Piedmont Floodplain Soils (MLRA 149B)
- ☐ TA6 - Mesic Spodic (MLRA 144A, 145, 149B)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: NR | Depth: 16 in. | **Hydric Soil Present?** ☑ Yes ☐ No

Remarks: Concentrations in Horizon 2 were faint, unable to determine color.

Stantec

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: Weaver Wind Project | Wetland ID: W218 | Sample Point: Wetland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Betula alleghaniensis*	10	Y	FAC
2.	*Acer rubrum*	10	Y	FAC
3.	*Abies balsamea*	5	Y	FAC
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	25		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Fraxinus pennsylvanica*	30	Y	FACW
2.	*Betula alleghaniensis*	20	Y	FAC
3.	*Acer rubrum*	5	N	FAC
4.	*Acer spicatum*	5	N	FACU
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	60		

Herb Stratum (Plot size: 2 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Carex crinita*	30	Y	OBL
2.	*Onoclea sensibilis*	25	Y	FACW
3.	*Parathelypteris noveboracensis*	25	Y	FAC
4.	*Aralia nudicaulis*	15	N	FACU
5.	*Rubus pubescens*	15	N	FACW
6	*Equisetum sylvaticum*	5	N	FACW
7.	*Betula alleghaniensis*	5	N	FAC
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	120		

Woody Vine Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 8 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	30	x 1 =	30
FACW spp.	75	x 2 =	150
FAC spp.	80	x 3 =	240
FACU spp.	20	x 4 =	80
UPL spp.	0	x 5 =	0
Total	205 (A)		500 (B)

Prevalence Index = B/A = ***2.439***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No — Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No — Dominance Test is > 50%
- ☑ Yes ☐ No — Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No — Morphological Adaptations (Explain) *
- ☐ Yes ☑ No — Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

Exhibit 7-2-3

Photos of Natural Resources Proposed for Impact and/or Adjacent Activity

Exhibit 7-2-3. Photographs of Natural Resources with Proposed Disturbanaces.

Wetland W279: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W276: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W277: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W278: Osborn. Proposed Disturbance: Vegetation clearing in wetland.


Wetland W110: Osborn. Proposed Disturbance: Vegetation clearing in wetland of special significance.


Wetland W164 and Stream S21: T22 MD. Proposed Disturbance: Vegetation clearing in wetland of special significance and along stream.

Wetland W166: T22 MD. Proposed Disturbance: Vegetation clearing in wetland of special significance.

Wetland W167: T22 MD. Proposed Disturbance: Vegetation clearing in wetland of special significance.

Wetland W172: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W174: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W175: Osborn. Proposed Disturbance: Vegetation clearing in wetland of special significance.

Wetland W186: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W189: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland of special signficance.

Wetland W211: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.


Wetland W224: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W232: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.


Wetland W231: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W229: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W242: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland of special significance.

Wetland W244: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W005: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W011: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W021: Osborn. Proposed Disturbance: Vegetation clearing in wetland of special significance.

Wetland W020: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W024: Osborn. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W271: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.


Wetland W270: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W273: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W272: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Wetland W268 and W267: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.


Wetland W269: Eastbrook. Proposed Disturbance: Vegetation clearing in wetland.

Stream S15: Osborn. Proposed Disturbance: Vegetation clearing along stream.

Stream S22: T22 MD. Proposed Disturbance: Vegetation clearing along stream.

Stream S26: Osborn. Proposed Disturbance: Vegetation clearing along stream.

Stream S27: Osborn. Proposed Disturbance: Vegetation clearing along stream.

Stream S30: Osborn. Proposed Disturbance: Vegetation clearing along stream.

Stream S34: Osborn. Proposed Disturbance: Vegetation clearing along stream.

IWWH UMO_10168: Osborn. Proposed Disturbance: Ground disturbance within existing road for underground collector.

IWWH UMO_13356: Osborn. Proposed Disturbance: Ground disturbance within existing road for underground collector.

IWWH UMO_12420: Osborn. Proposed Disturbance: Ground disturbance within existing road for underground collector.

Exhibit 7-2-4

Maine State Vernal Pool Results

Stantec Consulting Services Inc.
30 Park Drive, Topsham ME 04086-1737

May 29, 2015

Attention: Jason Czapiga and Beth Swartz
Maine Department of Inland Fisheries and Wildlife
650 State Street
Bangor, ME 04401

Reference: Vernal Pool Spring 2015 Surveys: Weaver Wind Project, Hancock County, Maine

Dear Jason and Beth,

As you area aware, Weaver Wind LLC, a subsidiary of SunEdison, submitted a Site Location of Development and Natural Resources Protection Act application to the Maine Department of Environmental Protection (DEP) for the proposed Weaver Wind Project (Project) in Hancock County, Maine. On March 3, 2015 Stantec submitted Maine State Vernal Pool Assessment Forms for 20 Potential Significant Vernal Pools (PSVPs) and 4 Vernal Pools (VPs) associated with the project. This submission is to update IFW with the results of that field work.

During the seasonally appropriate spring amphibian breeding season between May 1, and May 26, 2015, Stantec conducted surveys verify the presence of amphibian egg masses and document the productivity of the 20 Potential Significant Vernal Pools (PSVPs) and two vernal pools located outside of the amphibian breeding season that were originally identified during summer 2014 because egg masses were present.

Regarding VP_16KN_N, commented on in IFW's May 26, 2015 comments on the Weaver project, it is a permanent body of water, Hazlam Pond. On May 6, 2015 two streams were observed flowing into the pond from the south and fish were observed in the pond. Fish and two tributaries were not observed during the initial visit on August 20, 2014, and the area was misidentified in 2014 as a vernal pool. There is a form included in this submission to address this and clarify the field conditions.

Included with this letter are materials to assist in your review of vernal pools associated with the Project.

The following materials are enclosed for the identified vernal pools and PVPs associated with the Project:

1. Maine State Vernal Pool Assessment Forms for 2 Significant Vernal Pools and 13 vernal pools.

2. A spreadsheet providing the landowner information for each vernal pool and included with this submission.

Reference: Vernal Pool Data Forms: Weaver Wind Project, Hancock County, Maine

3. Shape files containing vernal pool center points, and center points and boundaries for vernal pools (on CD). The coordinate system for the shape files is: NAD 1983 Maine State Plane East US Survey Feet.

4. A CD containing electronic copies of the above-listed information.

5. A summary table of the results of the 2015 surveys.

Feel free to contact me if you have any questions about the information provided.

Regards,

STANTEC CONSULTING SERVICES INC

Brooke Barnes
Senior Associate, Environmental Services
Phone: (207) 406-5461
Fax: (207) 729-2715
brooke.barnes@stantec.com

c. Jim Cassida, SunEdision

Reference: Vernal Pool Data Forms: Weaver Wind Project, Hancock County, Maine

Summary Table of Spring 2015 Vernal Pool Survey

2014 PSVP/VP ID	2015 Stantec Vernal Pool ID	New Designation
VP_06KN_N	VP_06KN_N	Vernal pool
PSVP_06MJ_N	VP_50KN_N	Vernal pool
PSVP_01KN_N	VP_55KN_N	Vernal pool
PSVP_02KN_N	VP_56KN_N	Vernal pool
PSVP_01AA_N	VP_51KN_M	Vernal pool
PSVP_13KN_N	VP_52KN_N	Vernal pool
PSVP_11KN_N	VP_61KN_N	Vernal pool
PSVP_03JL_N	VP_59KN_N	Vernal pool
PSVP_04JL_N	VP_60KN_N	Vernal pool
PSVP_01CF_N	VP_64KN_N	Vernal pool
PSVP_02CF_N	VP_62KN_N	Vernal pool
PSVP_04CF_N	VP_65KN_N	Vernal pool
PSVP_17KN_N	SVP_53KN_N	Significant vernal pool
PSVP_05CF_N	VP_57KN_N	Vernal pool
PSVP_37KN_N	SVP_63KN_N	Significant vernal pool
VP_16KN_N	--	Hazlam Pond
PSVP_10KN_N	--	Not a pool
PSVP_15KN_N	--	Not a pool
PSVP_28KN_N	--	Not a pool
PSVP_29KN_N	--	Not a pool
PSVP_36KN_N	--	Not a pool
PSVP_12CF_N	--	Not a pool

PAUL R. LEPAGE
GOVERNOR

PATRICIA W. AHO
COMMISSIONER

August 3, 2015

Karol Worden
Stantec Consulting
20 Park Drive
Topsham, ME 04086

Re: Vernal Pool Significance Determination, Pool ID #s 2588, 2590, 2595–Osborn

Dear Karol Worden,

Vernal pools are temporary to semi-permanent wetlands occurring in shallow depressions that typically fill during the spring and dry during the summer or in drought years. They provide important breeding and foraging habitat for a wide variety of specialized wildlife species including several rare, threatened, and endangered species.

Based on your re survey of the vernal pools listed above, it has been determined that the vernal pools identified above on the property of Tree Top Manufacturing, Inc. are NOT SIGNIFICANT because either: 1. the features do not meet the definition of a vernal pool under the Significant Wildlife Habitat rules, 06-096 CMR 335(9) or 2. the vernal pools do not meet the biological standards for exceptional wildlife use of the Significant Wildlife Habitat rules, 06-096 CMR 335(9)(B). Therefore, activities within 250 feet of the pools are not regulated under the Natural Resources Protection Act (NRPA) unless there are other protected natural resources nearby such as streams or freshwater wetlands. I have attached a copy of the database printout that verifies the State's findings with respect to your surveys.

I want to also advise you that the pool areas on the property can be considered freshwater wetlands and therefore direct pool alterations may require permitting under the NRPA.

The Department will notify the landowner of the pool status under separate cover. If you have any questions or need further clarification, please contact me at (207) 446-1611 or email at: mike.mullen@maine.gov

Sincerely,

Michael K. Mullen
Division of Land Resource Regulation
Bureau of Land & Water Quality

cc. town file

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2588 Twp: Osborn
UTM Coordinates of Pool Center: 560011 E, 4954626 N
Observer's ID: PSVP_01KN_N
ProjectType: Weaver Wind

Landowner: Tree Top Manufacturing, Inc.
382 Cave Hill Road
Waltham, ME 04605

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 7/14/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: although surveyed well outside the recommended timing window for indicator species, the pool's small size likely precludes it ever meeting the criteria for SVP (photo suggests pool size is limited by surrounding topography/boulders).

IFW's Pool ID: 2588 Twp: Osborn
UTM Coordinates of Pool Center: 560011 E, 4954626 N
Observer's ID: VP_55KN_N (former PSVP_01KN_N)
ProjectType: Weaver Wind

Landowner: Tree Top Manufacturing, Inc.
382 Cave Hill Road
Waltham, ME 04605

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/13/2015, 05/26/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status remains as not significant vernal pool

---

IFW's Pool ID: 2590 Twp: Osborn
UTM Coordinates of Pool Center: 560032 E, 4954604 N
Observer's ID: PSVP_02KN_N
ProjectType: Weaver Wind

Landowner: Tree Top Manufacturing, Inc.
382 Cave Hill Road
Waltham, ME 04605

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 7/14/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Although surveyed well outside the recommended timing window for indicator species, pool size is small enough to preclude likely being able to meet criteria for SVP; photo suggests pool size is limited by surrounding topography.

IFW's Pool ID: 2590 Twp: Osborn
UTM Coordinates of Pool Center: 560032 E, 4954604 N
Observer's ID: VP_56KN_N (former PSVP 02KN_N_)
ProjectType: Weaver Wind

Landowner: Tree Top Manufacturing, Inc.
382 Cave Hill Road
Waltham, ME 04605

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status remains as not significant vernal pool

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2595 Twp: Osborn
UTM Coordinates of Pool Center: 564690 E, 4955223 N
Observer's ID: VP_50KN_N (former PSVP_06MJ_N_
ProjectType: Weaver Wind

Landowner: Tree Top Manufacturing, Inc.
382 Cave Hill Road
Waltham, ME 04605

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/1/2015 Additional Survey Dates: 05/13/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition

IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool; permanent inlet/outlet connected to stream; pool hydroperiod is likely permanent

---

IFW's Pool ID: 2595 Twp: Osborn
UTM Coordinates of Pool Center: 564690 E, 4955223 N
Observer's ID: PSVP_06MJ_N
ProjectType: Weaver Wind

Landowner: Tree Top Manufacturing, Inc.
382 Cave Hill Road
Waltham, ME 04605

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 7/10/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition

IFW Comments: Pool surveyed outside the recommended timing window for indicator species

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PAUL R. LEPAGE
GOVERNOR

PATRICIA W. AHO
COMMISSIONER

August 3, 2015

Karol Worden
Stantec Consulting
20 Park Drive
Topsham, ME 04086

Re: Vernal Pool Significance Determination, Pool ID # 2586–T22 MD BPP

Dear Karol Worden,

Vernal pools are temporary to semi-permanent wetlands occurring in shallow depressions that typically fill during the spring and dry during the summer or in drought years. They provide important breeding and foraging habitat for a wide variety of specialized wildlife species including several rare, threatened, and endangered species.

Based on your re survey of the vernal pool listed above, it has been determined that the vernal pool identified above on the property of URSA Major, LLC is NOT SIGNIFICANT because either: 1. the feature does not meet the definition of a vernal pool under the Significant Wildlife Habitat rules, 06-096 CMR 335(9) or 2. the vernal pool does not meet the biological standards for exceptional wildlife use of the Significant Wildlife Habitat rules, 06-096 CMR 335(9)(B). Therefore, activities within 250 feet of the pool are not regulated under the Natural Resources Protection Act (NRPA) unless there are other protected natural resources nearby such as streams or freshwater wetlands. I have attached a copy of the database printout that verifies the State's findings with respect to your survey.

I want to also advise you that the pool area on the property can be considered a freshwater wetland and therefore direct pool alterations may require permitting under the NRPA.

The Department will notify the landowner of the pool status under separate cover. If you have any questions or need further clarification, please contact me at (207) 446-1611 or email at: mike.mullen@maine.gov

Sincerely,

Michael K. Mullen
Division of Land Resource Regulation
Bureau of Land & Water Quality

cc. town file

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PAUL R. LEPAGE
GOVERNOR

PATRICIA W. AHO
COMMISSIONER

August 3, 2015

Karol Worden
Stantec Consulting
20 Park Drive
Topsham, ME 04086

Re: Vernal Pool Significance Determination, Pool ID #s 2601, 2605–Osborn

Dear Karol Worden,

Vernal pools are temporary to semi-permanent wetlands occurring in shallow depressions that typically fill during the spring and dry during the summer or in drought years. They provide important breeding and foraging habitat for a wide variety of specialized wildlife species including several rare, threatened, and endangered species.

Based on your re survey of the vernal pools listed above, it has been determined that the vernal pools identified above on the property of URSA Major, LLC are SIGNIFICANT. I have attached a copy of the database printout that verifies the State's findings with respect to our surveys.

As a significant vernal pool, all areas on the URSA Major, LLC property within 250 feet of the vernal pool depressions, known as the "critical terrestrial habitat", will be subject to the requirements of the Natural Resources Protection Act, 38 M.R.S.A. §§480-A to 480-FF, and the Significant Wildlife Habitat rules, 06-096 CMR 335.

The Department will ensure that the vernal pools' location and status is entered and mapped in the State's vernal pool database. Note that if the pool depression (only) crosses two or more property boundaries the abutter(s) are similarly subject to the requirements of the Natural Resources Protection Act and the Significant Wildlife Habitat rules.

The Department will notify the landowner of the pool status under separate cover. If you have any questions or need further clarification, please contact me at (207) 446-1611 or email at: mike.mullen@maine.gov

Sincerely,

Michael K. Mullen
Division of Land Resource Regulation
Bureau of Land & Water Quality

cc. town file

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PAUL R. LEPAGE
GOVERNOR

PATRICIA W. AHO
COMMISSIONER

August 3, 2015

Karol Worden
Stantec Consulting
20 Park Drive
Topsham, ME 04086

Re: Vernal Pool Significance Determination, Pool ID #s 2587, 2589, 2591, 2592, 2593, 2594, 2596, 2597, 2598, 2599, 2600, 2602, 2603, 2604, 2608, 2609–Osborn

Dear Karol Worden,

Vernal pools are temporary to semi-permanent wetlands occurring in shallow depressions that typically fill during the spring and dry during the summer or in drought years. They provide important breeding and foraging habitat for a wide variety of specialized wildlife species including several rare, threatened, and endangered species.

Based on your re survey of the vernal pools listed above, it has been determined that the vernal pools identified above on the property of URSA Major, LLC are NOT SIGNIFICANT because either: 1. the features do not meet the definition of a vernal pool under the Significant Wildlife Habitat rules, 06-096 CMR 335(9) or 2. the vernal pools do not meet the biological standards for exceptional wildlife use of the Significant Wildlife Habitat rules, 06-096 CMR 335(9)(B). Therefore, activities within 250 feet of the pools are not regulated under the Natural Resources Protection Act (NRPA) unless there are other protected natural resources nearby such as streams or freshwater wetlands. I have attached a copy of the database printout that verifies the State's findings with respect to your surveys.

I want to also advise you that the pool areas on the property can be considered freshwater wetlands and therefore direct pool alterations may require permitting under the NRPA.

The Department will notify the landowner of the pool status under separate cover. If you have any questions or need further clarification, please contact me at (207) 446-1611 or email at: mike.mullen@maine.gov

Sincerely,

Michael K. Mullen
Division of Land Resource Regulation
Bureau of Land & Water Quality

cc. town file

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2586 Twp: T22 MD BPP
UTM Coordinates of Pool Center: 565258 E, 4955217 N
Observer's ID: VP_51KN_M (former PSVP_01AA_N)
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/1/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool; pool impounded by road.

IFW's Pool ID: 2586 Twp: T22 MD BPP
UTM Coordinates of Pool Center: 565258 E, 4955217 N
Observer's ID: PSVP_01AA_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 7/18/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition
IFW Comments: surveyed outside recommended timing window for indicator species.

IFW's Pool ID: 2587 Twp: Osborn
UTM Coordinates of Pool Center: 562120 E, 4961573 N
Observer's ID: PSVP_01CF_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/19/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: pool surveyed well outside the recommended timing window for indicator species.

IFW's Pool ID: 2587 Twp: Osborn
UTM Coordinates of Pool Center: 562120 E, 4961573 N
Observer's ID: VP_64KN_N (former PSVP_01CF_N)
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/13/2015, 05/26/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2589 Twp: Osborn
UTM Coordinates of Pool Center: 561716 E, 4961201 N
Observer's ID: PSVP_02CF_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/19/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool surveyed well outside recommended timing window; photo suggests pool could be larger during spring high water (forested swamp, moss hummocks, pockets, etc).

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2589 Twp: Osborn
UTM Coordinates of Pool Center: 561716 E, 4961201 N
Observer's ID: VP_62KN_N (formerly PSV_02_CF_N)
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/13/2015, 05/26/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2591 Twp: Osborn
UTM Coordinates of Pool Center: 559259 E, 4961565 N
Observer's ID: PSVP_03JL_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/14/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: although pool surveyed well outside recommended timing window for indicator species, photo suggests surrounding habitat not likely to support pool large enough to support SVP

IFW's Pool ID: 2591 Twp: Osborn
UTM Coordinates of Pool Center: 559259 E, 4961565 N
Observer's ID: VP_59KN_N (former PSVP_03JL_N)
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status remains as not significant vernal pool

---

IFW's Pool ID: 2592 Twp: Osborn
UTM Coordinates of Pool Center: 560496 E, 4962225 N
Observer's ID: PSVP_04CF_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/19/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: pool surveyed well outside recommended timing window for all indicator species.

IFW's Pool ID: 2592 Twp: Osborn
UTM Coordinates of Pool Center: 560496 E, 4962225 N
Observer's ID: VP_65KN_N (former PSVP_04CF_N)
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/14/2015, 05/26/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2593 Twp: Osborn
Observer's ID: VP_60KN_N (former PSVP04JL_N)
UTM Coordinates of Pool Center: 559098 E, 4961295 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2593 Twp: Osborn
Observer's ID: PSVP_04JL_N
UTM Coordinates of Pool Center: 559098 E, 4961295 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/14/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool surveyed outside recommended timing window for indicator species.

IFW's Pool ID: 2594 Twp: Osborn
Observer's ID: VP_57KN_N (former PSVP_05CF_N)
UTM Coordinates of Pool Center: 563417 E, 4957794 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/13/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2594 Twp: Osborn
Observer's ID: PSVP_05CF_N
UTM Coordinates of Pool Center: 563417 E, 4957794 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/25/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: pool surveyed well outside the recommended timing window for indicator species.

IFW's Pool ID: 2596 Twp: Osborn
Observer's ID: PSVP_10KN_N
UTM Coordinates of Pool Center: 559433 E, 4961482 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2014 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status remains as not significant vernal pool

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2596 Twp: Osborn
UTM Coordinates of Pool Center: 559433 E, 4961482 N
Observer's ID: PSVP_10KN_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/14/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Although pool was surveyed well outside the recommended timing window for indicator species, pool size is likely too small to ever support criteria for SVP; photo suggests pool size is limited by surrounding topography/boulders.

IFW's Pool ID: 2597 Twp: Osborn
UTM Coordinates of Pool Center: 559098 E, 4961274 N
Observer's ID: PSVP_11KN_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/14/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Pool surveyed well outside recommended timing window for indicator species.

IFW's Pool ID: 2597 Twp: Osborn
UTM Coordinates of Pool Center: 559098 E, 4961274 N
Observer's ID: VP_61KN_N (former PSVP_11KN_N)
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/14/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2598 Twp: Osborn
UTM Coordinates of Pool Center: 560828 E, 4964289 N
Observer's ID: PSVP_12CF_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 10/15/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition

IFW Comments: Pool surveyed well outside the recommended timing window for indicator species.

IFW's Pool ID: 2598 Twp: Osborn
UTM Coordinates of Pool Center: 560828 E, 4964289 N
Observer's ID: PSVP_12CF_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition

IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool; unnatural origin - impounded by road

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2599 Twp: Osborn
Observer's ID: PSVP_13KN_N

UTM Coordinates of Pool Center: 560457 E, 4963902 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/14/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Pool surveyed well outside the recommended timing window for indicator species; although pool size is small, photo suggest pool could be larger during spring high water.

IFW's Pool ID: 2599 Twp: Osborn
Observer's ID: VP_52KN_N (former PSVP_13KN_N)

UTM Coordinates of Pool Center: 560457 E, 4963902 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2600 Twp: Osborn
Observer's ID: PSVP_15KN_N

UTM Coordinates of Pool Center: 561731 E, 4963972 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/15/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Although pool was surveyed well outside the recommended timing window for indicator species, its small size and surrounding topography/habitat (as seen in photo) suggest pool is likely limited in size and ability to meet criteria for SVP.

IFW's Pool ID: 2600 Twp: Osborn
Observer's ID: PSVP_15KN_N

UTM Coordinates of Pool Center: 561731 E, 4963972 N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Resurveyed - status remains as not significant vernal pool

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2601 Twp: Osborn
UTM Coordinates of Pool Center: 560717 E, 4964222 N
Observer's ID: PSVP_17KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/22/2014
IFW's Recommendation: GREEN: SIGNIFICANT
IFW Comments: pool surveyed well outside recommended survey window for indicator species.

IFW's Pool ID: 2601 Twp: Osborn
UTM Coordinates of Pool Center: 560717 E, 4964222 N
Observer's ID: SVP_53KN_N (former PSVP17KN_N)
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: GREEN: SIGNIFICANT
IFW Comments: Resurveyed - status updated from potential vernal pool to significant vernal pool; exceeds WF egg mass criteria.

IFW's Pool ID: 2602 Twp: Osborn
UTM Coordinates of Pool Center: 561365 E, 4963955 N
Observer's ID: PSVP_28KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2602 Twp: Osborn
UTM Coordinates of Pool Center: 561365 E, 4963955 N
Observer's ID: PSVP_28KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 9/22/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool surveyed well outside the recommended timing window for indicator species

---

IFW's Pool ID: 2603 Twp: Osborn
UTM Coordinates of Pool Center: 561428 E, 4963911 N
Observer's ID: PSVP_29KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 9/22/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool surveyed well outside the recommended timing window for indicator species

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2603 Twp: Osborn
UTM Coordinates of Pool Center: 561428 E, 4963911 N
Observer's ID: PSVP_29KN_N
ProjectType: Weaver Wind

Landowner:		Observer:	
	URSA Major, LLC		Katelin Nickerson - Stantec Consulting
	C/O AFM, 40 Champion Lane		30 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 katelin.nickerson@stante

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2604 Twp: Osborn
UTM Coordinates of Pool Center: 562516 E, 4963483 N
Observer's ID: PSVP_36KN_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 10/1/2014
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool surveyed well outside the recommended timing window for indicator species

---

IFW's Pool ID: 2604 Twp: Osborn
UTM Coordinates of Pool Center: 562516 E, 4963483 N
Observer's ID: PSVP_36KN_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/5/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool

---

IFW's Pool ID: 2605 Twp: Osborn
UTM Coordinates of Pool Center: 562364 E, 4961073 N
Observer's ID: SVP_63KN_N (former PSVP_37KN_N)
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/14/2015
IFW's Recommendation: GREEN: SIGNIFICANT
IFW Comments: Resurveyed - status updated from potential vernal pool to significant vernal pool; exceeds WF, SS, BSS egg mass criteria; fairy shrimp present.

IFW's Pool ID: 2605 Twp: Osborn
UTM Coordinates of Pool Center: 562364 E, 4961073 N
Observer's ID: PSVP_37KN_N
ProjectType: Weaver Wind

Landowner:		Contact:	
	URSA Major, LLC		Karol Worden - Stantec Consulting
	C/O AFM, 40 Champion Lane		20 Park Drive
	Milford, ME 04461		Topsham, ME 04086
			(207) 729-1199 karol.worden@stantec.co

Survey Date: 10/22/2014
IFW's Recommendation: GREEN: SIGNIFICANT
IFW Comments: Pool surveyed well outside the recommended timing window for indicator species.

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Friday, July 31, 2015

IFW's Pool ID: 2608 Twp: Osborn
UTM Coordinates of Pool Center: 560948 E, 4962888 N
Observer's ID: VP_16KN_N - no longer a VP
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition

IFW Comments: Resurveyed - status updated from potential vernal pool to not significant vernal pool; permanent pond - not a vernal pool

---

IFW's Pool ID: 2608 Twp: Osborn
UTM Coordinates of Pool Center: 560948 E, 4962888 N
Observer's ID: VP_16KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/20/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition

IFW Comments: Only 15% of pool surveyed and pool surveyed well outside recommended timing window for indicator species; insufficient evidence to support viable population of fish.

IFW's Pool ID: 2609 Twp: Osborn
UTM Coordinates of Pool Center: 559893 E, 4961732 N
Observer's ID: VP_06KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 5/6/2015 Additional Survey Dates: 05/14/2015

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Resurveyed - status remains as not significant vernal pool

---

IFW's Pool ID: 2609 Twp: Osborn
UTM Coordinates of Pool Center: 559893 E, 4961732 N
Observer's ID: VP_06KN_N
ProjectType: Weaver Wind

Landowner: URSA Major, LLC
C/O AFM, 40 Champion Lane
Milford, ME 04461

Contact: Karol Worden - Stantec Consulting
20 Park Drive
Topsham, ME 04086
(207) 729-1199 karol.worden@stantec.co

Survey Date: 8/6/2014

IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria

IFW Comments: Although pool was surveyed well outside of recommended timing window, photo suggests pool size restricted to foot print around boulder and will likely never be large enough to support criteria for SVP.

Exhibit 7-3

2014 Preconstruction Avian and Bat Surveys Report

2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project

Weaver Wind Project
Hancock County, Maine

Stantec

Prepared for:
First Wind, LLC
129 Middle Street, 3rd Floor
Portland, ME 04101

Prepared by:
Stantec Consulting
30 Park Drive
Topsham, ME 04086

195600884

November 21, 2014

Table of Contents

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 1
1.1 PROJECT BACKGROUND 1
1.2 PROJECT AREA DESCRIPTION 1

2.0 BAT ACOUSTIC MONITORING 3
2.1 INTRODUCTION 3
2.2 METHODS 3
2.2.1 Data Collection 3
2.2.2 Data Analysis 6
2.2.3 Weather Data 8
2.3 RESULTS 8
2.3.1 Bull Hill Wind Project for Comparison 12
2.4 DISCUSSION 14
2.4.1 Timing of Activity 14
2.4.2 Species Composition 14
2.4.3 Comparison with the Bull Hill Wind Project 14
2.4.4 Weather 15

3.0 NOCTURNAL RADAR SURVEY 15
3.1 INTRODUCTION 15
3.2 METHODS 15
3.2.1 Deployment 16
3.3 RESULTS 18
3.3.1 Spring 18
3.3.2 Fall 23
3.4 DISCUSSION 29
3.4.1 Passage Rates 30
3.4.2 Flight Heights 31
3.4.3 Weather 32

4.0 BREEDING BIRD SURVEY 33
4.1 INTRODUCTION 33
4.2 METHODS 33
4.2.1 Data Collection 33
4.2.2 Data Summary and Analysis 34
4.3 RESULTS 35
4.3.1 Weather Summary 35
4.3.2 Overall Results 35
4.3.3 Results by Habitat Type 35
4.3.4 Species Abundance and Diversity 36
4.3.5 Rare, Threatened and Endangered Species 36

4.3.6 Great Horned Owl Playback Surveys and Incidental Species 36
4.4 DISCUSSION 38

5.0 DIURNAL RAPTOR MIGRATION SURVEY 38
5.1 INTRODUCTION.. 38
5.2 METHODS 38
5.2.1 Data Collection 38
5.2.2 Data Summary and Analysis 39
5.3 FALL 2013 RESULTS 40
5.3.1 Fall 2013 Survey Effort and Timing.. 40
5.3.2 Fall 2013 Weather 42
5.3.3 Fall 2013 Raptor Observations 43
5.3.4 Fall 2013 Flight Paths and Flight Heights 45
5.3.5 Fall 2013 Behaviors.. 47
5.3.6 Fall 2013 Incidental Species 47
5.4 SPRING 2014 RESULTS 48
5.4.1 Spring 2014 Survey Effort and Timing 48
5.4.2 Spring 2014 Weather 49
5.4.3 Spring 2014 Raptor Observations 50
5.4.4 Spring 2014 Flight Paths and Flight Heights 51
5.4.5 Spring 2014 Behaviors... 53
5.4.6 Spring 2014 Incidental Species 53
5.5 FALL 2014 RESULTS 54
5.5.1 Fall 2014 Survey Effort and Timing.. 54
5.5.2 Fall 2014 Weather 56
5.5.3 Fall 2014 Raptor Observations 57
5.5.4 Fall 2014 Flight Paths and Flight Heights 59
5.5.5 Fall 2014 Behaviors.. 61
5.5.6 Fall 2014 Incidental Species 61
5.6 DISCUSSION 62

6.0 EAGLE USE SURVEYS 63
6.1 INTRODUCTION.. 63
6.2 METHODS 64
6.3 RESULTS 64
6.4 DISCUSSION 66

7.0 REFERENCES.. 66

LIST OF TABLES

Table 2-1. Summary of Bat Detector Field Survey Effort and Results, Weaver Wind Project, 2014. 9
Table 2-2. Monthly Detection Rates (Calls per Detector Night) for All Detectors Combined, Weaver Wind Project, 2014. 10

Table 2-3. Number of Calls by Guild or Species per Detector, Weaver Wind Project, 2014. 11
Table 2-4. Summary of bat detector field survey effort and results for met detectors deployed at the Bull Hill Wind Project, 2009 and 2010, and a comparison to met detectors at the Weaver Wind Project, 2014. 12
Table 2-5. Number of calls by guild or species per met detector at the Bull Hill Wind Project, 2009 and 2010, and a comparison to met detectors, Weaver Wind Project, 2014. 13
Table 3-1. Seasonal passage rates at the Bull Hill and Weaver wind projects. 30
Table 3-2. Seasonal flight heights at the Bull Hill and Weaver wind projects. 31
Table 3-3. Seasonal percent of targets below turbine height at the Bull Hill and Weaver wind projects. 32
Table 4-1. Weather summary for breeding bird surveys, Weaver Wind Project, spring 2014. 35
Table 4-2. Summary of breeding bird point count results by habitat type, excluding observations of birds >100 m from the observer and flyovers, Weaver Wind Project, spring 2014. 36
Table 4-3. Bird species observed incidentally and/or during the great horned owl playback survey, spring 2014, Weaver Wind Project[1] 37
Table 5-1. Survey effort and results summary, Weaver Wind Project, fall 2013. 41
Table 5-2. Wind and sky conditions, Weaver Wind Project, fall 2013. 43
Table 5-3. Summary of raptor locations and average minimum flight heights, Weaver Wind Project, fall 2013. 46
Table 5-4. Number of raptor observations by behavior in study area, Weaver Wind Project, fall 2013. 47
Table 5-5. Non-raptor avian species observed incidentally during raptor surveys, Weaver Wind Project, spring 2014. 47
Table 5-6. Survey effort and results summary, Weaver Wind Project, spring 2014. 48
Table 5-7. Wind and sky conditions, Weaver Wind Project, spring 2014. 49
Table 5-8. Summary of raptor locations and average minimum flight heights, Weaver Wind Project, spring 2014. 52
Table 5-9. Number of raptor observations by behavior in study area, Weaver Wind Project, spring 2014. 53
Table 5-10. Non-raptor avian species observed incidentally during raptor surveys, Weaver Wind Project, spring 2014. 54
Table 5-11. Seasonal passage rates at the Bull Hill, Hancock, and Weaver wind projects. 63
Table 6-1. Summary of eagle minutes and eagle exposure-minutes, Weaver Wind Project, spring 2014. 65
Table 6-2. Summary of eagle minutes, eagle exposure-minutes and passage rates by survey plot, Weaver Wind Project, 2014 66

LIST OF FIGURES

Figure 1-1. Bird and bat survey locations and Project area, Weaver Wind Project, 2014. 2

Figure 2-1. Met 1 High detector, Weaver Wind Project, 2014. 4
Figure 2-2. Met 1 Low detector, Weaver Wind Project, 2014. 5
Figure 2-3. Met 2 High detector, Weaver Wind Project, 2014. 5
Figure 2-4. Met 2 Low detector, Weaver Wind Project, 2014. 6
Figure 2-5. Monthly bat detection rates by detector location, Weaver Wind Project, 2014. 9
Figure 2-6. Number of call sequences by hour after sunset, Weaver Wind Project, 2014. 10
Figure 2-7. Mean nightly wind speed and calls per detector night recorded at all detectors, Weaver Wind Project, 2014. 11
Figure 2-8. Mean nightly temperature and calls per detector night recorded at all detectors, Weaver Wind Project, 2014. 11
Figure 2-9. Monthly bat detection rates by detector location, Bull Hill Wind Project, 2009 and 2010, with a comparison to detection rates, Weaver Wind Project, 2014. 13
Figure 3-1. Radar on Een Ridge in the Weaver Wind Project area, 2014. 17
Figure 3-2. Screenshots from actual radar files in horizontal mode (left) and vertical mode (right), Weaver Wind Project, spring 2014. 17
Figure 3-3. Nightly passage rates, Weaver Wind Project, spring 2014 (error bars ± 1 SE). 18
Figure 3-4. Hourly passage rates for the season, Weaver Wind Project, spring 2014........ 19
Figure 3-5. Mean flight direction, Weaver Wind Project, spring 2014 (the bracket along the margin of the histogram is the 95% confidence interval)................... 19
Figure 3-6. Mean nightly flight height of targets, Weaver Wind Project, spring 2014 (error bars ± 1 SE). 20
Figure 3-7. Percent of targets observed flying below turbine height, Weaver Wind Project, spring 2014.. 21
Figure 3-8. Hourly target flight height distribution, Weaver Wind Project, spring 2014. 21
Figure 3-9. Flight height whisker plot depicting the vertical distribution of targets for each survey night, Weaver Wind Project, spring 2014. 22
Figure 3-10. Nightly mean wind speed (m/s), Weaver Wind Project, spring 2014............ 23
Figure 3-11. Nightly mean temperature (°C), Weaver Wind Project, spring 2014............ 23
Figure 3-12. Nightly passage rates, Weaver Wind Project, fall 2014 (error bars ± 1 SE). 24
Figure 3-13. Hourly passage rates for the season, Weaver Wind Project, fall 2014........... 25
Figure 3-14. Mean flight direction, Weaver Wind Project, fall 2014 (the bracket along the margin of the histogram is the 95% confidence interval)................... 25
Figure 3-15. Mean nightly flight height of targets, Weaver Wind Project, fall 2014 (error bars ± 1 SE). 26
Figure 3-16. Percent of targets observed flying below turbine height, Weaver Wind Project, fall 2014. 27
Figure 3-17. Hourly target flight height distribution, Weaver Wind Project, fall 2014......... 27
Figure 3-18. Flight height whisker plot depicting the vertical distribution of targets for each survey night, Weaver Wind Project, fall 2014.. 28

Figure 3-19. Nightly mean wind speed (m/s), Weaver Wind Project, fall 2014. 29
Figure 3-20. Nightly mean temperature (°C), Weaver Wind Project, fall 2014. 29
Figure 5-1. Fall 2013 survey timeframe (green box) and raptor species' migration window in the Northeast U.S. (species dates as reported by Wheeler 2003). 42
Figure 5-2. Daily raptor observations, Weaver Wind Project, fall 2013. 44
Figure 5-3. Number of raptor observations by species, Weaver Wind Project, fall 2013. 44
Figure 5-4. Number of observations of raptors per survey hour, Weaver Wind Project, fall 2013. 45
Figure 5-5. Number of raptor observations within turbine areas at heights above and below 180 m, Weaver Wind Project, fall 2013. 46
Figure 5-6. Spring 2014 survey timeframe (green box) and raptor species' migration window in the Northeast U.S. (species dates as reported by Wheeler 2003). 49
Figure 5-7. Daily raptor observations, Weaver Wind Project, spring 2014........................... 50
Figure 5-8. Number of raptor observations by species, Weaver Wind Project, spring 2014. 51
Figure 5-9. Number of observations of raptors per survey hour, Weaver Wind Project, spring 2014.. 51
Figure 5-10. Number of raptor observations within turbine areas at heights above and below 180 m, Weaver Wind Project, spring 2014... 53

LIST OF APPENDICES

APPENDIX A BAT ACOUSTIC SURVEY DETECTOR TABLES A.1

APPENDIX B NOCTURNAL RADAR SURVEY TABLES B.1

APPENDIX C BREEDING BIRD SURVEY TABLES C.1

APPENDIX D DIURNAL RAPTOR MIGRATION SURVEY PHOTOS AND TABLES D.1

Executive Summary

As part of the permitting process for the proposed Weaver Wind Project (Project), First Wind, LLC contracted Stantec Consulting Services Inc. (Stantec) to conduct pre-construction bird and bat surveys at the Project. Surveys were initiated in fall 2013 and will continue until April 2015. Surveys were conducted based on the Maine Department of Inland Fisheries and Wildlife's (MDIFW) two most recent Wind Power Preconstruction Study Recommendations dated November 2013 and April 2014, discussions held with MDIFW during a meeting with First Wind and Stantec on 2 June 2014 at MDIFW's Bangor Office, and the Work Plan dated 18 June 2014 that was submitted to MDIFW and approved. Pre-construction bird and bat surveys conducted or initiated at the Project include:

- 2013 Fall Diurnal Raptor Migration Surveys
- 2014 Spring, Summer, and Fall Acoustic Bat Monitoring
- 2014 Spring and Fall Nocturnal Migration Radar Surveys
- 2014 Breeding Bird Surveys
- 2014 Spring Diurnal Raptor Migration Surveys
- 2014 Fall Diurnal Raptor Migration Surveys
- 2014-2015 Eagle Point Count Surveys (ongoing)
- 2014 Aerial Eagle Nest Surveys (*Results included in separate* report: *Spring 2014 Aerial Bald Eagle Nest Survey – Bull Hill, Hancock, and Weaver Wind Projects* [Stantec 2014])
- 2014 Raptor Nest Surveys (*Results included in separate* report: *Spring 2014 Aerial Bald Eagle Nest Survey Report – Bull Hill, Hancock, and Weaver Wind Projects* [Stantec 2014] and the breeding bird survey section of this report).
- 2014 Great Blue Heron Surveys (*Results included in separate* report: *Spring 2014 Aerial Bald Eagle Nest Survey – Bull Hill, Hancock, and Weaver Wind Projects* [Stantec 2014] and the raptor migration section of this report)

Bat Acoustic Monitoring

Stantec biologists conducted acoustic bat surveys using 4 Anabat detectors from 22 April to 15 October 2014. One "high" detector and 1 "low" detector were deployed in 2 available on-site meteorological (met) towers. Per MDIFW guidelines, the "high" detectors were deployed at 20 m above ground level and the "low" detectors were 5 m above ground level.

There were 334 bat call sequences recorded by all detectors combined, for an overall detection rate of 0.5 bat call sequences per detector-night (calls/detector-night). For all detector locations combined, acoustic activity rates peaked in August at 1.4 calls per detector night. The UNKN guild represented the majority of calls (n = 160; 47.9%; of these, 60.6% were Low Frequency and 39.4% were High Frequency) followed by BBSH (n = 78; 23.4%) and HB (n = 67; 20.1%).

Nocturnal Radar Survey

Stantec biologists conducted nocturnal radar surveys in spring 2014 on 20 nights from 28 April to 29 May and in fall 2014 on 20 nights from 18 August to 8 October to document the abundance, flight patterns, and flight altitudes of nocturnal migrants at the Project. Surveys were conducted from sunset to sunrise using X-band radar. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar was located on Een Ridge located centrally within the Project area. The radar array was situated on staging at a height of approximately 4 m (12 ft) above ground level, which provided the radar with good visibility of the surrounding airspace.

Spring Radar Survey

The overall mean passage rate for the spring survey period was 806 ± 56 t/km/hr. Nightly mean passage rates varied from 49 ± 7 t/km/hr on 28 April to 2,586 ± 518 t/km/hr on 21 May. The seasonal mean flight height of targets was 365 ± 2 m (1,198 ft) above the radar site. Nightly mean flight heights ranged from 114 m ± 10 m on 4 May to 508 ± 6 m on 3 May. The percentage of targets flying below turbine height (180 m) ranged nightly from 10–83%; the seasonal average was 29%. Mean flight direction for the season was east-northeast at 72° ± 42°.

Fall Radar Survey

The overall mean passage rate for the fall survey period was 657 ± 29 t/km/hr. Nightly mean passage rates varied from 239 ± 45 t/km/hr on 8 October to 1,122 ± 150 t/km/hr on 8 September. The seasonal mean flight height of targets was 412 ± 1 m (1,350 ft) above the radar site. Nightly mean flight heights ranged from 252 ± 6 m on 4 September to 575 ± 8 m on 25 September. The percentage of targets flying below turbine height ranged nightly from 13–41%; the seasonal average was 23%. Mean flight direction for the season was west-southwest at 259 ± 92°.

Breeding Bird Survey

Stantec biologists conducted breeding bird point count surveys during May and June 2014 according to the MDIFW *Curtailment Policy and Wind Power Preconstruction St*udy Recommendations (April 2014) and the work plan for the Project dated 18 June 2014. Surveys were conducted in 6 different habitat types representative of the Project area: recently disturbed hardwood forest, mature hardwood forest, recently disturbed mixed forest, forest edge due to man-made clearing, recently disturbed wetland, and softwood plantation. Biologists sampled 20 survey points to assess breeding bird communities in areas representative of the Project area and proposed turbines. Biologists visited each survey point 3 times during the peak of the songbird breeding season.

Biologists detected 599 individuals representing 52 species[1]. Excluding flyovers and birds observed beyond 100 m from the observer, biologists recorded 41 species and 434 individuals within 100 m of the survey locations. Black-throated green warbler (*Setophaga virens*; n = 38) and chestnut-sided warbler (*Dendroica pensylvanica*; n = 31) were 2 two most common species detected as non-flyovers within 100 m of all count locations.

Recently disturbed mixed forest habitat had the greatest number of individuals (n = 124), highest species richness (SR; 29), and highest Shannon-Diversity Index (1.28). We did not detect any federally or state-listed species during surveys. We detected the following state species of special concern either during or incidental to surveys: American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), chestnut-sided warbler (*Dendroica pensylvanica*), eastern towhee (*Pipilo erythrophthalmus*), least flycatcher (*Empidonax minimus*), veery (*Catharus fuscescens*), and white-throated sparrow (*Zonotrichia albicollis*).

The potential for presence of raptor nests within the Project area was assessed during breeding bird surveys as well as other on-site surveys (aerial eagle nest surveys and eagle point count surveys) as described in the Weaver Work Plan (June 2014).

While there were no active raptor nests found within 1 mile of turbine locations, there were at least 2 species of raptor suspected to be breeding in the Project area. During breeding bird surveys, attempts to locate raptor nests were made using broadcast calls of great horned owl (*Bubo virginianus*) following the completion of each point count. A single broad-winged hawk (*Buteo platypterus*) responded to the broadcast calls by perching nearby and vocalizing back, seeming agitated. During the diurnal raptor migration surveys, a pair of sharp-shinned hawks (*Accipiter striatus*) was observed on 25 September 2013. The pair was observed in powered flight and perching near the observation location for 6 and half hours during the survey. While no nest was confirmed for these observations, the behaviors they exhibited suggested possible nesting/breeding activity.

Other species of raptor were observed in the Project area but no breeding behaviors were observed for these other birds.

Diurnal Raptor Migration Survey

Stantec conducted raptor migration surveys in fall 2013 and spring and fall 2014. The purpose of the surveys was to investigate raptor migration activity at the Project, according to methods

[1] Individuals observed that could not be identified to species due to distance from observer or flew over too quickly to identify included unidentified bird, unidentified songbird, unidentified thrush, unidentified warbler, and unidentified woodpecker.

outlined in the MDIFW *Curtailment Policy and Wind Power Preconstruction Study Recommendations* (April 2014), the work plan for the Project dated 18 June 2014, as well as methods consistent with those at other proposed wind projects in Maine and in the northeast.

Fall 2013

Ten surveys were completed from 11 September 2013 to 21 October 2013 for a total of 70 survey hours. Sixty-two raptor observations were documented in fall 2013. The seasonal passage rate was 0.89 raptor observations per hour (raptors/hr). Of the 62 raptor observations, 48 (77%) occurred within turbine areas. Of the 48 raptor observations in turbine areas, 41 (85% of those in turbine areas) occurred at flight heights below the proposed maximum turbine height (180 m) for at least a portion of their flight. The average minimum flight height of those observed within turbine areas was 84 m (276 ft).

Spring 2014

Ten surveys were completed from 21 April 2014 to 29 May 2014 for a total of 70 survey hours. There were 113 raptor observations documented during spring 2014. The seasonal passage rate was 1.61 raptor observations per hour (raptors/hr). Of the 113 raptor observations, 60 (53%) occurred within turbine areas. Of the 60 raptor observations in turbine areas, 60 (100% of those in turbine areas) occurred at flight heights below the proposed maximum turbine height (180 m) for at least a portion of their flight. The average minimum flight height of those observed within turbine areas was 61 m (200 ft).

Fall 2014

Ten surveys were completed from 18 September 2014 to 11 November 2014 for a total of 70 survey hours. Eighty-eight raptor observations were documented in fall 2014. The seasonal passage rate was 1.26 raptor observations per hour (raptors/hr). Of the 88 raptor observations, 59 (67%) occurred within turbine areas. Of the 59 raptor observations in turbine areas, 57 (97% of those in turbine areas) occurred at flight heights below the proposed maximum turbine height (180 m) for at least a portion of their flight. The average minimum flight height of those observed within turbine areas was 72 m (236 ft).

At the Project, raptor activity and passage rates varied daily and seasonally, and were likely influenced by stochastic factors including weather and visibility. Raptor passage rates at the Project were comparable to those documented during 3 raptor migrations surveys conducted at nearby Bull Hill Wind Project, 1 raptor migration survey conducted at nearby Hancock Wind Project, and other projects in the northeast.

The use of the Project area by great blue herons (*Ardea herodias*) was assessed during the raptor migration surveys as well as other on-site surveys (aerial eagle nest surveys and eagle point count surveys) as described in the Weaver Work Plan (June 2014). No great blue herons were observed using the areas within the proposed turbine locations during any on-site surveys.

Eagle Use Surveys

Stantec conducted point count surveys for eagles at the Project consistent with the work plan dated 18 June 2014, the United States Fish and Wildlife Service (USFWS) Eagle Conservation Plan (ECP) Guidance, and discussions with Sarah Nystrom, the Northeast Region Eagle Coordinator of the USFWS. Point count surveys consisted of 2-hour visual surveys at 6 locations[2] within the Project area. Each location attempted to survey an area of 2 km^2 (800-m radius circle). To date, Stantec has conducted 9 surveys from 22 April to 9 October 2014; surveys are on-going and Stantec will complete 18 surveys in 1 year with surveys ending in April 2015. Surveys are conducted once approximately every 3 weeks. This report includes results of the first 9 surveys. Though eagles were the target species, Stantec biologists recorded all raptors observed during eagle point count surveys. Stantec also recorded any incidental observations of eagles observed outside of survey hours such as while traveling between survey points or while conducting other surveys.

In 9 surveys (108 hours), Stantec recorded 9 eagle observations: 7 bald eagles (*Haliaeetus leucocephalus*), and 2 eagles that could not be identified to species (i.e., it could not be determined if the eagle was a bald or golden eagle (*Aquila chrysaetos*)due to the distance of the bird from the observer, lighting, or short duration of the observation). Eagles were observed at 3 out of the 6 survey locations: Points 7, 32, and 39. Stantec recorded 25 total eagle minutes inside the survey areas and 17 total eagle minutes inside the survey areas and in the approximate rotor-sweep zone of the turbines (i.e., 45 –180 m). The greatest number of total eagle minutes was recorded at Point 32 (15 minutes), which is also the raptor and radar survey location. The total eagle passage rate (eagle minutes per hour) was 0.004.

[2] Per the April 2013 ECP Guidelines, the number of proposed point count locations was determined by calculating the entire turbine area including a 1-km buffer around turbines, calculating 30% of the area, and dividing by 2 (to account for the 2 km^2 plots). Point count locations were based on consultation with USFWS on 16 April 2014 and approved by USFWS on 28 April 2014.

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

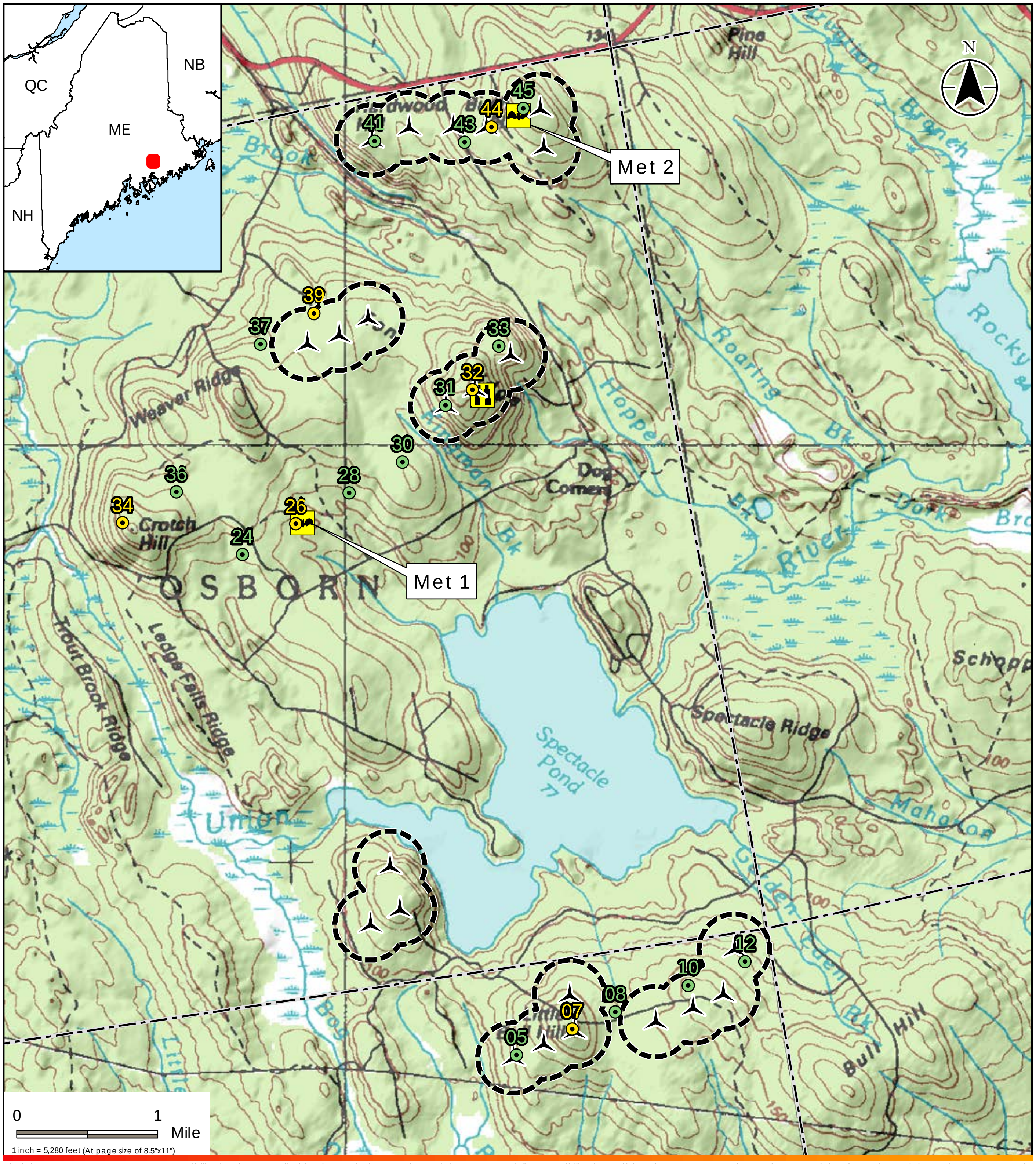
First Wind, LLC (First Wind) has proposed the Weaver Wind Project (Project) in Hancock County, Maine (Figure 1-1). The Project is in the planning stages of design, but is expected to be a 76 MW Project using 23 Vestas V117 3.3 MW turbines and associated infrastructure (i.e., access roads, transmission lines, and electrical substation). The proposed turbines are expected to have a maximum height of 180 m(591 ft).

As part of the permitting process for the proposed Weaver Wind Project, First Wind contracted Stantec Consulting Services Inc. (Stantec) to conduct pre-construction bird and bat surveys at the Project. Surveys were initiated in fall 2013. Surveys were conducted based on the Maine Department of Inland Fisheries and Wildlife's (MDIFW) two most recent Wind Power Preconstruction Study Recommendations dated November 2013 and April 2014 (MDIFW Study Recommendations), discussions held with MDIFW during a meeting with First Wind and Stantec on 2 June 2014 at MDIFW's Bangor Office, discussions with Sarah Nystrom, the Northeast Region Eagle Coordinator of the USFWS on 28 April, 2014, and the agency approved work plan dated 18 June 2014.

1.2 PROJECT AREA DESCRIPTION

The Project area is located within the Downeast Maine Ecoregion as defined in Maine's Comprehensive Wildlife Conservation Strategy (MDIFW 2005). The Downeast Maine Ecoregion extends from Ellsworth to Eastport and inland to north of Route 9. This ecoregion is characterized by low acidic summits, blueberry barrens, coastal spruce-fir forests, and industrial timberlands.

The Project area includes the ridgelines on Hardwood Hill, Birch Hill, Een Ridge, and Little Bull Hill (Figure 1-1). Peak elevations in the Project area range from approximately 155 m (509 ft) to 211 m (692 ft). The Project area is dominated by mixed forest including paper birch (*Betula papyrifera*), American beech (*Fagus grandifolia*), balsam fir (*Abies balsamea*), and red spruce (*Picea rubens*). The Project area also includes multiple spruce and fir plantations. Forest management activities and logging in the area are ongoing. Evidence of these activities, including active logging roads, skidder trails and managed plantations, is present throughout the Project area.



Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

195600884

Stantec

30 Park Drive
Topsham, ME USA 04086
Phone (207) 729-1199

Prepared by DLJ on 2014-10-16
Reviewed by LSB on 2014-11-03

00884_01_BirdBat_Locus.mxd

Legend

- Proposed Turbine Layout (11/6/14)
- Breeding Bird Survey Location
- Eagle Point Count/Breeding Bird Survey Location
- Bat Detector Location
- Raptor Survey/Radar Location
- Project Area (11/6/14)

Client/Project
Weaver Wind Project
Hancock, County, Maine

Figure No.
1

Title
Bird and Bat Survey Locations
11/20/2014

2.0 BAT ACOUSTIC MONITORING

2.1 INTRODUCTION

Bats use high frequency echolocation to maneuver through the landscape during migration or in search of food and water. Although the echolocation sounds produced by bats are above the frequency range of human hearing, electronic equipment can be used to record these high frequency sounds. Acoustic sampling of bat activity has become a standard pre-construction survey for proposed wind-energy development (Kunz et al. 2007). This type of sampling allows for simultaneous data collection at varying heights and across long periods of time. Although acoustic surveys are associated with several major assumptions (Hayes 2000) and results cannot be used to determine the number of bats inhabiting an area or determine the number of bats that will be killed post-construction, acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. While these data may be useful in predicting trends in post-construction mortality rates, the current lack of data on this topic precludes quantitative prediction of risk. The objective of the 2014 acoustic survey at the Project was to document bat activity patterns through all active periods for bats from April through mid-October.

2.2 METHODS

2.2.1 Data Collection

Stantec biologists deployed 4 Anabat detectors from 22 April to 15 October 2014. Anabat detectors are frequency division detectors, which divide the frequency of echolocation sounds made by bats by a factor of 16, and then record these sounds onto removable compact flash cards for subsequent analysis. Detectors were programmed to begin monitoring at 18:00 hours each night and end monitoring at 08:00 hours each morning. The audio sensitivity setting of each Anabat system was set between 6 and 7 (on a scale of 1–10) to maximize sensitivity while limiting ambient background noise and interference.

One "high" detector and 1 "low" detector were deployed in 2 available on-site meteorological (met) towers. Per MDIFW study recommendations, detectors were deployed at 20 m above ground level and 5 m above ground level in 2 available meteorological (met) towers. Met Tower 1 was located centrally within the Project area and Met Tower 2 was located in the northern portion of the Project area (Figure 1-1). Both met towers were constructed recently and were located in newly-formed forest clearings approximately 150 m in diameter. The Met 1 High and Met 1 Low detectors were both deployed on the tower itself at heights of 20 m and 5 m, respectively (Figures 2-1 and 2-2). The Met 2 High detector was deployed on the tower at a height of 20 m. The rope for the Met 2 High detector slipped out of the pulley system during a regular maintenance check on 8 May and the detector was moved to a tree along the edge of the clearing at a height of 5 m above ground level until the detector could be re-deployed in the tower at a height of 20 m above ground on 14 May (Figure 2-3). The Met 2 Low detector was deployed in a tree along the edge of the clearing at 5 m above ground level (Figure 2-4).

Figure 2-1. Met 1 High detector, Weaver Wind Project, 2014.

Figure 2-2. Met 1 Low detector, Weaver Wind Project, 2014.

Figure 2-3. Met 2 High detector, Weaver Wind Project, 2014.

Figure 2-4. Met 2 Low detector (inset: close up of waterproof housing), Weaver Wind Project, 2014.

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in a waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspended the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a curved plastic joint was used to funnel sound into the downward-facing microphone, allowing the microphone to record the airspace horizontally surrounding the detector (Figure 2-4).

2.2.2 Data Analysis

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett et al. 2006). Call sequences typically include a series of calls characteristic of normal flight or prey location ("search phase") and capture periods (feeding "buzzes").

Potential call files were extracted from data files using CFCread® software. The default settings for CFCread® were used during this file extraction process. This software screens all data recorded by the detector and extracts bat call files using a filter. Settings used by the filter include a maximum time between calls of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter and the more noise files and poor quality call sequences that are retained within the dataset.

Following the extraction of call files, each file was visually inspected for species identification and to determine that only bat calls were included in the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Arnett et al. 2006, Hayes 1997), detection rates are summarized on both of these temporal scales. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz et al. (2007). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would have required much larger sample sizes (Arnett et al. 2006, Hayes 1997).

Bat calls were individually marked and categorized by species group, or "guild," based on visual comparison to reference calls. Eight species of bats occur in Maine, based upon their normal geographical range (Whitaker and Hamilton 1998), including:

- little brown bat (*Myotis lucifugus)*
- northern long-eared bat (*M. septentrionalis*)
- eastern small-footed bat (*M. leibii*)
- silver-haired bat (*Lasionycteris noctivagans*)
- tri-colored bat (*Perimyotis subflavus*)
- big brown bat (*Eptesicus fuscus*)
- eastern red bat (*Lasiurus borealis*)
- hoary bat (*Lasiurus cinereus*)

All of these species, except the big brown bat, are state Species of Special Concern (MDIFW 2014). The eastern small-footed bat is also listed as a Species of Greatest Conservation Need under Maine's Wildlife Action Plan (http://www.maine.gov/ifw/wildlife/reports/wap.html). The northern long-eared bat is currently under consideration for federal listing under the Endangered Species Act. Further, the three *Myotis* species occurring in Maine are currently under consideration for listing in the state of Maine (MDIFW 2014).

Each bat species is capable of expressing characteristic call types; however, overlap in certain call patterns is common in some species that call within the same frequency range. Additionally, calls from any species may lack sufficient detail needed for species level identification because of background noise, distance of the bat from the microphone, weather, or other environmental factors. To compensate for these limitations in the analysis process, the following guilds were created to account for ambiguous calls that could not be confidently identified to species:

- **Myotis (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.

- **Eastern red bat/tri-colored bat (RBTB)** – Eastern red bats (LABO) and tri-colored bats (PESU). These two species produce calls distinctive to each species. However, significant overlap in the call pulse shape, frequency range, and slope can occur.
- **Big brown bat/silver-haired bat (BBSH)** – Big brown (EPFU) and silver-haired bats (LANO). These species' call signatures are often difficult to distinguish and have therefore been included as one guild in this report.
- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.
- **Unknown (UNKN)** – All call sequences with less than 5 pulses, or poor quality sequences (those with indistinct call characteristics or overwhelming background static). These unknown sequences were further identified as either:
  - "High frequency unknown" **(HFUN)** for sequences with a minimum frequency above 30 to 35 kilohertz (kHz) (for this region, HFUN most likely represents eastern red bats, tri-colored bats, and *Myotis* species since these species typically produce ultrasound sequences of more than 30 kHz); or
  - "Low frequency unknown" **(LFUN)** for sequences with a minimum frequency below 30 to 35 kHz (big brown, silver-haired, and hoary bats would be the species in this region typically producing ultrasound sequences of less than 30 kHz).

This method of guild level identification represents a conservative approach to bat data analysis. Because some species occasionally produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled, and mean detection rates (number of recordings/detector-night) were calculated for the entire sampling period. Additionally, the sunset time was subtracted from the time of recording to determine the number of hours after sunset when each file was recorded.

2.2.3 Weather Data

Weather data were retrieved from one of the onsite met towers in the Project area. Temperature and wind speed data were used for analysis of bat detector results. Nightly mean temperature and nightly mean wind speed were calculated for each night throughout the study period.

2.3 RESULTS

Acoustic bat detectors were deployed from 22 April through 15 October 2014. There were 334 bat call sequences recorded by all detectors combined for an overall detection rate of 0.5 bat call sequences per detector-night (calls/detector-night) (Appendix A Tables 1-4; Table 2-1).

Table 2-1. Summary of Bat Detector Field Survey Effort and Results, Weaver Wind Project, 2014.

Location	Dates Deployed	Calendar Nights	Detector-Nights*	Recorded Sequences	Detection Rate **	Maximum Sequences recorded ***
Met 1 High	4/22/14 - 10/15/14	177	163	123	0.8	12
Met 1 Low	4/22/14 - 10/15/14	177	177	25	0.1	6
Met 2 High	4/22/14 - 10/15/14	177	162	40	0.2	7
Met 2 Low	4/22/14 - 10/15/14	177	164	146	0.9	25
Overall Results		***708***	***666***	***334***	***0.5***	--
* One detector-night is equal to a one detector successfully operating throughout the night.						
** Number of bat echolocation sequences recorded per detector-night.						
*** Maximum number of bat passes recorded from any single detector for a detector-night.						

Individual detectors had variable detection rates throughout the survey season (Figure 2-5). Met 1 High generally had higher monthly detection rates than Met 1 Low. Met 2 High had lower detection rates than Met 2 Low. For all detector locations combined, detection rates peaked in August when 1.4 calls per detector night were recorded (Table 2-2).

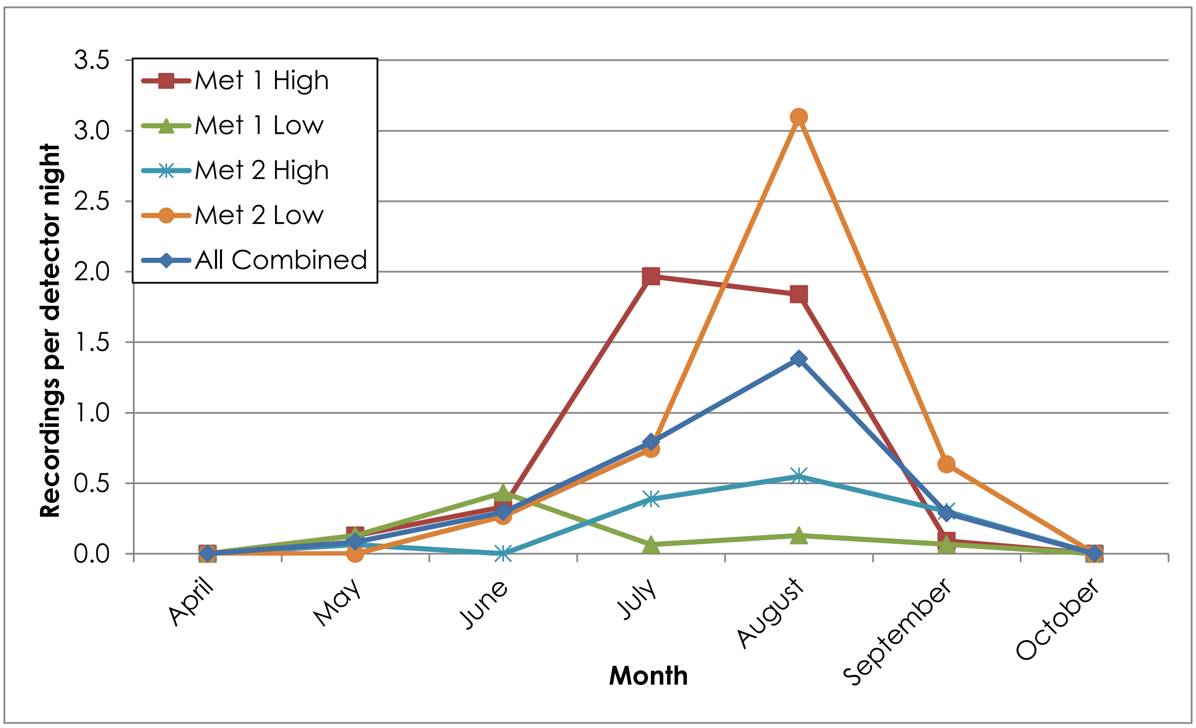


Figure 2-5. Monthly bat detection rates by detector location, Weaver Wind Project, 2014.

Table 2-2. Monthly Detection Rates (Calls per Detector Night) for All Detectors Combined, Weaver Wind Project, 2014.

Month	Dates	Calendar Nights	Detector-Nights*	Recorded Sequences	Detection Rate **
April	April 1-30	9	28	0	0.0
May	May 1-31	31	119	10	0.1
June	June 1-30	30	105	31	0.3
July	July 1-31	31	124	98	0.8
August	August 1-31	31	118	163	1.4
September	September 1-30	30	112	32	0.3
October	October 1-15	15	60	0	0.0
Overall Results		***177***	***666***	***334***	***0.5***
* One detector-night is equal to a one detector successfully operating throughout the night.					
** Number of bat echolocation sequences recorded per detector-night.					

On a nightly basis, acoustic activity peaked at 1 hour after sunset then gradually declined thereafter, with a slight secondary peak 4 hours after sunset (Figure 2-6).

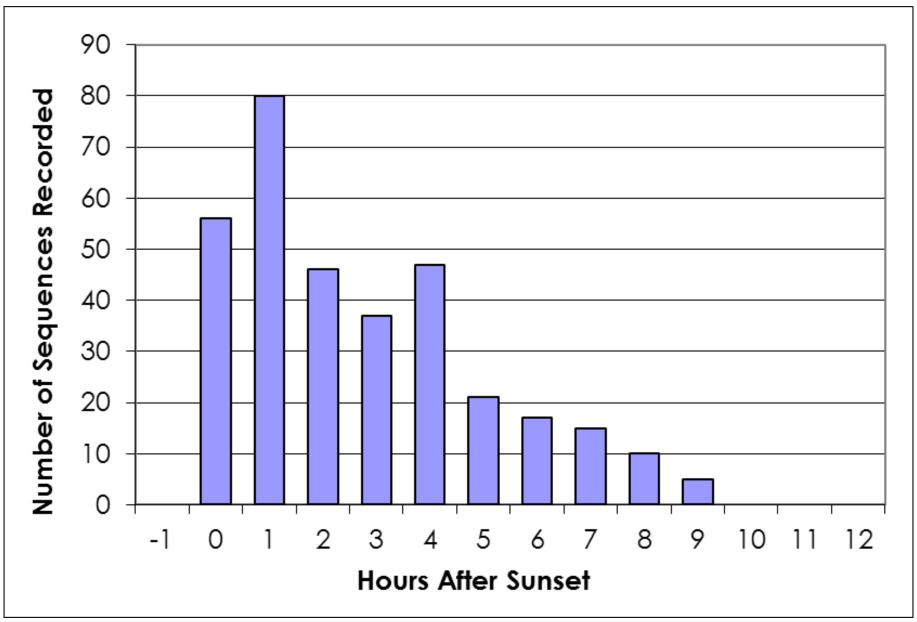


Figure 2-6. Number of call sequences by hour after sunset, Weaver Wind Project, 2014.

The acoustic survey at the Project detected calls from all species groups at variable rates (Table 2-3). In some cases, files were able to be assigned to individual species: big brown bat (n = 9 call sequences), silver-haired bat (n = 14), hoary bat (n = 67), and red bat (n = 11). The largest number of calls were assigned to the UNKN guild (n = 160; 47.9%). Over half of these UNKN calls (n = 89; 55.6%) were recorded at the Met 2 Low detector; the only detector deployed in a tree instead of on a met tower. Low frequency unknown (LFUN) calls made up 60.6% of the UNKN calls recorded across all detectors (n = 97); high frequency unknown (HFUN) made up 39.4% (n = 63).

Table 2-3. Number of Calls by Guild or Species per Detector, Weaver Wind Project, 2014.

Detector	Guild					Total
	BBSH	HB	MYSP	RBTB	UNKN	
Met 1 High	33	37	5	6	42	123
Met 1 Low	8	3	0	0	14	25
Met 2 High	20	3	1	1	15	40
Met 2 Low	17	24	6	10	89	146
Total	**78**	**67**	**12**	**17**	**160**	**334**
Guild Composition %	**23.4%**	**20.1%**	**3.6%**	**5.1%**	**47.9%**	

The night with the peak number of bat calls for all four detectors (n = 36), 6 August, had a nightly mean wind speed of 5 meters per second (m/s) and a nightly mean temperature of 16 degrees Celsius (°C; Figures 2-7 and 2-8).

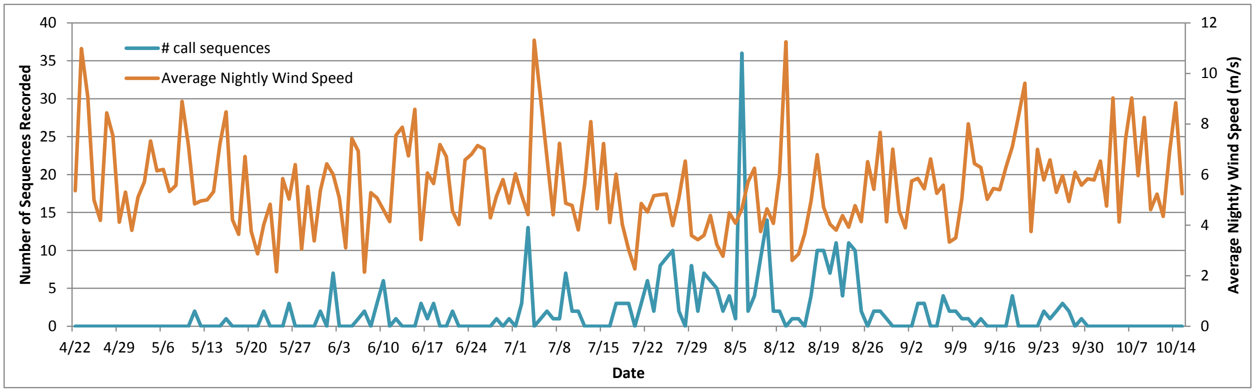


Figure 2-7. Mean nightly wind speed and calls per detector night recorded at all detectors, Weaver Wind Project, 2014.

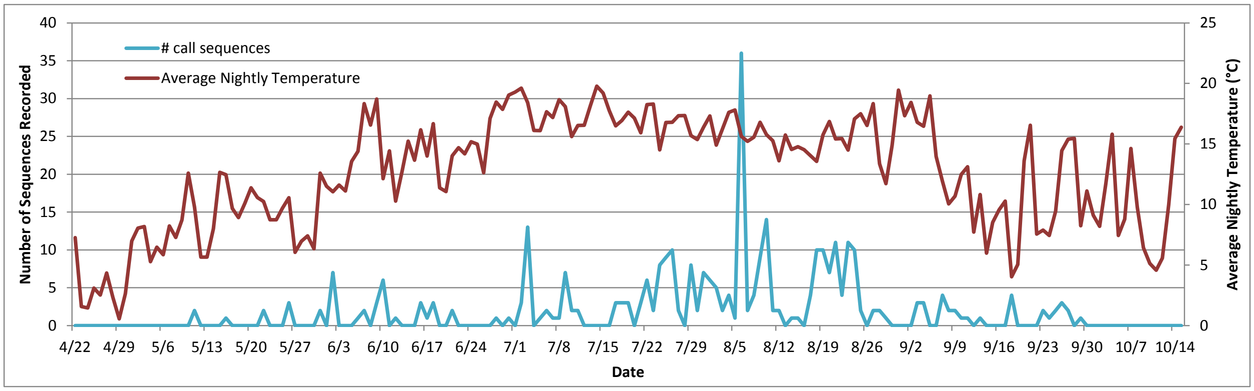


Figure 2-8. Mean nightly temperature and calls per detector night recorded at all detectors, Weaver Wind Project, 2014.

2.3.1 Bull Hill Wind Project for Comparison

Stantec conducted pre-construction acoustic surveys at the nearby Bull Hill Wind Project (Bull Hill) in fall 2009 and spring and summer 2010. Two acoustic detectors were placed in a met tower on Little Bull Hill in the previous Bull Hill Project area, which is currently the location of a proposed turbine for the Weaver Wind Project, making that data highly applicable to the Weaver Project. The Met High detector at Bull Hill was deployed at 50 m above ground level, and the Met Low detector was deployed at 35 m above ground level. During the Bull Hill acoustic surveys these two detectors were deployed from 14 July through 4 November, 2009, and again from 15 April through 14 July, 2010. During the combined survey season at Bull Hill there were 110 bat call sequences recorded, resulting in a detection rate of 0.3 call/detector-night (Table 2-4).

Table 2-4. Summary of bat detector field survey effort and results for met detectors deployed at the Bull Hill Wind Project, 2009 and 2010, and a comparison to met detectors at the Weaver Wind Project, 2014.

Location	Dates Deployed	Calendar Nights	Detector-Nights*	Recorded Sequences	Detection Rate **	Maximum Sequences recorded ***
Met High	7/14/09 - 10/15/09; 4/15/10 - 7/14/10	185	175	18	0.1	3
Met Low	7/14/09 - 11/4/09; 4/15/10 - 7/14/10	205	193	92	0.5	8
Bull Hill Met Tower Total	N/A	**390**	**368**	**110**	**0.3**	**8**
Weaver Met Tower 1 Total	4/22/14 - 10/15/14	**354**	**340**	**148**	**0.4**	**12**
Weaver Met Tower 2 Total	4/22/14 - 10/15/14	**354**	**326**	**186**	**0.6**	**25**

* One detector-night is equal to a one detector successfully operating throughout the night.
** Number of bat echolocation sequences recorded per detector-night.
*** Maximum number of bat passes recorded from any single detector for a detector-night.

Detection rates varied throughout the survey season at Bull Hill (Figure 2-9). The Met detectors deployed at Bull Hill in 2009 and 2010 had detection rates most similar to the Met 1 detectors at Weaver Wind Project, where rates peaked in July instead of August.

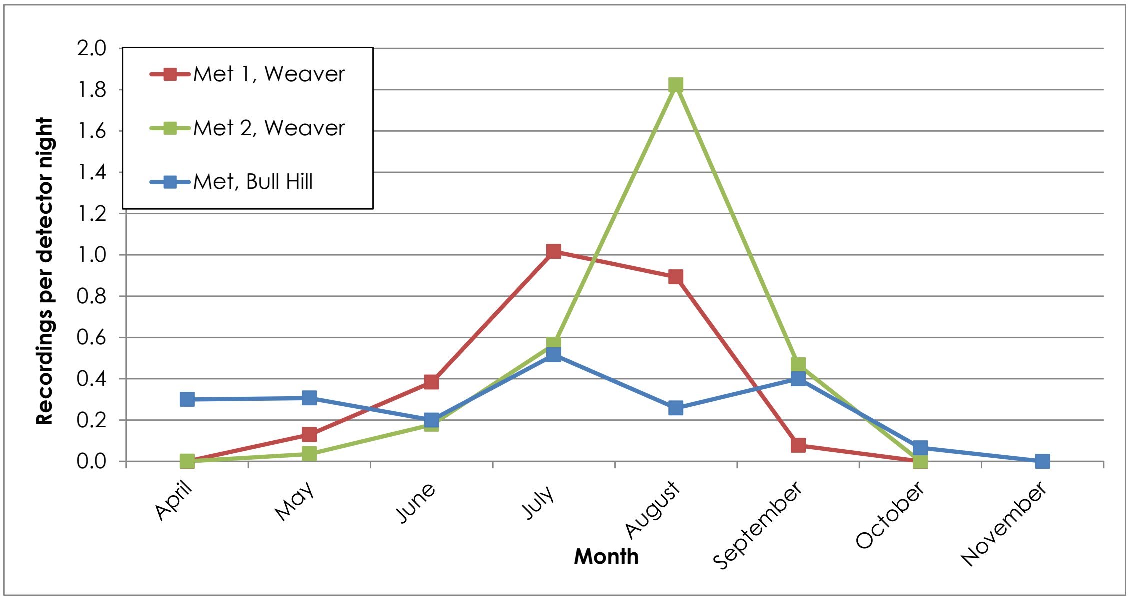


Figure 2-9. Monthly bat detection rates by detector location, Bull Hill Wind Project, 2009 and 2010, with a comparison to detection rates, Weaver Wind Project, 2014.

Acoustic surveys at Bull Hill detected calls from all species groups (Table 2-5). The largest number of calls was assigned to the UNKN guild during Bull Hill surveys (n = 62; 56.4%). One-fifth of the calls recorded at the Bull Hill met tower was assigned to the MYSP guild (n = 22; 20.0%), making it the second most common guild observed.

Table 2-5. Number of calls by guild or species per met detector at the Bull Hill Wind Project, 2009 and 2010, and a comparison to met detectors, Weaver Wind Project, 2014.

Detector	Guild					Total
	BBSH	HB	MYSP	RBTB	UNKN	
Met High	2	4	2	1	9	18
Met Low	10	7	20	2	53	92
Bull Hill Met Tower Total	**12**	**11**	**22**	**3**	**62**	**110**
Weaver Met Tower 1 Total	**41**	**40**	**5**	**6**	**56**	**148**
Weaver Met Tower 2 Total	**37**	**27**	**7**	**11**	**104**	**186**
Bull Hill Met Tower Guild Composition	10.9%	10.0%	20.0%	2.7%	56.4%	N/A
Weaver Met Tower 1 Guild Composition	27.7%	27.0%	3.4%	4.1%	37.8%	N/A
Weaver Met Tower 2 Guild Composition	19.9%	14.5%	3.8%	5.9%	55.9%	N/A

2.4 DISCUSSION

2.4.1 Timing of Activity

Results from the bat acoustic survey at Weaver Wind Project are representative of trends often documented by acoustic surveys conducted during the spring migration, summer residency, and fall migration periods. Detection rates were very low or zero in the spring, gradually increased through the summer months, peaked in August, and then gradually decreased in the fall. This pattern is typical of passive acoustic bat survey data and corresponds to the changing local bat population as individuals enter the area during spring migration and leave during fall migration. The detection rate peak in August was driven by recordings at the Met 2 Low detector; this detector was located in a tree instead of on the met tower itself.

2.4.2 Species Composition

Detection rates were low, with only one call file recorded every two days on average. The UNKN guild contained the largest number of call files. About half of these calls came from the Met 2 Low detector, which was expected as this was the only detector deployed in a tree. Tree detectors often record more low-quality calls as wind creates high frequency disturbances in nearby trees and leaves. When looking at the UNKN call files as a whole, about one-third were identified as HFUN and two-thirds as LFUN. High frequency calls could be those of red bats, tricolored bats, or bats from the genus *Myotis*. Considering that very few *Myotis* calls were identified (only 3.6% of all files recorded), and no calls were identified as tricolored bats, it's probable that the majority of high frequency unknown calls were those of red bats that could not be identified due to low call quality. Low frequency calls could be those of big brown bats, silver-haired bats, or hoary bats. Low frequency unknown calls could be any of these three species. Of the calls identified to low frequency species, hoary bats were identified most often, followed by silver-haired bats and then big brown bats. It is probable that the low frequency unknown calls could follow this same pattern.

2.4.3 Comparison with the Bull Hill Wind Project

Detection rates are typically lowest at detectors highest above ground level, and rates increase as detector height decreases. Met detectors at the Bull Hill Wind Project were deployed significantly higher above ground level (35 m and 50 m) than detectors at the Weaver Wind Project (5 m and 20 m). However, met detectors at Bull Hill had very similar detection rates to those at the Project. Tree detectors were also deployed at Bull Hill in 2009 and 2010 and had much higher detection rates than those observed at the Project (tree detector rates at Bull Hill ranged from 6.7 to 15.0 calls/detector-night in fall 2009 and from 5.3 to 11.2 calls/detector-night in spring and summer 2010). Higher detection rates at tree detectors is expected, and the single detector deployed in a tree at the Project had the highest detection rate observed in 2014, but it was still much lower than the tree detector rates observed at Bull Hill. Notably, the acoustic survey at Bull Hill occurred before white-nose syndrome spread into the state and caused declines in *Myotis* species population sizes. *Myotis* species were the most often identified guild during the 2009/2010 Bull Hill acoustic surveys, but were the least often identified species guild at the Project in 2014.

2.4.4 Weather

Results of available studies have shown bat activity to be positively correlated with nightly mean temperatures and negatively correlated with average nightly wind speed (Fiedler 2004, Reynolds 2006). So few bat calls were recorded at the Project that it is difficult to make any inferences about trends. It can be noted that 52% (n = 173) of call sequences were recorded when average nightly temperatures were 16 °C or above and 69% (n = 232) of call sequences were recorded when average nightly wind speeds were 5 m/s or less.

When considering the level of activity documented at the Project, it is important to acknowledge that numbers of recorded bat call sequences cannot be correlated with the number of bats in an area because acoustic detectors do not differentiate between individuals (Hayes 2000). Thus, results of acoustic surveys must be interpreted with caution. Methods surrounding acoustic bat surveys are continually evolving, and there are currently little data aiding in the interpretation of the number of calls per detector night. Although interpretations are limited, the surveys represent a sample of activity and the general species groups that occur in the Project area across an annual activity cycle for bats.

3.0 NOCTURNAL RADAR SURVEY

3.1 INTRODUCTION

Documenting the patterns of nocturnal migrants requires the use of radar or other non-visual technologies. Therefore, Stantec conducted nocturnal radar surveys consistent with MDIFW's 2014 Wind Power Preconstruction Study Recommendations and the Weaver Work Plan (18 June 2014) in spring 2014 on 20 nights from 28 April to 29 May and in fall 2014 on 20 nights from 18 August to 8 October to document the abundance, flight patterns, and flight altitudes of night-migrating species at the Project.

3.2 METHODS

X-band marine surveillance radar, similar to that described by Cooper et al. (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts and has the ability to track small animals, including birds, bats, and insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals. Consequently, all animals, excluding insects, observed on the radar screen were identified as "targets." The radar has an "echo trail" function that captures past echoes of flight trails, enabling determination of flight direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5 ft) waveguide antenna. The antenna has a vertical beam height of 20° (10° above and below horizontal).

The radar was operated in 2 modes (surveillance and vertical mode) from sunset to sunrise each survey night, and both modes of operation were used during each hour of sampling. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the Project site. By analyzing the echo trail, the flight direction and flight speed of targets can be determined. In vertical mode, the radar unit is tilted 90° to survey the airspace above the radar (Harmata et al. 1999). In vertical mode, target echoes do not provide directional data but do provide information on the altitude of targets passing through a vertical radar beam with a 20° angle of view.

The radar was operated at a range of 1.4 kilometers (km) (0.75 nautical miles, 0.9 miles) to allow detection of small targets. When radar is operated at ranges greater than 1.4 km, the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, which limits the detection and observable movement pattern of individual targets. Consequently, 1.4 km is the appropriate detection range for this type of study.

The radar display was connected to a computer with video recording software, enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every 10 minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. From each hour of samples collected, a stratified random sample set was developed for analysis by randomly selecting 6 one-minute horizontal samples and 6 one-minute vertical samples per hour of survey. This sampling schedule allowed for randomization of sample selection and prevented double-counting of targets.

Weather data were retrieved from an onsite meteorological (met) tower in the Project area. Temperature, wind speed, and wind direction data were used for analysis and interpretation of radar results. Additionally, to consider the atmospheric influences on migration, we interpreted regional surface weather map images to determine the dates that pressure systems (high, low, or none) moved through the region. Surface weather maps, prepared by the National Centers for Environmental Prediction, the Hydro-meteorological Prediction Center, and the National Weather Service, were downloaded daily for the survey period.

3.2.1 Deployment

Stantec deployed the radar unit and conducted surveys on Een Ridge, centrally located within the Project area at an elevation of approximately 209 m (686 ft) (Figures 1-1 and 3-1). To maximize the airspace sampled and reduce ground clutter interference, the radar antenna was elevated approximately 4 m (12 ft) above ground level.

Figure 3-1. Radar on Een Ridge in the Weaver Wind Project area, 2014.

Below are examples of the radar's view of the surrounding airspace and targets as depicted on the video files (Figure 3-2).

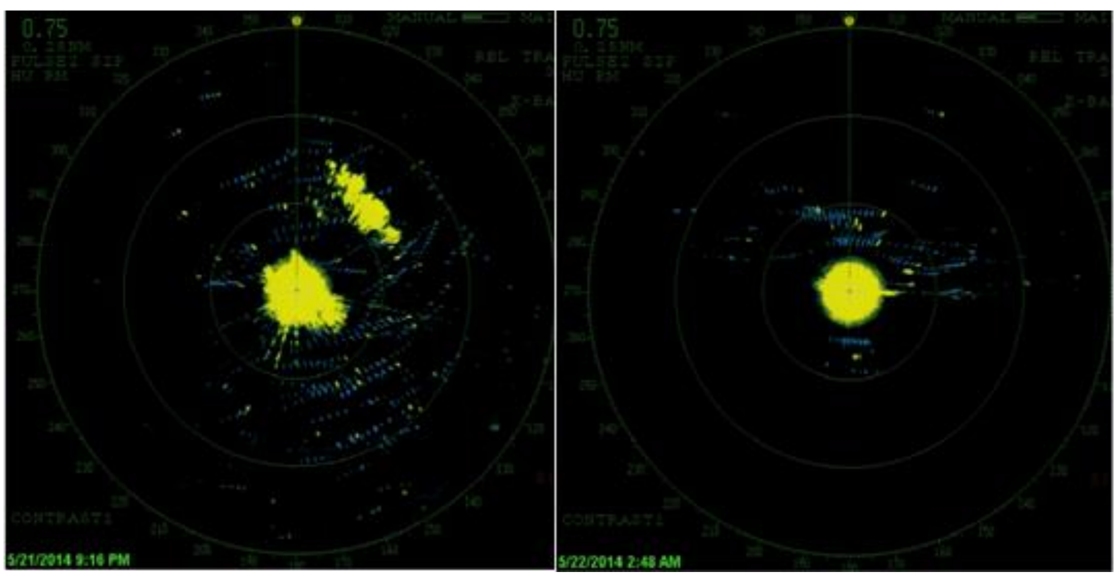


Figure 3-2. Screenshots from actual radar files in horizontal mode (left) and vertical mode (right), Weaver Wind Project, spring 2014.

3.3 RESULTS

Stantec conducted nocturnal radar surveys in spring on 20 nights from 28 April to 29 May and in fall on 20 nights from 18 August to 8 October.

3.3.1 Spring

Spring radar surveys were conducted on 20 nights between 28 April and 29 May 2014 (Appendix B Table 1) resulting in 188 total hours surveyed.

Nightly mean passage rates ranged from 49 ± 7 targets per kilometer per hour (t/km/hr) on 28 April to 2,586 ± 518 t/km/h on 21 May. The overall passage rate for the survey period was 806 ± 56 t/km/hr (Figure 3-3; Appendix B Table 2). Individual hourly passage rates varied between nights and throughout the season, ranging from 0 t/km/hr during the 10th hour of 8 May to 5,161 t/km/hr during the 5th hour of 21 April (Appendix B Table 2). For the entire season, passage rates increased after sunset, peaked during hours 3 and 5, and declined until sunrise (Figure 3-4).

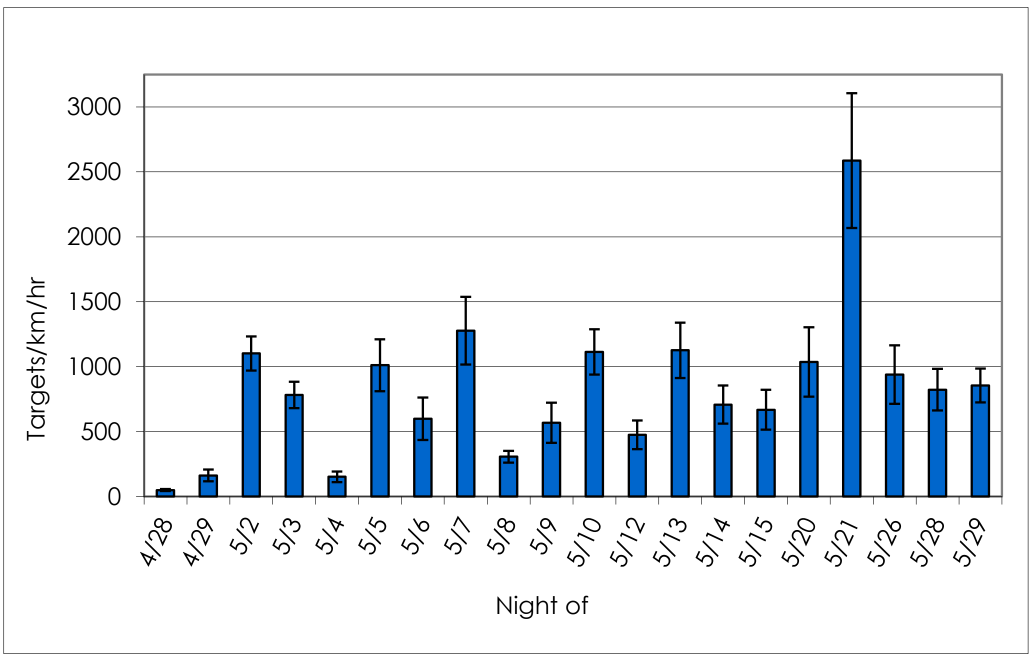


Figure 3-3. Nightly passage rates, Weaver Wind Project, spring 2014 (error bars ± 1 SE).

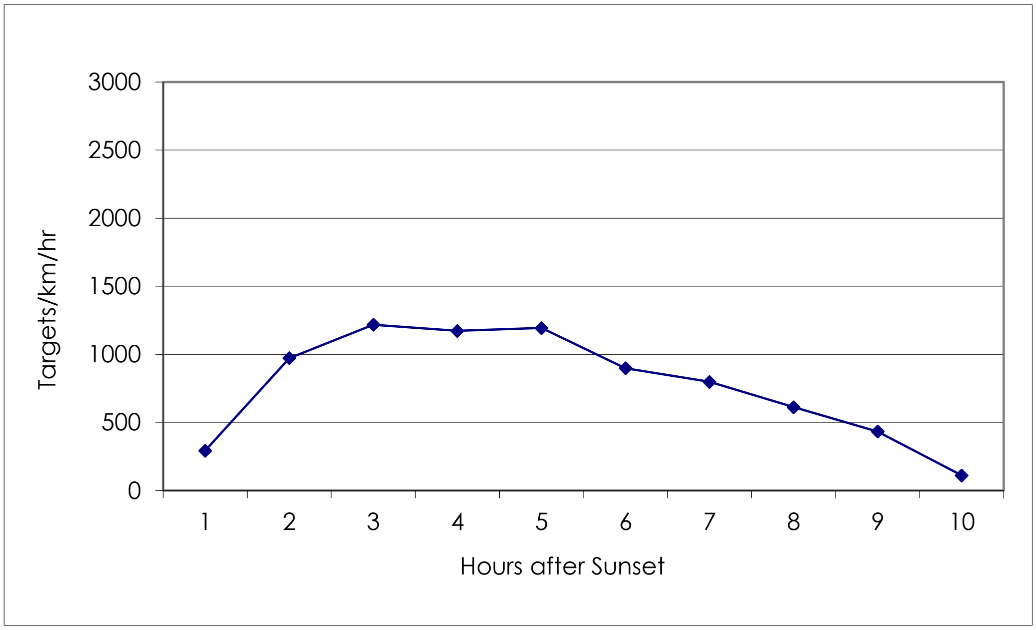


Figure 3-4. Hourly passage rates for the season, Weaver Wind Project, spring 2014.

Mean flight direction of nocturnal migrants was 72° ± 42°, east-northeast, but varied among nights (Figure 3-5; Appendix B Table 3).

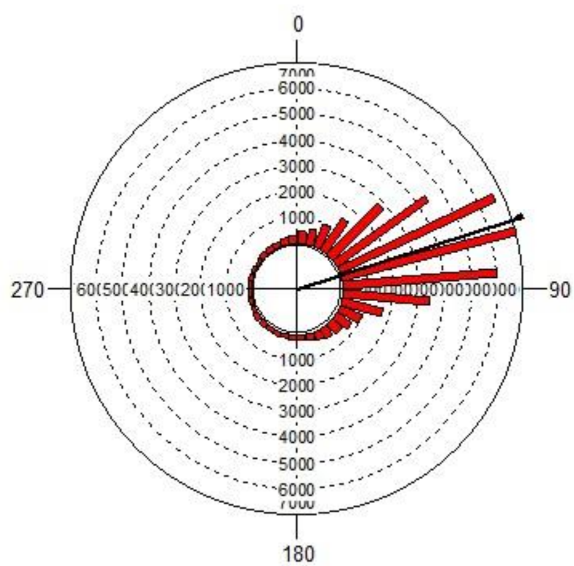


Figure 3-5. Mean flight direction, Weaver Wind Project, spring 2014 (the bracket along the margin of the histogram is the 95% confidence interval).

The seasonal mean flight height of targets was 365 ± 2 m (1,198 ft) above the radar site. The mean nightly flight height ranged from 114 ± 10 m on 4 May to 508 ± 6 m on 3 May (Figure 3-6; Appendix B Table 4). The percent of targets observed flying below 180 m was 29% for the season and varied nightly from 10% on 14 May (n = 332 targets below turbine height) to 83% on 4 May (n

= 66) (Figure 3-7; Appendix B Table 4). For the season, mean hourly flight heights varied between the hours after sunset and were lowest during hours 1 and 5 through 8 (Figure 3-8).

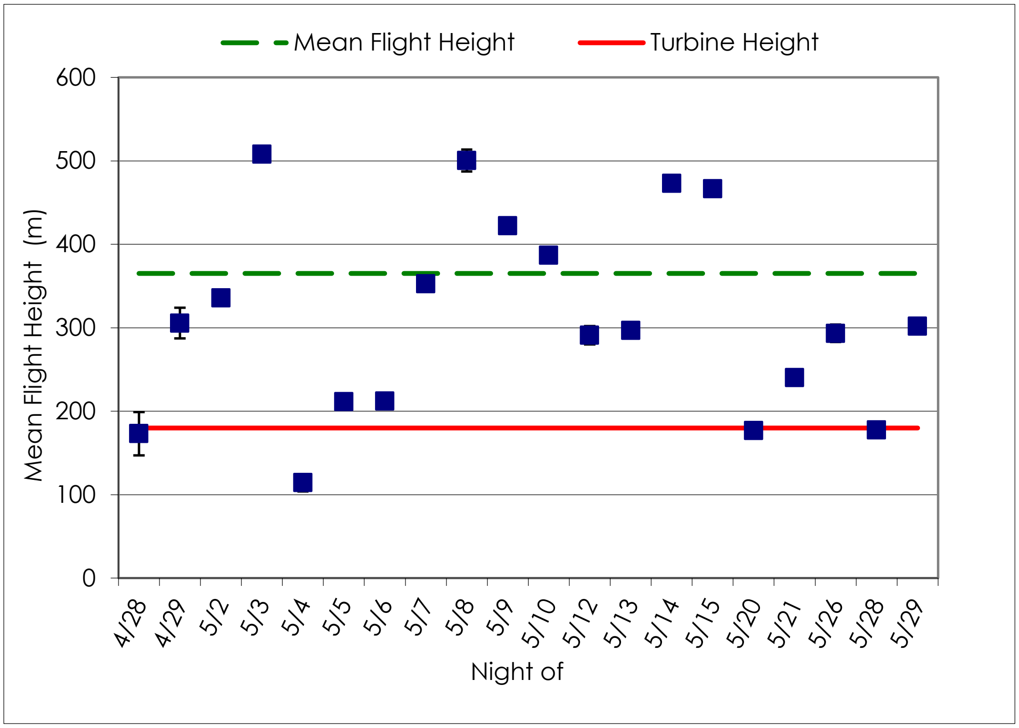


Figure 3-6. Mean seasonal (green line) and nightly mean flight height (blue squares) of targets, Weaver Wind Project, spring 2014 (error bars ± 1 SE).

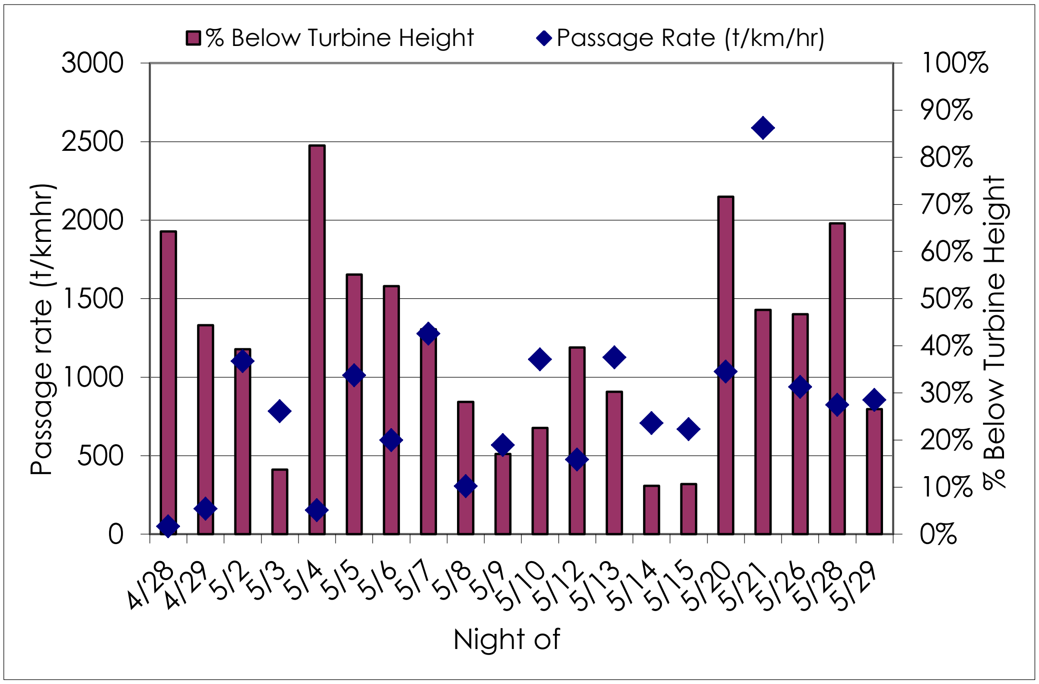


Figure 3-7. Percent of targets observed flying below turbine height, Weaver Wind Project, spring 2014.

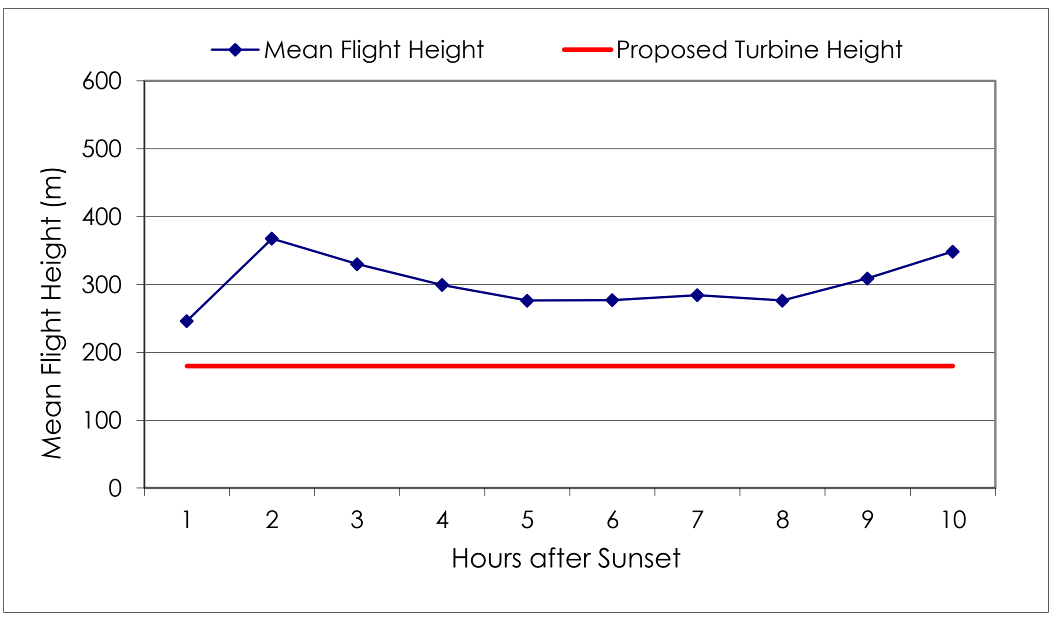


Figure 3-8. Hourly target flight height distribution, Weaver Wind Project, spring 2014.

Figure 3-9 shows the distribution of individual nightly flight heights of all targets relative to turbine height. The yellow boxes depict the middle 50% of targets. The error bars depict the statistical outliers, or 25% of targets above and below the middle 50% of targets. The horizontal line within each box represents the nightly median flight height. Nightly mean flight height was below 180 m on 4 survey nights: 28 April, 4 May, 20 May and 28 May.

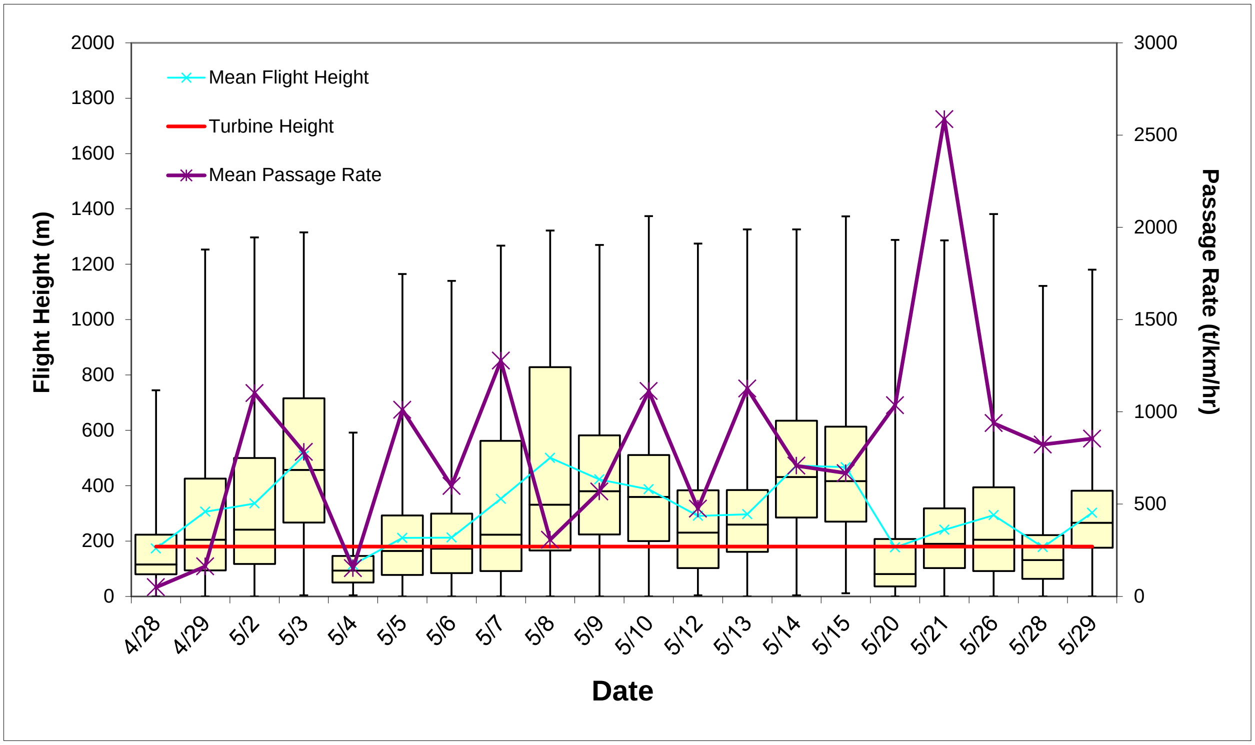


Figure 3-9. Flight height whisker plot depicting the vertical distribution of targets for each survey night, Weaver Wind Project, spring 2014.

During the nights surveyed, average nightly wind speed varied between 3 and 9 m/s, with a mean of 6 m/s (Figure 3-10). Mean nightly temperatures varied throughout the survey period from 1–13°C, with a mean of 8°C (Figure 3-11).

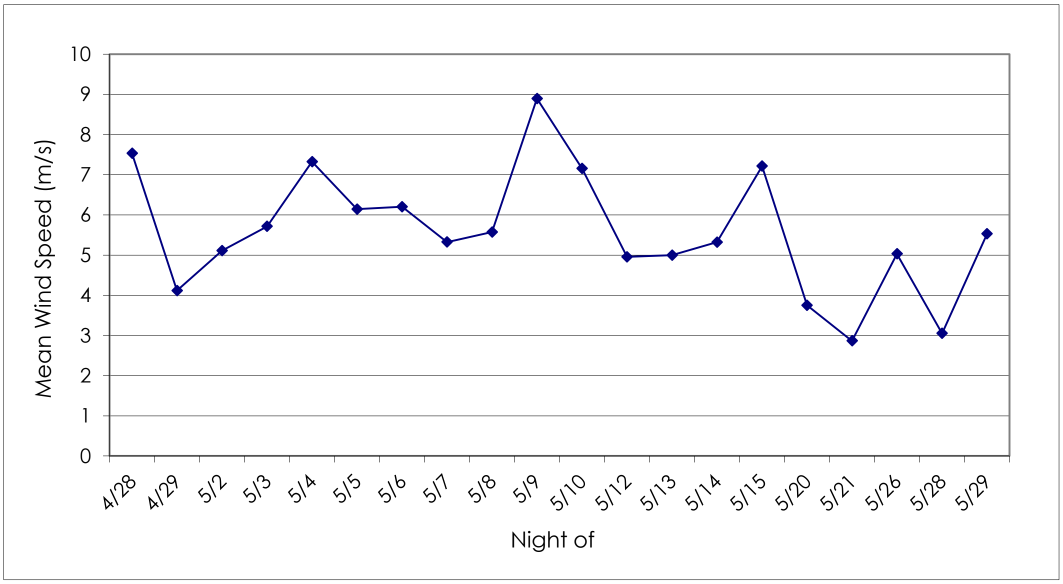


Figure 3-10. Nightly mean wind speed (m/s), Weaver Wind Project, spring 2014.

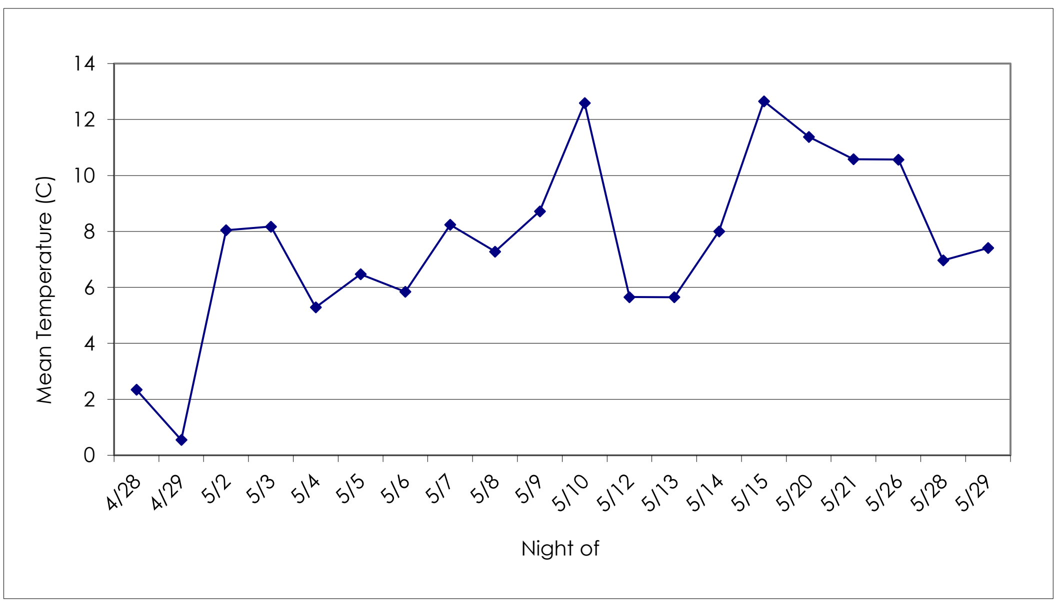


Figure 3-11. Nightly mean temperature (°C), Weaver Wind Project, spring 2014.

3.3.2 Fall

Stantec biologists conducted fall radar surveys on 20 nights between August 18 and October 8, 2014 (Appendix B Table 5), resulting in 211 total hours surveyed.

Nightly passage rates ranged from 239 ± 45 t/km/hr on 8 October to 1,122 ± 150 t/km/h on 8 September. The overall passage rate for the survey period was 657 ± 29 t/km/hr (Figure 3-12; Appendix B Table 6). Individual hourly passage rates varied between nights and throughout the season, ranging from 11 t/km/hr during the 11th hour of 3 October and the 1st hour of 6 October to 1,986 t/km/hr during the 2nd hour of 8 September (Appendix B Table 6). For the entire fall season, passage rates increased after sunset, peaked during hour 3, and decreased until sunrise (Figure 3-13).

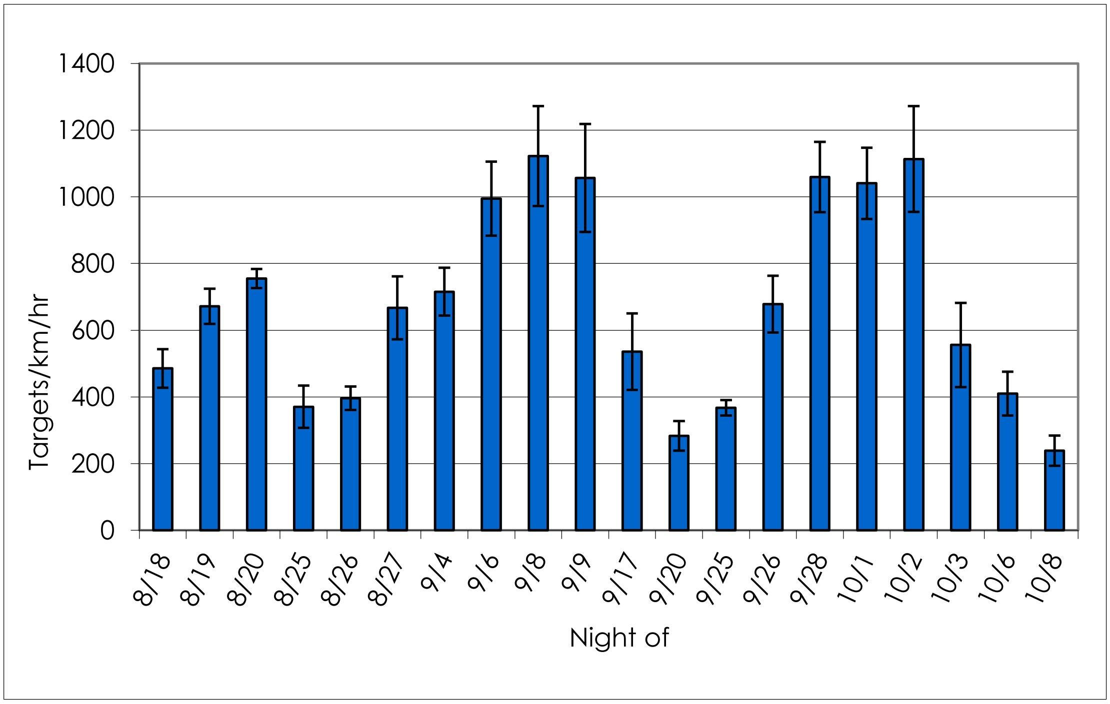


Figure 3-12. Nightly passage rates, Weaver Wind Project, fall 2014 (error bars ± 1 SE).

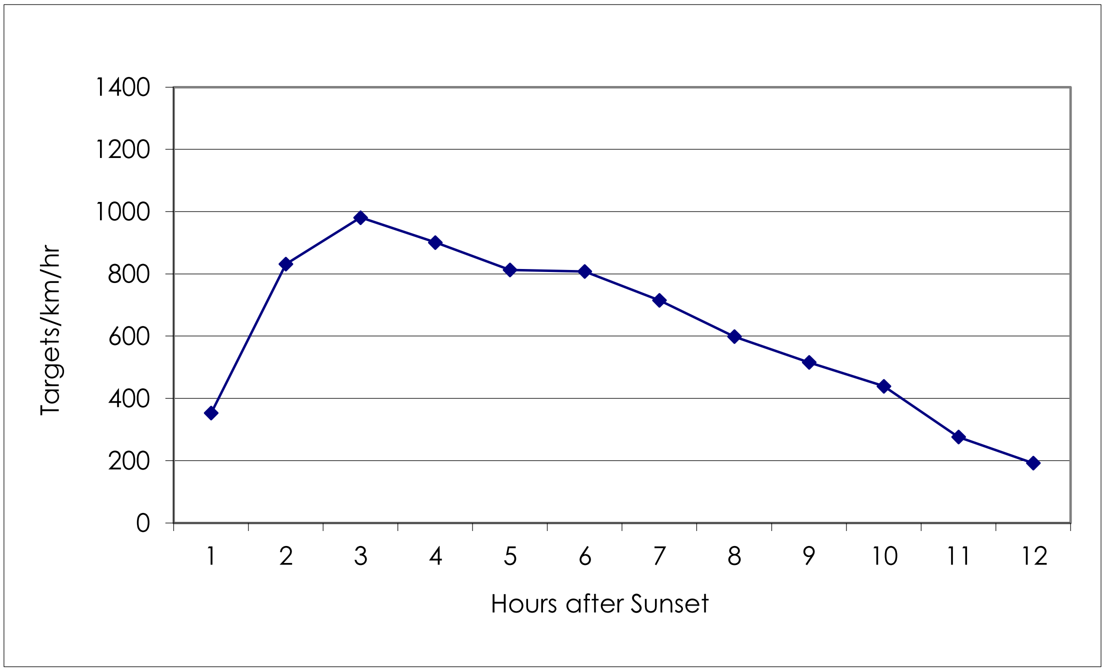


Figure 3-13. Hourly passage rates for the season, Weaver Wind Project, fall 2014.

Mean flight direction of nocturnal migrants was 259° ± 92°, west-southwest, but varied among nights (Figure 3-14; Appendix B Table 7).

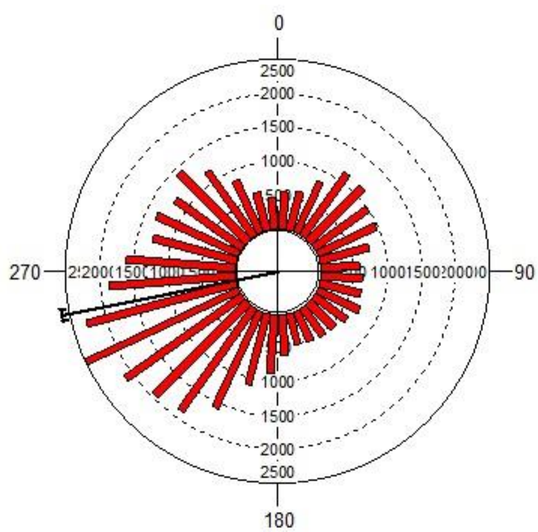


Figure 3-14. Mean flight direction, Weaver Wind Project, fall 2014 (the bracket along the margin of the histogram is the 95% confidence interval).

The seasonal mean flight height of targets was 412 ± 1 m (1,350 ft) above the radar site. The average nightly flight height ranged from 252 ± 6 m on 4 September to 575 ± 8 m on 25 September (Figure 3-15; Appendix B Table 8). The percent of targets flying below turbine height was 23% for the season. Percent of targets observed flying below turbine height varied nightly from 13% on 26 September (n = 481) to 41% on 4 September (n = 607) (Figure 3-16; Appendix B Table 8). For the season, mean hourly flight heights were lowest during hours 1 and 11 but did not vary greatly between the hours after sunset (Figure 3-17).

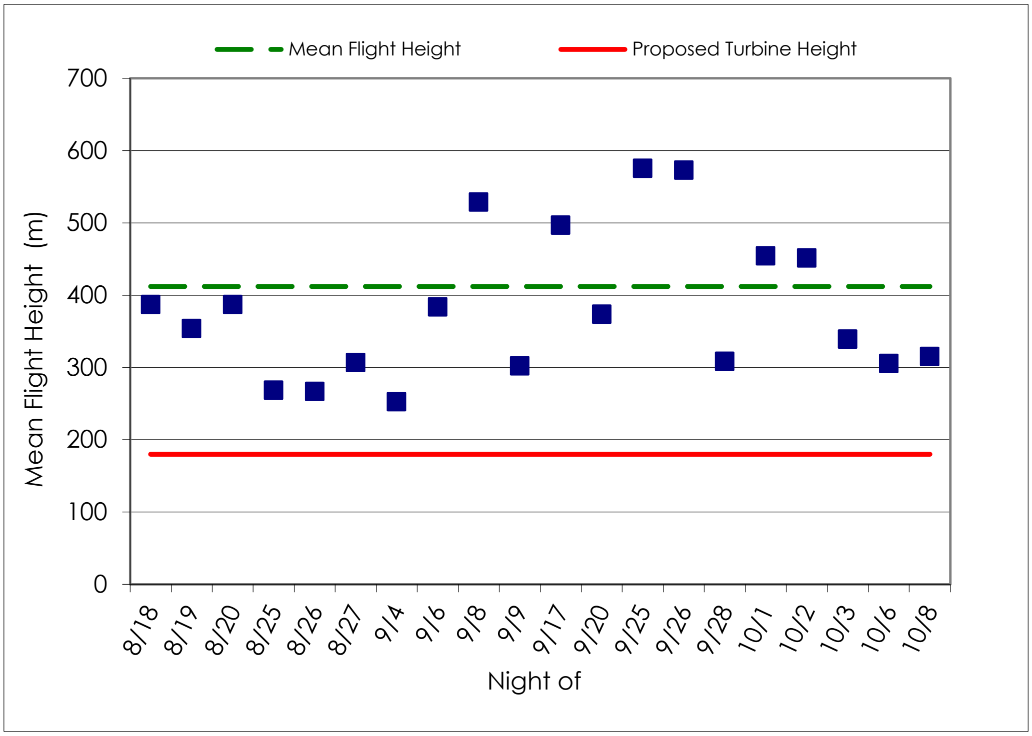


Figure 3-15. Mean seasonal (green line) and nightly mean flight height (blue squares) of targets, Weaver Wind Project, fall 2014 (error bars ± 1 SE).

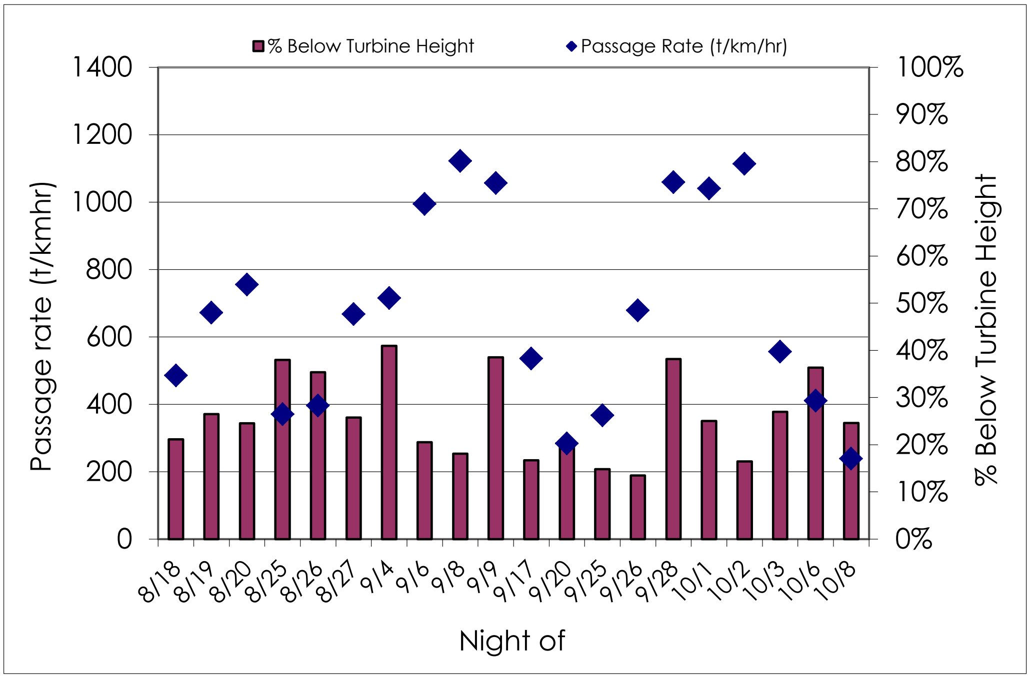


Figure 3-16. Percent of targets observed flying below turbine height, Weaver Wind Project, fall 2014.

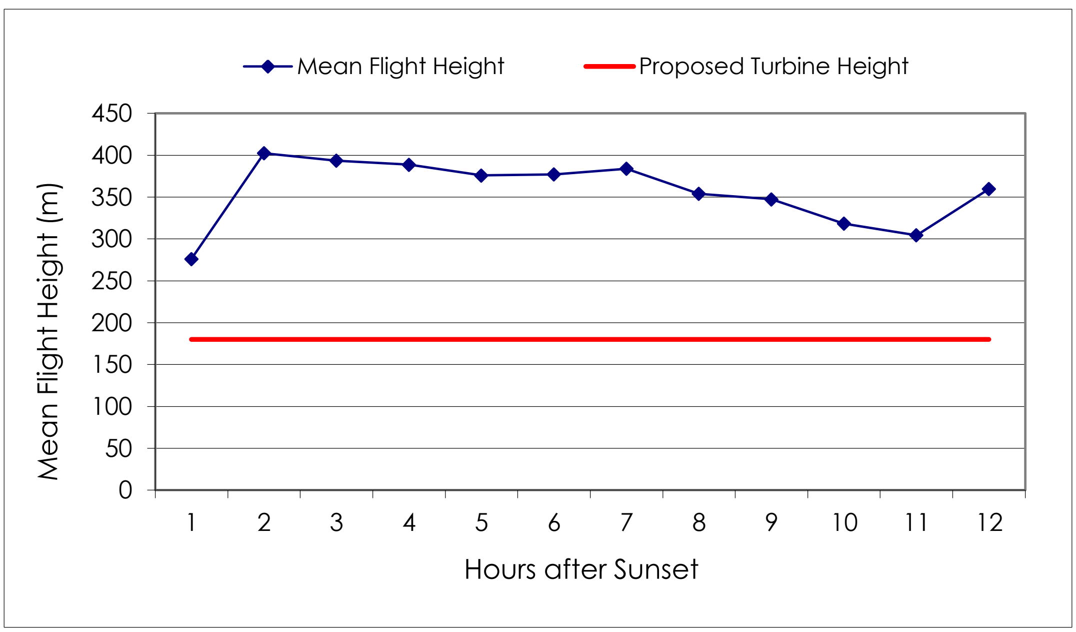


Figure 3-17. Hourly target flight height distribution, Weaver Wind Project, fall 2014.

Figure 3-18 shows the distribution of individual nightly flight heights of all targets relative to turbine height. The yellow boxes depict the middle 50% of targets. The error bars depict the statistical outliers, or 25% of targets above and below the middle 50% of targets. The horizontal line within each box represents the nightly median flight height value. No nights in fall had nightly mean flight heights below 180 m.

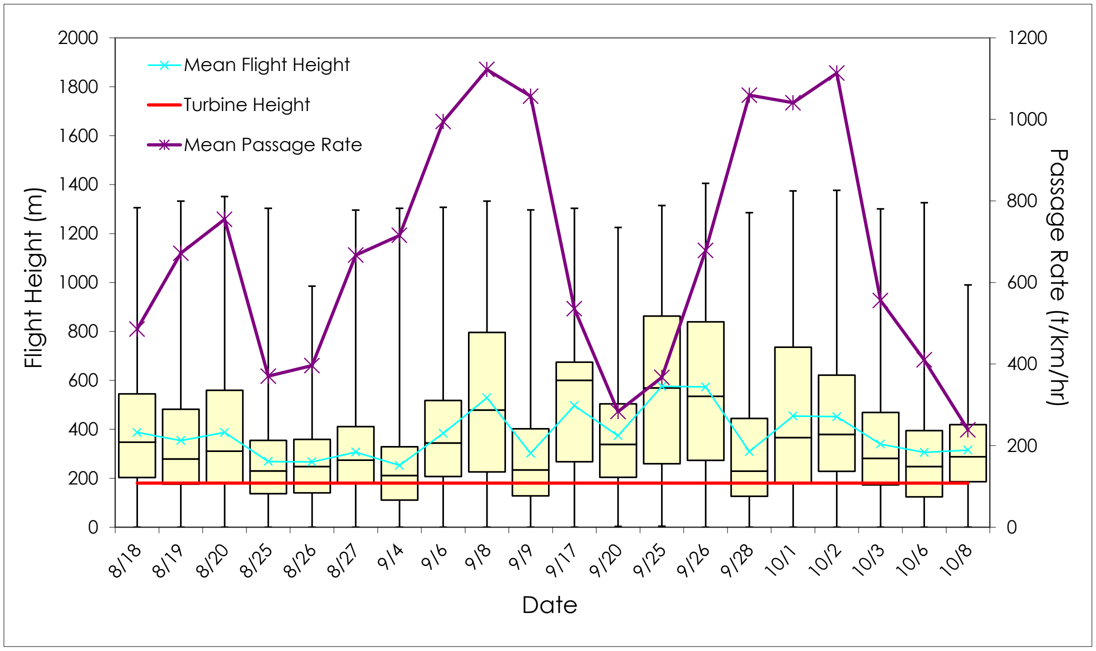


Figure 3-18. Flight height whisker plot depicting the vertical distribution of targets for each survey night, Weaver Wind Project, fall 2014.

During the nights surveyed, average nightly wind speed varied between 3 and 10 m/s, with an overall mean of 6 m/s (Figure 3-19). Mean nightly temperatures varied throughout the survey period from 8–18°C, with an overall mean of 13°C (Figure 3-20).

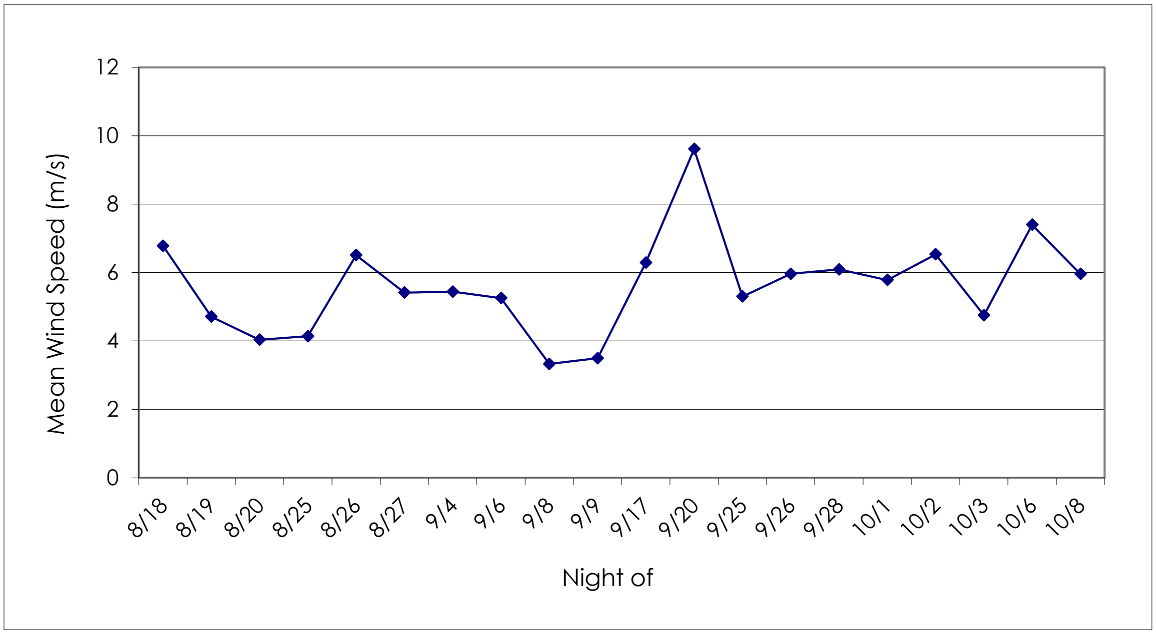


Figure 3-19. Nightly mean wind speed (m/s), Weaver Wind Project, fall 2014.

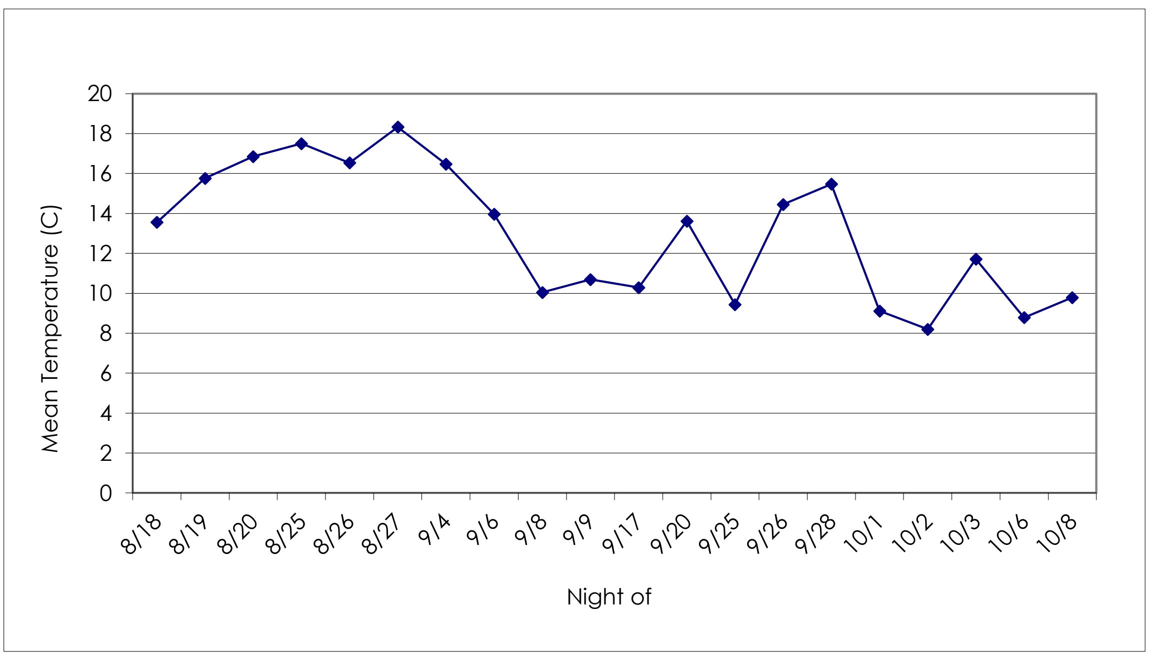


Figure 3-20. Nightly mean temperature (°C), Weaver Wind Project, fall 2014.

3.4 DISCUSSION

Radar surveys are designed and implemented to sample migration activity over a particular location to provide site-specific data at a project. Results of radar surveys provide a "snapshot" of avian migration; in this case, over the Weaver Wind Project area during dates typical for spring and fall migration in Maine. The radar was elevated to a height that allowed for a good view of the surrounding airspace and surveys in the Project documented patterns in nocturnal migration similar to those documented at recent pre-construction radar surveys conducted on forested ridges in Maine and in the eastern U.S. (Appendix B Tables 9 and 10). These include highly variable passage rates among nights and average nightly flight heights typically over 200 m.

3.4.1 Passage Rates

Nightly mean passage rates were highly variable, indicating that nocturnal migration was pulsed, presumably due to seasonal timing and regional weather conditions. The seasonal average passage rate at the Project during spring (806 ± 56 t/km/hr) was above the range of results at proposed wind projects in Maine (147–543 t/km/hr) and within the range of results at proposed wind projects in the eastern U.S. (110–1,020 t/km/hr; Appendix B Table 9). The average passage rate at the Project during fall (657 ± 29 t/km/hr) was within the range of results observed at proposed wind projects in Maine(201–803 t/km/hr) and in the eastern U.S. (64–980 t/km/hr; Appendix B Table 10).

Stantec conducted radar surveys at the nearby Bull Hill Wind Project during the pre-construction phase in spring 2010 and 2011and fall 2009 and 2011. The average passage rate at the Bull Hill Wind Project during spring 2010 and spring 2011 were both lower than during spring 2014 at Weaver (Table 3-1). The average passage rate at the Bull Hill Wind Project during fall 2009 was similar to fall 2014 at Weaver (Table 3-1). The average passage rate at the Bull Hill Wind Project during fall 2011 was lower than during fall 2014 at Weaver (Table 3-1).

Table 3-1. Seasonal passage rates at the Bull Hill and Weaver wind Projects.

Season	Average passage rate (t/km/hr)
Bull Hill	
Spring 2010	387 ± 21
Spring 2011	519 ± 57
Fall 2009	614 ± 32
Fall 2011	431 ± 26
Weaver	
Spring 2014	806 ± 56
Fall 2014	657 ± 29

Comparing passage rates between sites, even those nearby, must be done with caution, as differences are likely due to differences in radar view between sites, dates of survey (as migration is pulsed), and varying weather patterns among sites and among years. In this case, since the Bull Hill Wind Project and Weaver Wind Project are in close proximity, the difference in passage rates between the 2 Projects likely is due to yearly variation in migration.

3.4.2 Flight Heights

The increasing number of publicly available radar studies at proposed wind projects show a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of 200 m or more above the ground (Appendix B Tables 9 and 10). Mean flight height in spring (365 ± 2 m) was well above proposed turbine height and within the range of results at proposed wind projects in Maine (210–412 m) and in the East (210–552 m). Mean flight height in fall (412 ± 1 m) also was well above proposed turbine height and within the range of flight heights at proposed wind projects in Maine (279–453 m) and in the East (203–644 m). Nightly mean flight height was below the proposed turbine height of 180 m in spring on April 28 (173 m), May 4 (114 m), May 20 (177 m), and May 28 (177 m). No nightly mean flight heights in fall were below turbine height.

The mean flight height at the Bull Hill Wind Project during spring 2010 was lower than during spring 2014 at Weaver (Table 3-2). The mean flight height at the Bull Hill Wind Project during spring 2011 was similar to spring 2014 at Weaver (Table 3-2). The mean flight heights at the Bull Hill Wind Project during fall 2009 and fall 2011 were lower than during fall 2014 at Weaver (Table 3-2).

Table 3-2. Seasonal flight heights at the Bull Hill and Weaver wind Projects.

Season	Average flight height (m)
Bull Hill	
Spring 2010	217 ± 8
Spring 2011	371 ± 3
Fall 2009	357 ± 9
Fall 2011	279 ± 2
Weaver	
Spring 2014	365 ± 2
Fall 2014	412 ± 1

Percent below proposed turbine height in spring 2014 (29%) was within the range of results at studies conducted at proposed wind projects in Maine and in the East (3–38% [Maine studies had the lowest and highest percent below proposed turbine height]; Table 3-3; Appendix B Table 9). Percent below proposed turbine height in fall 2014 (23%) was within the range of results at studies conducted at proposed wind projects in Maine (8–26%), and in the East (1–40%; Appendix B Table 10).

The percent below proposed turbine height (175m) at the Bull Hill Wind Project during spring 2010 was higher than during spring 2014 at Weaver. The percent below proposed turbine height at the Bull Hill Wind Project during spring 2011 was similar to spring 2014 at Weaver (Table 3-3; Appendix B Table 9). The percent below proposed turbine height at the Bull Hill Wind Project during fall 2009 was similar to fall 2014 at Weaver. The percent below proposed turbine height at the Bull Hill Wind Project during fall 2011 was higher than during fall 2014 (Table 3-3; Appendix B Table 10).

Table 3-3. Seasonal percent of targets below turbine height at the Bull Hill and Weaver wind Projects.

Season	Percent below proposed turbine height
Bull Hill (proposed turbine height: 175m)	
Spring 2010	45%
Spring 2011	27%
Fall 2009	20%
Fall 2011	35%
Weaver (proposed turbine height: 180m)	
Spring 2014	29%
Fall 2014	23%

3.4.3 Weather

Nightly variation in the magnitude and flight characteristics of nocturnal migrants is not uncommon and is often attributed to weather patterns such as cold fronts and winds aloft (Hassler et al. 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman et al. 1982, Gauthreaux 1991). Overall, the spring 2014 migration season consisted of moderate weather conditions. The night with the lowest passage rate in spring (28 April) was characterized by a low pressure system in the region with mostly cloudy and overcast skies over the Project area. The night consisted of below average temperatures and strong winds coming from the northeast. The night with the highest passage rate in spring (21 May), was also characterized by a low pressure system moving through the region with mostly cloudy and overcast skies over the Project area. The night consisted of above average temperatures and weak winds coming from the northwest. The nights with the lowest passage rate in fall were 20 September and 8 October. The night of 20 September was characterized by overcast skies in the beginning of the night to variable skies in the late night/early morning hours. The night consisted of moderate temperatures and strong winds coming from the south. October 8 was characterized by a low pressure system moving through the region during the day with mostly cloudy skies throughout the night over the Project area. The night consisted of below average temperatures and moderate winds coming from the west. The night with the highest passage rate in the fall (8 September), was characterized by a high pressure system moving through the region with clear skies over the Project area. The night consisted of below average temperatures and weak winds coming from the south.

4.0 BREEDING BIRD SURVEY

4.1 INTRODUCTION

Stantec conducted breeding bird surveys at the Project during May and June 2014 to assess species composition, abundance, diversity, and distribution of songbirds in the Project area during the breeding season. Surveys targeted the occurrence of breeding songbirds, in particular neotropical migrants, state-listed species, raptors, and species of special concern. However, observers recorded all species detected either acoustically or visually, including raptors, waterfowl, and flyovers during surveys and incidentally between surveys while traveling to and from survey locations.

4.2 METHODS

4.2.1 Data Collection

Stantec biologists conducted 3 surveys in the Project area once in late May and twice in June. Surveys targeted the period between sunrise and 12:00 pm on days with suitably clear weather, mild temperatures, mild wind speeds, and light to no precipitation. At each survey point, the biologist conducted a 10-minute count and recorded on standardized datasheets all species detected (visually and acoustically), the number of individuals, and the approximate distance from the observer. The biologist also recorded weather information at each survey location and any notes on possible disturbances which may have influenced results (e.g., logging operation noise, highway noise, human presence, etc.).

Prior to the survey, a biologist reviewed aerial photographs and maps of the Project area and identified survey locations based on the following criteria:

- Ability to sample preliminary layout of Project infrastructure
- Ability to sample the various habitats in the Project area
- Site access (i.e., roads)
- Participating landowner parcels
- Separated by at least 250 m (820 ft)

Stantec identified and mapped 20 breeding bird survey locations that met the above criteria. Each proposed turbine "string" contained at least 1 and up to 7 survey locations. Mapped survey locations were geo-located in ArcGIS® to derive coordinates for waypoints. Waypoints were then loaded into a Global Positioning System (GPS) unit to facilitate locating the survey location in the field. Figure 1-1 shows the survey locations. Each point count occurred at the same mapped location during the 3 site visits ± a few meters based on the accuracy of the GPS unit. The biologist surveyed all points during each of the 3 surveys.

Consistent with the Work Plan (dated 18 June 2014), Stantec conducted great horned owl (*Bubo virginianus)* playback surveys in an effort to detect raptors that may be breeding in the area[3]. The playback surveys were conducted during the 2 breeding bird surveys in June. After the point count was completed at each breeding bird survey location, Stantec broadcasted calls of great horned owl for 5 minutes. Raptors who appeared territorial during the broadcast (i.e., approached the area where the playback came from and/or vocalized) were thought to be nesting in close proximity.

4.2.2 Data Summary and Analysis

Habitats sampled were characterized by forest type and any man-made or natural disturbances. Observers estimated the general timeframe when the disturbance occurred (recent disturbances up to approximately 40 years).

We used species and number of individuals documented during surveys to calculate species richness, relative abundance, frequency of occurrence, and community diversity (Shannon Diversity Index) for each habitat, each species (when applicable), and for all species and habitats combined. These indices were then calculated for just those birds observed within 100 m from observers and non-flyovers to more accurately describe the breeding bird community within 100 m of count locations and proposed turbine locations. These indices are described below.

- Species richness is the total number of species that were detected, not including unidentified genera of birds (e.g., unidentified flycatcher, unidentified warbler, etc.).
- Relative abundance quantifies the number of individuals of a species in relation to other species observed. Relative abundance takes into account the total number of individuals detected, the number of times each point count location was surveyed, and the number of survey points.
- Frequency of occurrence, expressed as a percentage, measures the percentage of points where a particular species is detected.
- Shannon Diversity Index (SDI) is a measure of species diversity in a community or habitat. SDI provides more information about community composition than species richness because it takes into account relative abundance and the evenness of the distribution of species. It indicates how abundance is distributed among all the species in a community or habitat. A high SDI value represents a diverse and equally distributed community and a lower value represents a less diverse community. As an example, a SDI value of 0 would represent a habitat type with just one species present.

[3] This method for assessing breeding raptors at the Project was recommended by MDIFW at a meeting with Stantec and First Wind on 2 June 2014.

4.3 RESULTS

4.3.1 Weather Summary

Biologists conducted point count surveys on May 28–30, June 10–13, and June 27–28. Wind and rain conditions did not adversely affect bird detection on these days; weather parameters for survey days are summarized in Table 4-1. Wind speeds were generally calm. Sky conditions during surveys were variable, from clear to overcast with drizzle on 2 survey days. Temperatures throughout the counts ranged from 3.1°C–18.3°C.

Table 4-1. Weather summary for breeding bird surveys, Weaver Wind Project, spring 2014.

Date	Round	Wind Speed*	Average Temperature (°C)	Sky Conditions
28-May	1	1, 2, 3	6.4	cloudy, drizzle
29-May	1	0	3.1	clear or few clouds
30-May	1	0	5.3	clear to partly cloudy
10-Jun	2	0, 1	18.3	cloudy
11-Jun	2	0	15.4	partly cloudy to clear
12-Jun	2	0	17.0	cloudy, drizzle
13-Jun	2	0, 1	13.0	cloudy
27-Jun	3	0, 1	13.9	clear or few clouds
28-Jun	3	0, 1	13.6	clear or few clouds
* 0=<1 mph; 1=1–3 mph; 2=4–7 mph; 3=9–12 mph				

4.3.2 Overall Results

Biologists detected 599 individuals representing 52 species[4] at the 20 point count locations (Appendix C Table 1). Appendix C Table 1 shows the species detected, numbers of individuals detected, and distance from observer.

4.3.3 Results by Habitat Type

There were 6 habitats present in the study area: recently disturbed hardwood forest, mature hardwood forest, recently disturbed mixed forest, forest edge due to man-made clearing, recently disturbed wetland, and softwood plantation. Past and recent disturbances in the Project area were primarily logging activity. Plantation refers to either spruce (*Picea* sp.) or balsam fir (*Abies balsamea*) plantations of various age classes.

Table 4-2 summarizes the results of the surveys and analysis by habitat classification, excluding observations of birds >100 m from the observer and flyovers. For birds within 100 m of the observer and non-flyovers, biologists recorded 41 species and 434 individuals.

[4] Additional individuals observed that could not be identified to species due to distance from observer or flew over too quickly to identify included unidentified bird, unidentified songbird, unidentified thrush, unidentified warbler, and unidentified woodpecker.

Table 4-2. Summary of breeding bird point count results by habitat type, excluding observations of birds >100 m from the observer and flyovers, Weaver Wind Project, spring 2014.

Habitat Type	# BBS Points	Total Birds Observed	Relative Abundance	Species Richness[1]	Shannon Diversity Index
hardwood forest, recently disturbed (10–15 yrs)	2	50	0.38 ± 0.03	21	0.59
hardwood forest, mature	2	28	0.27 ± 0.02	17	0.35
mixed forest, recently disturbed (15–30 yrs)	6	124	0.22 ± 0.02	29	1.28
forest edge, man-made clearing	3	90	0.36 ± 0.04	26	0.96
wetland, recently disturbed (5–40 yrs)	2	34	0.31 ± 0.03	16	0.41
plantation (spruce or balsam fir)	5	108	0.38 ± 0.03	19	1.04
All points	**20**	**434**	**0.32 ± 0.009**	**41**	**3.29**

[1] Not including unidentified genera of birds (e.g., unidentified warbler, *Parulidae*).

4.3.4 Species Abundance and Diversity

Excluding flyovers and birds detected >100 m from the observer, black-throated green warbler (*Setophaga virens*; n = 38) and chestnut-sided warbler (*Dendroica pensylvanica*; n = 31) were the 2 two most common species detected among the 20 count locations. Relative abundance of black-throated green warbler was highest in recently disturbed wetland (RA = 1.00; n = 6). Relative abundance of chestnut-sided warbler was highest in forest edge and man-made clearing (RA = .89; n = 8) (Appendix C Tables 2).

Appendix C Table 2 shows the relative abundance and frequency of each species observed by habitat type. Recently disturbed mixed forest habitat had the greatest number of individuals (n = 124), highest species richness (SR; 29), and highest Shannon-Diversity Index (1.28). The most commonly detected birds in this habitat type included black-throated green warbler (n = 11), common yellowthroat (*Geothlypis trichas*; n = 9), hermit thrush (*Catharus guttatus*; n = 8), ovenbird (*Seiurus aurocapilla*; n = 8), magnolia warbler (*Setophaga magnolia*; n = 7), and blackburnian warbler (*Setophaga fusca*; n = 7).

4.3.5 Rare, Threatened and Endangered Species

No federally or state-listed species were detected. The following state species of special concern were detected either during or incidental to surveys: American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), chestnut-sided warbler (*Dendroica pensylvanica*), eastern towhee (*Pipilo erythrophthalmus*), least flycatcher (*Empidonax minimus*), veery (*Catharus fuscescens*), and white-throated sparrow (*Zonotrichia albicollis*).

4.3.6 Great Horned Owl Playback Surveys and Incidental Species

The great horned owl playbacks elicited a single raptor response by a broad-winged hawk (*Buteo platypterus*) at point count #5 (also proposed turbine location #5) on 28 June. Approximately 4 minutes after the broadcast began the broad-winged hawk flew onto an eastern white pine (*Pinus strobus*) branch above the observer and vocalized frequently, seemingly agitated. It remained perched for the last minute of the broadcast and after the observer left the location. A second species that vocalized during the great horned owl playbacks was northern flicker (*Colaptes auratus*) (Table 4-3). During the playback at point count # 8, a pair of flickers approached the point, perched in a hardwood, and vocalized toward the broadcast.

Biologists recorded 1 raptor during point count surveys, observed as a flyover: red-shouldered hawk. Raptor species observed incidentally between point count surveys included American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), and sharp-shinned hawk (*Accipiter striatus*).

Table 4-3. Bird species observed incidentally and/or during the great horned owl playback survey, spring 2014, Weaver Wind Project[1]

Species Common Name	Species Scientific Name	# Individuals	Vocalized or showed territorial behavior during GHOW playback
American kestrel	*Falco sparverius*	1	
American robin	*Turdus migratorius*	1	
black-and-white warbler	*Mniotilta varia*	2	
blackburnian warbler	*Setophaga fusca*	2	
black-capped chickadee	*Poecile atricapillus*	1	
black-throated blue warbler	*Setophaga caerulescens*	3	
black-throated green warbler	*Setophaga virens*	1	
blue-headed vireo	*Vireo solitarius*	3	
broad-winged hawk	***Buteo platypterus***	**1**	**y**
cedar waxwing	*Bombycilla cedrorum*	1	
common raven	*Corvus corax*	1	
dark-eyed junco	*Junco hyemalis*	1	
downy woodpecker	*Picoides pubescens*	1	
eastern wood-pewee	*Contopus virens*	1	
great crested flycatcher	*Myiarchus crinitus*	1	
Nashville warbler	*Oreothlypis ruficapilla*	1	
northern flicker	*Colaptes auratus*	2	y
northern parula	*Setophaga americana*	1	
ovenbird	*Seiurus aurocapilla*	1	
red-eyed vireo	*Vireo olivaceus*	1	
red-tailed hawk	*Buteo jamaicensis*	2	
ruby-crowned kinglet	*Regulus calendula*	1	
ruffed grouse	*Bonasa umbellus*	1	y[1]
sharp-shinned hawk	*Accipiter striatus*	1	
veery	*Catharus fuscescens*	2	
winter wren	*Troglodytes hiemalis*	2	
GHOW = great horned owl			
[1] Territorial behavior when biologists first approached breeding bird point count location prior to			

survey; not during GHOW playback

4.4 DISCUSSION

Point count surveys are a common method used to assess presence/absence of breeding songbird species that sing diurnally, to estimate relative abundance among species detected, and to characterize bird communities by habitat. The point count data collected in 2014 provides baseline information about the songbird communities in the habitats of the Project that correspond with the proposed turbine locations.

The spring 2014 breeding bird surveys occurred in suitable weather conditions for detection of birds during the peak breeding period, May and June, for songbirds in Maine. The 2014 surveys were based on standard USGS methods for point count surveys conducted in the region, modified to account for the areas expected to be directly impacted (i.e., proposed turbine locations). Results of the surveys provide a suitable reflection of the baseline breeding bird community in the Project area.

Species detected during the surveys are generally common, regionally abundant, and are representative of the habitats in which they were observed. No federally or state-listed species were observed during the breeding bird surveys.

5.0 DIURNAL RAPTOR MIGRATION SURVEY

5.1 INTRODUCTION

Stantec conducted raptor migration surveys in fall 2013 and spring and fall 2014. The purpose of the surveys was to investigate raptor migration activity at the Project, according to methods outlined in the Maine Department of Inland Fisheries and Wildlife's (MDIFW) *Curtailment Policy and Wind Power Preconstruction Study Recommendations* (April 2014), and the work plan dated 18 June, as well as methods consistent with those at other proposed wind projects in Maine and in the northeast.

5.2 METHODS

5.2.1 Data Collection

The fall 2013 and spring and fall 2014 raptor migration surveys were conducted from Een Ridge, located centrally within the Project area (Figure 1-1). Views from the observation location in each cardinal direction are shown in Appendix D Figures 1–4. Surveys targeted 10 days during each survey season with optimal migration weather such as fair days with thermal development and winds generally from a following direction (north in the fall, south in the spring). Surveys also included a few days with sub-optimal migration weather, characterized by moderate winds and varied wind direction.

Surveys were conducted between 9:00 am and 4:00 pm during the peak hours of thermal development and raptor activity. During surveys the observer scanned the sky and surrounding landscape by eye and with binoculars. The observer documented each raptor observation or pass.

The following was recorded for each observation:

- Flight path drawn on a study area map
- Time of observation
- Species identification (when possible)
- Number of individuals
- Age (when possible)
- If the bird occurred within turbine areas (i.e., 400 m [1/4 mile] horizontal buffer around proposed turbines)
- If the bird crossed a ridgeline located within turbine areas
- The bird's minimum flight height[5] above ground level inside turbine areas, outside turbine areas, and when crossing a ridgeline inside a turbine area, when applicable
- Flight behaviors inside and outside turbine areas
- Time over turbine areas, when applicable
- Flight azimuth
- General behavior notes

For the purposes of this report, the "study area" was considered the observable airspace above the surrounding topography as viewed from the observation location. A raptor that passed within a 400 m horizontal distance from proposed turbines was recorded as "within the turbine area". This conservative turbine area buffer accounts for an observer's lack of precision with respect to a raptor's location when observed from a distance. Observers also recorded non-raptor avian species observed incidentally during surveys.

5.2.2 Data Summary and Analysis

Raptor observation data were summarized by survey season and survey day. The following data were summarized:

- Daily and seasonal observation rates (raptors observed per hour)
- Number of species and individuals
- Hourly observation totals

[5] Nearby objects with known heights, such as met towers and trees, were used to estimate flight height.

- Percentage of birds observed in the study area that occurred specifically within the turbine areas (i.e., 400 m [1/4 mile] horizontal distance from proposed turbines)
- For those birds observed within turbine areas, the percentage of birds seen below proposed turbine height (180 m)
- Percentage of birds observed crossing over ridges inside turbine areas
- Average minimum flight height of birds inside, outside, and crossing a ridge inside turbine areas
- Behaviors of raptors observed inside of and outside of turbine areas

For summary and analysis, a single "pass" of a raptor was considered a single raptor observation; that is, an "observation" is considered a view of a single raptor from the time it is detected to the time it flies out of view. Differentiating between individuals is nearly impossible for this type of survey. Consequently, the same individual bird could be detected and recorded multiple times as separate raptor observations. This approach to characterizing raptor activity is conservative and differs from other types of hawk watch surveys which census migrant populations instead of documenting general raptor activity in the area.

5.3 FALL 2013 RESULTS

5.3.1 Fall 2013 Survey Effort and Timing

Ten surveys were completed from 11 September to 21 October for a total of 70 survey hours (Table 5-1).

Table 5-1. Survey effort and results summary, Weaver Wind Project, fall 2013.

Range of survey dates	**9/11 to 10/21**
No. survey days	**10**
No. survey hours	**70**
No. raptor species observed	**10**
Raptor species observed (common name)	**Scientific name**
American kestrel	*Falco sparverius*
bald eagle	*Haliaeetus leucocephalus*
broad-winged hawk	*Buteo platypterus*
Cooper's hawk	*Accipiter cooperii*
merlin	*Falco columbarius*
northern harrier	*Circus cyaneus*
red-shouldered hawk	*Buteo lineatus*
red-tailed hawk	*Buteo jamaicensis*
sharp-shinned hawk	*Accipiter striatus*
turkey vulture	*Cathartes aura*
unidentified raptor	n/a
unidentified accipiter	n/a
unidentified buteo	n/a
Total no. observations of raptors	62
No. raptor observations/hour	0.89
Total no. observations of raptors within turbine areas (percent of total observations)	48 (77%)
Total no. of observations of raptors seen in turbine area and below 180 m height (percent of obs. in turbine areas)	41 (85%)

The fall 2013 survey timeframe overlapped with the known migration window for the 15 raptor species which typically occur in the northeast during migration (Figure 5-1).

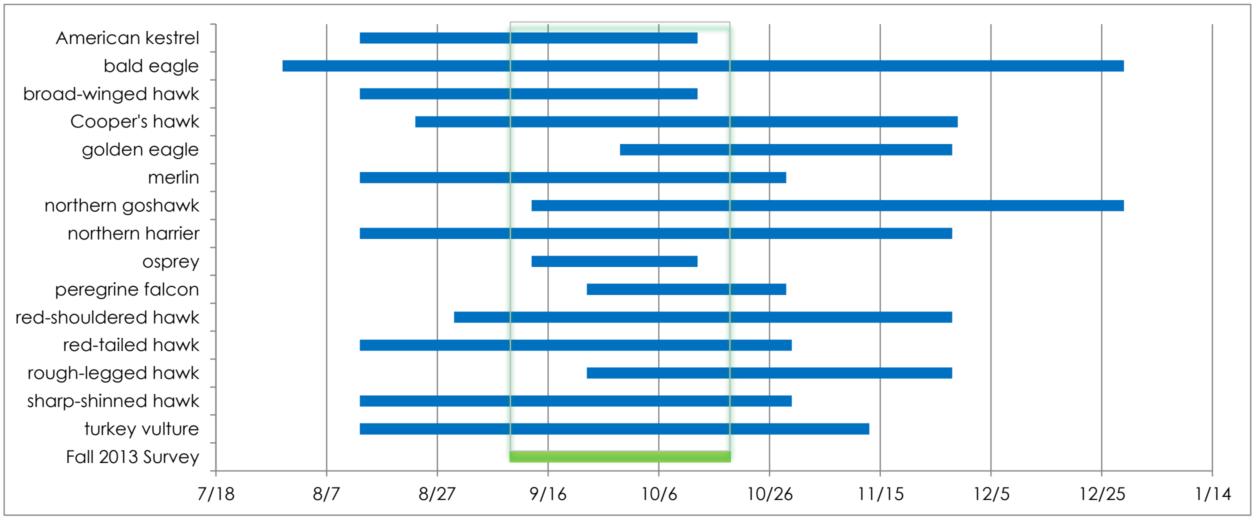


Figure 5-1. Fall 2013 survey timeframe (green box) and raptor species' migration window in the Northeast U.S. (species dates as reported by Wheeler 2003).

5.3.2 Fall 2013 Weather

Seven survey days were characterized with northerly (following) winds; wind direction on other survey days was southerly or variable (Table 5-2). Wind speeds ranged from calm (0 miles per hour [mph]) to strong (13-18 mph). Sky conditions were most often clear to partly cloudy, though a few survey days were overcast or characterized by morning fog (Table 5-2).

Table 5-2. Wind and sky conditions, Weaver Wind Project, fall 2013.

Date	Wind direction	Wind speed code (s)	General weather description
9/11/2013	S	0-1	Fog in AM limited visibility, fog lifting 11am; clear, hazy, hot PM.
9/18/2013	WNW	2	Mostly clear skies.
9/19/2013	N	2	Mostly clear skies.
9/25/2013	N	1-3	Overcast with moderate winds.
10/6/2013	variable	0-2	Clear skies with good visibility, light wind.
10/8/2013	NW	3-4	Sunny with good visibility, strong winds. Following windy and rainy day on 10/7.
10/9/2013	N	0-1	Clear skies, light wind. Frost previous night.
10/19/2013	S	1-4	Overcast with moderate winds.
10/20/2013	NW	2-3	Becoming mostly sunny, light winds.
10/21/2013	NNW	2-4	Clear skies, strong winds.
Wind Speed codes 1 = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph			

5.3.3 Fall 2013 Raptor Observations

Sixty-two raptor observations were documented in fall 2013 (Table 5-1). The seasonal passage rate was 0.89 raptor observations per hour (raptors/hr). Daily passage rates ranged from 0 raptors/hr on 19 October and 20 October, to 3.56 raptors/hr on 11 September (Figure 5-2; Appendix D Table 1).

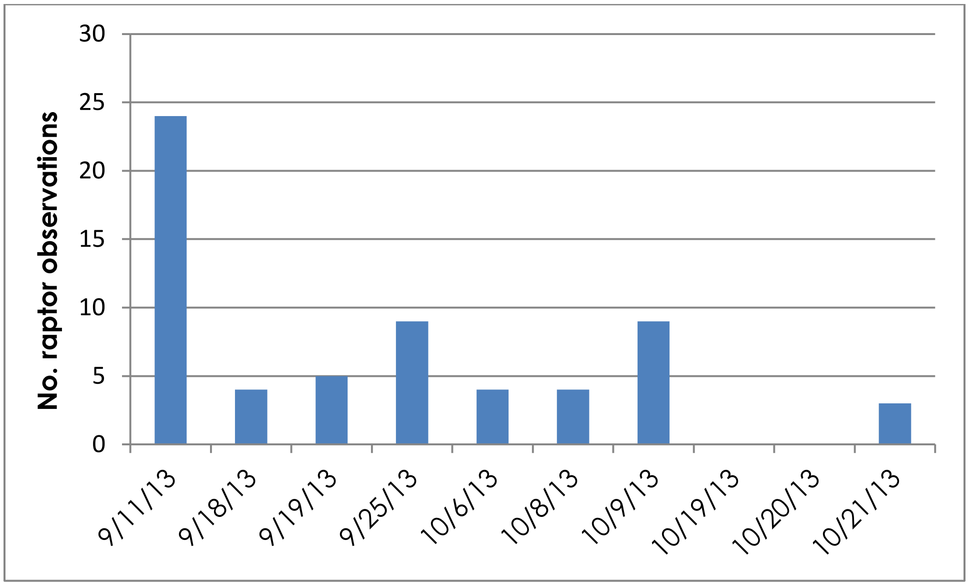


Figure 5-2. Daily raptor observations, Weaver Wind Project, fall 2013.

There were 9 raptor species documented (Table 5-1, Figure 5-3). In addition, there were individuals (unidentified raptor, unidentified accipiter, and unidentified buteo) that could not be identified to species due to the bird being too far from the observer or the bird flying within sight of the observer, but passing too quickly to identify. Turkey vulture (n = 18, 29%) and broad-winged hawk (n = 13, 21%) were the species most commonly observed.

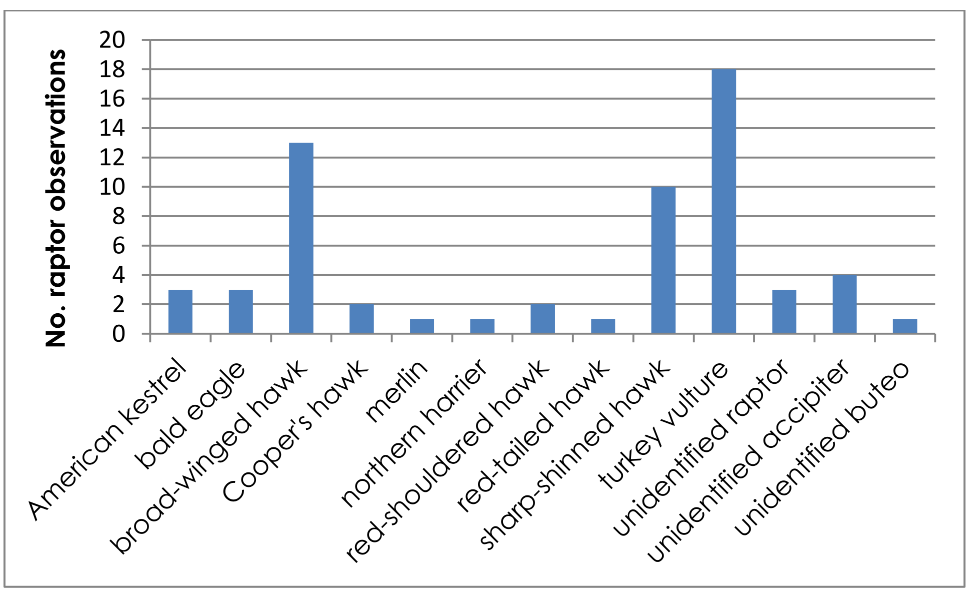


Figure 5-3. Number of raptor observations by species, Weaver Wind Project, fall 2013.

Raptor observations peaked between 12:00 and 1:00 pm, and again between 2:00 to 3:00 pm (Figure 5-4; Appendix D Table 2).

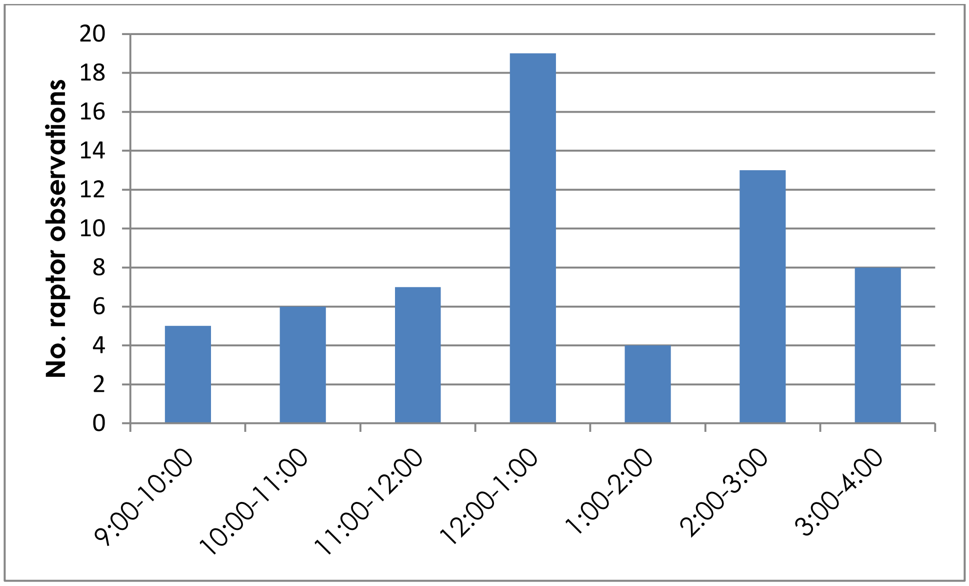


Figure 5-4. Number of observations of raptors per survey hour, Weaver Wind Project, fall 2013.

5.3.4 Fall 2013 Flight Paths and Flight Heights

Of the 62 raptor observations, 48 (77%) occurred within turbine areas. Of the 48 raptor observations in turbine areas, 41 (85% of those in turbine areas) occurred at flight heights below the proposed maximum turbine height (180 m) for at least a portion of their flight (Table 5-3, Figure 5-5; Appendix D Table 3). The average minimum flight height of those observed within turbine areas was 84 m (276 ft). Of the 48 raptors observed within turbine areas, 28 (58%) crossed a ridge in the Project area (Table 5-3). The average minimum flight height of those raptors that crossed a ridge in the Project area was 52 m (171 ft).

Table 5-3. Summary of raptor locations and average minimum flight heights, Weaver Wind Project, fall 2013.

Species	No. outside of turbine areas	No. inside turbine area	No. inside crossed ridge
American kestrel	1	2	
bald eagle	3		
broad-winged hawk		13	5
Cooper's hawk		2	2
merlin		1	1
northern harrier	1		
red-shouldered hawk		2	
red-tailed hawk		1	
sharp-shinned hawk		10	8
turkey vulture	7	11	8
unidentified raptor	1	2	
unidentified accipiter		4	4
unidentified buteo	1		
Total	**14**	**48**	**28**
Percent of Observations	**23%**	**77%**	**58%**
Average minimum flight height (m)	**222**	**84**	**52**

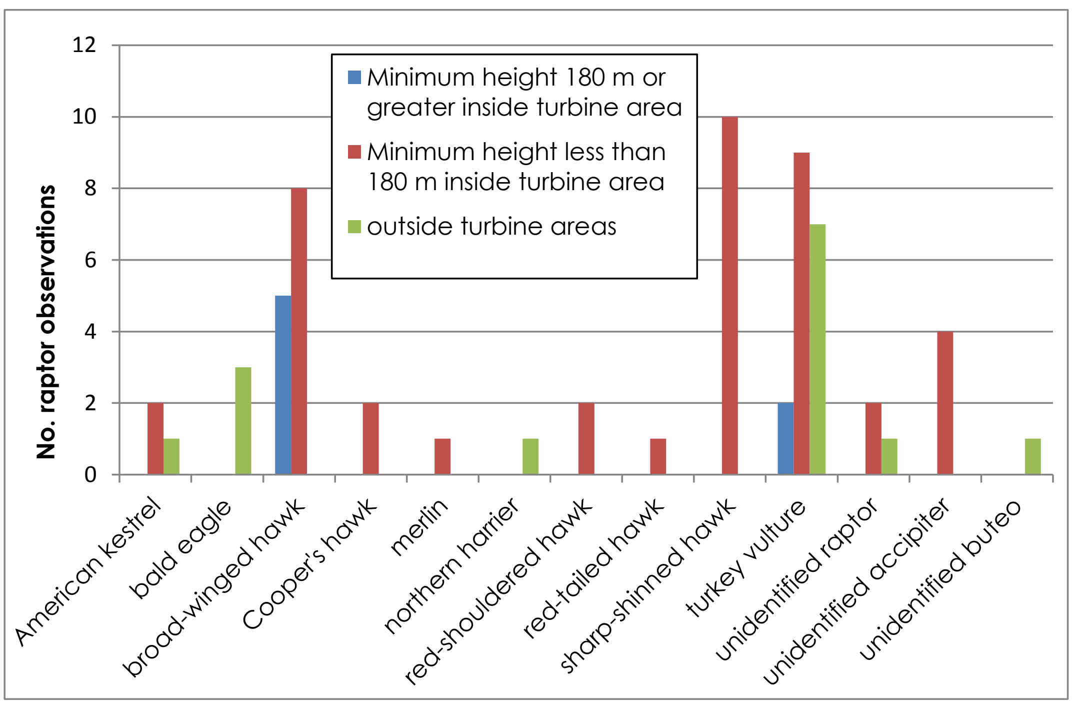


Figure 5-5. Number of raptor observations within turbine areas at heights above and below 180 m, Weaver Wind Project, fall 2013.

5.3.5 Fall 2013 Behaviors

Some raptors exhibited multiple behaviors while inside and outside turbine areas; therefore there are more behavior observations than total raptor observations (Table 5-4). Soaring and/or gliding was the most commonly observed behavior both inside and outside turbine areas (Table 5-4). Few foraging and perched behaviors were observed in turbine areas.

Table 5-4. Number of raptor observations by behavior in study area, Weaver Wind Project, fall 2013.

Behavior	OUTSIDE turbine area	INSIDE turbine area
soaring, gliding	14	27
powered flight	7	18
foraging	0	1
perched	0	3

5.3.6 Fall 2013 Incidental Species

Surveyors recorded 16 non-raptor avian species incidental to surveys (Table 5-5). None were federally or state-threatened or endangered species.

Table 5-5. Non-raptor avian species observed incidentally during raptor surveys, Weaver Wind Project, fall 2014.

Common name	Scientific name
American crow	*Corvus brachyrhynchos*
American goldfinch	*Spinus tristis*
American robin	*Turdus migratorius*
black-capped chickadee	*Poecile atricapillus*
blue jay	*Cyanocitta cristata*
cedar waxwing	*Bombycilla cedrorum*
common raven	*Corvus corax*
common yellowthroat	*Geothlypis trichas*
dark-eyed junco	*Junco hyemalis*
downy woodpecker	*Picoides pubescens*
hairy woodpecker	*Picoides villosus*
northern flicker	*Colaptes auratus*
pileated woodpecker	*Dryocopus pileatus*
ruby-throated hummingbird	*Archilochus colubris*
unidentified passerine	*N/A*
unidentified sparrow	*N/A*
white-throated sparrow	*Zonotrichia albicollis*
yellow-rumped warbler	*Setophaga coronata*

5.4 SPRING 2014 RESULTS

5.4.1 Spring 2014 Survey Effort and Timing

Ten surveys were completed from 21 April to 29 May for a total of 70 survey hours (Table 5-6).

Table 5-6. Survey effort and results summary, Weaver Wind Project, spring 2014.

Range of survey dates	**4/21 to 5/29**
No. survey days	**10**
No. survey hours	70
No. raptor species observed	9
Raptor species observed (common name)	**Scientific name**
American kestrel	*Falco sparverius*
bald eagle	*Haliaeetus leucocephalus*
broad-winged hawk	*Buteo platypterus*
Cooper's hawk	*Accipiter cooperii*
northern harrier	*Circus cyaneus*
osprey	*Pandion haliaetus*
red-tailed hawk	*Buteo jamaicensis*
sharp-shinned hawk	*Accipiter striatus*
turkey vulture	*Cathartes aura*
unidentifed raptor	*n/a*
unidentified accipter	*n/a*
unidentified buteo	*n/a*
Total no. observations of raptors	113
No. raptor observations/hour	1.61
Total no. observations of raptors within turbine areas (percent of total observations)	60 (53%)
Total no. of observations of raptors seen in turbine area and below 180 m height (percent of obs. in turbine areas)	60 (100%)

The spring 2014 survey timeframe overlapped with the known migration window for the 15 raptor species which typically occur in the northeast during migration (Figure 5-6).

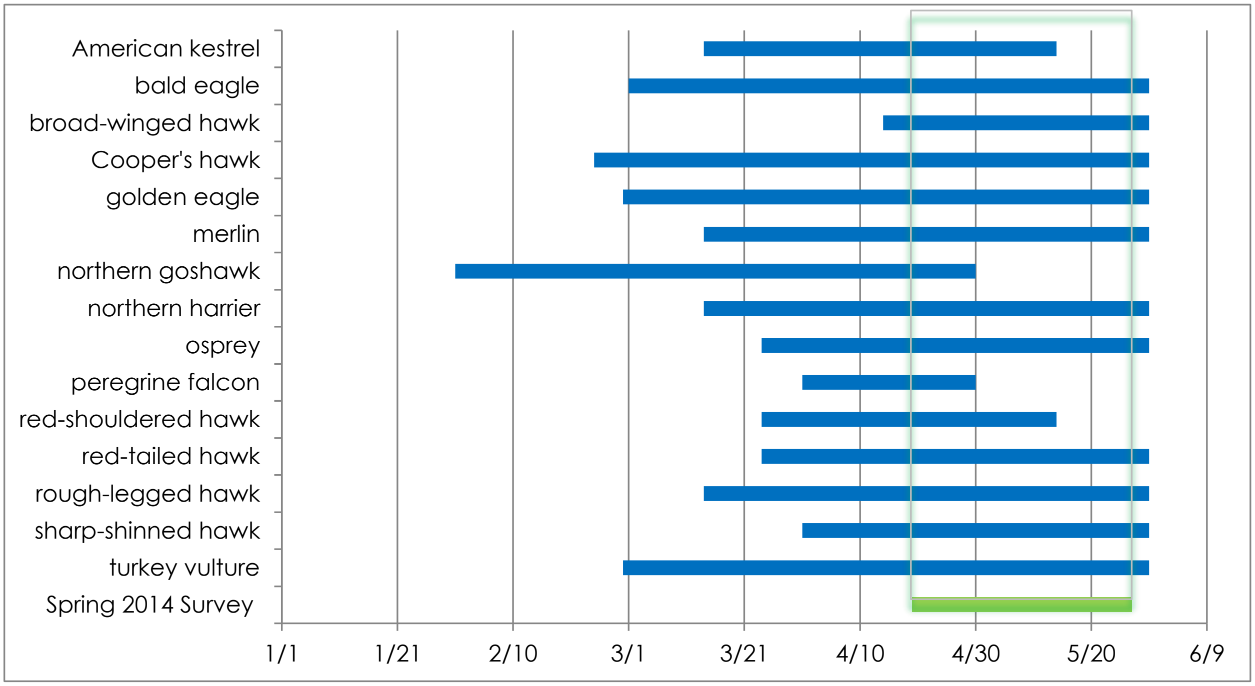


Figure 5-6. Spring 2014 survey timeframe (green box) and raptor species' migration window in the Northeast U.S. (species dates as reported by Wheeler 2003).

5.4.2 Spring 2014 Weather

Wind direction during the spring 2014 surveys was generally variable (Table 5-7). Wind speeds ranged from calm (0 mph) to strong (13-18 mph), but were generally 4-7 mph or less. Sky conditions were most often clear to partly cloudy, though a few survey days were overcast and only 1 survey day was characterized by periods of mist or drizzle (Table 5-7).

Table 5-7. Wind and sky conditions, Weaver Wind Project, spring 2014.

Date	Wind direction	Wind speed code (s)	General weather description
4/21/2014	S	2-4	partly cloudy to overcast
4/25/2014	NW	2-3	mostly sunny
5/7/2014	NW	2	mostly sunny
5/8/2014	NW	2	clear
5/9/2014	variable	2	clear
5/12/2014	variable	1-2	clear
5/13/2014	variable	1-2	clear
5/21/2014	variable	0-2	periods of mist and drizzle
5/28/2014	E	2	overcast
5/29/2014	variable	0-1	clear
Wind Speed codes 1 = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph			

5.4.3 Spring 2014 Raptor Observations

There were 113 raptor observations documented during spring 2014 (Table 5-6). The seasonal passage rate was 1.61 raptor observations per hour (raptors/hr). Daily passage rates ranged from 0 raptors/hr on 28 May to 4.57 raptors/hr on 21 April (Figure 5-7; Appendix D Table 4).

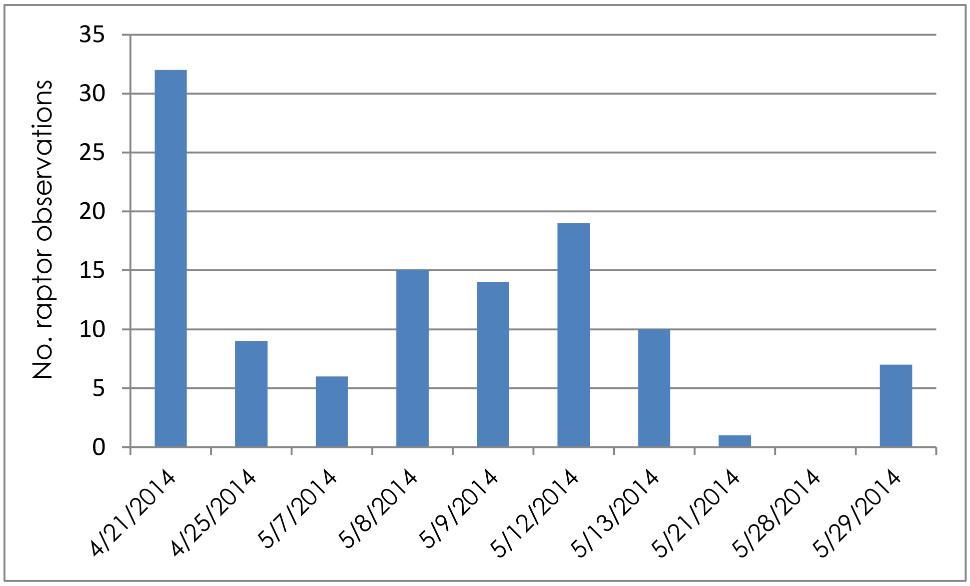


Figure 5-7. Daily raptor observations, Weaver Wind Project, spring 2014.

There were 9 raptor species documented (Table 5-6, Figure 5-8). In addition, there were individuals (unidentified raptor, unidentified accipiter, and unidentified buteo) that could not be identified to species due to the bird being too far from the observer or the bird flying within sight of the observer, but passing too quickly to identify. Turkey vulture (n = 29, 26%) and broad-winged hawk (n = 24, 21%) were the species most commonly observed.

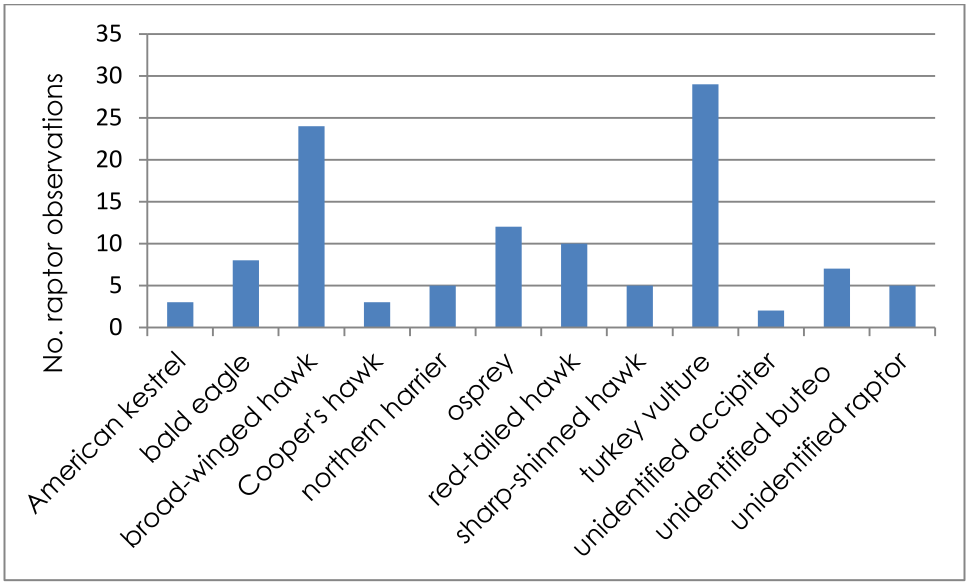


Figure 5-8. Number of raptor observations by species, Weaver Wind Project, spring 2014.

There was no pronounced hourly peak in raptor activity, as was observed during the fall surveys; rather, raptor activity occurred relatively evenly across survey hours (Figure 5-9; Appendix D Table 5).

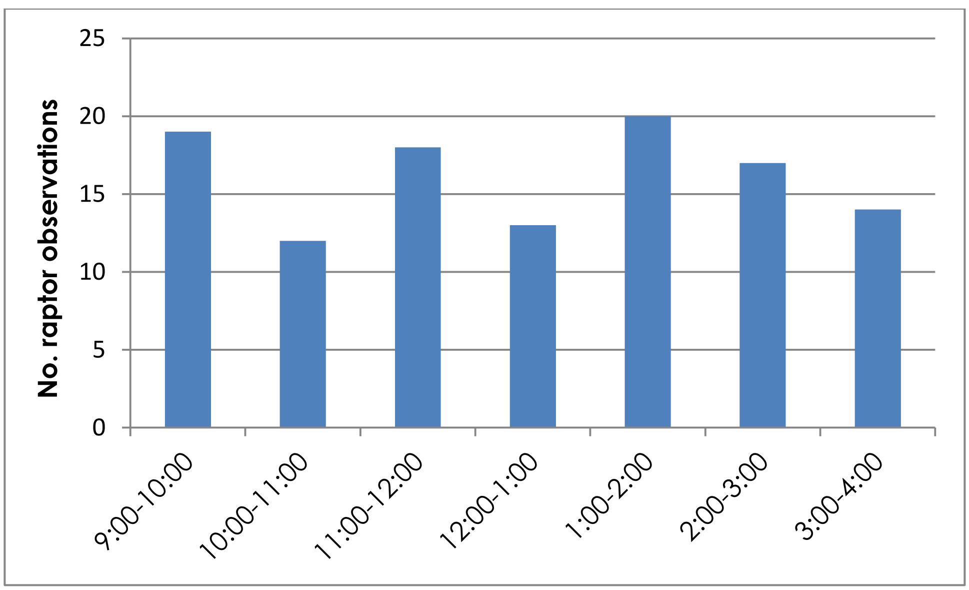


Figure 5-9. Number of observations of raptors per survey hour, Weaver Wind Project, spring 2014.

5.4.4 Spring 2014 Flight Paths and Flight Heights

Of the 113 raptor observations, 60 (53%) occurred within turbine areas. Of the 60 raptor observations in turbine areas, 60 (100%) occurred at flight heights below the proposed maximum turbine height (180 m) for at least a portion of their flight (Table 5-8, Figure 5-10; Appendix D Table 6). The average minimum flight height of those observed within turbine areas was 61 m (200 ft). Of the 60 raptors observed within turbine areas, 54 (90% of those inside turbine areas) crossed a ridge in the Project area (Table 5-8). The average minimum flight height of those raptors that crossed a ridge in the Project area was 57 m (187 ft).

Table 5-8. Summary of raptor locations and average minimum flight heights, Weaver Wind Project, spring 2014.

Species	No. outside of turbine areas	No. inside turbine area	No. inside crossed ridge
American kestrel	1	2	2
bald eagle	7	1	1
broad-winged hawk	10	14	12
Cooper's hawk	1	2	2
northern harrier		5	5
osprey	8	4	4
red-tailed hawk	3	7	5
sharp-shinned hawk	1	4	4
turkey vulture	15	14	13
unidentified accipiter		2	2
unidentified buteo	4	3	2
unidentified raptor	3	2	2
Total	**53**	**60**	**54**
Percent of Observations	**47%**	**53%**	**90%**
Average minimum flight height (m)	**109**	**61**	**57**

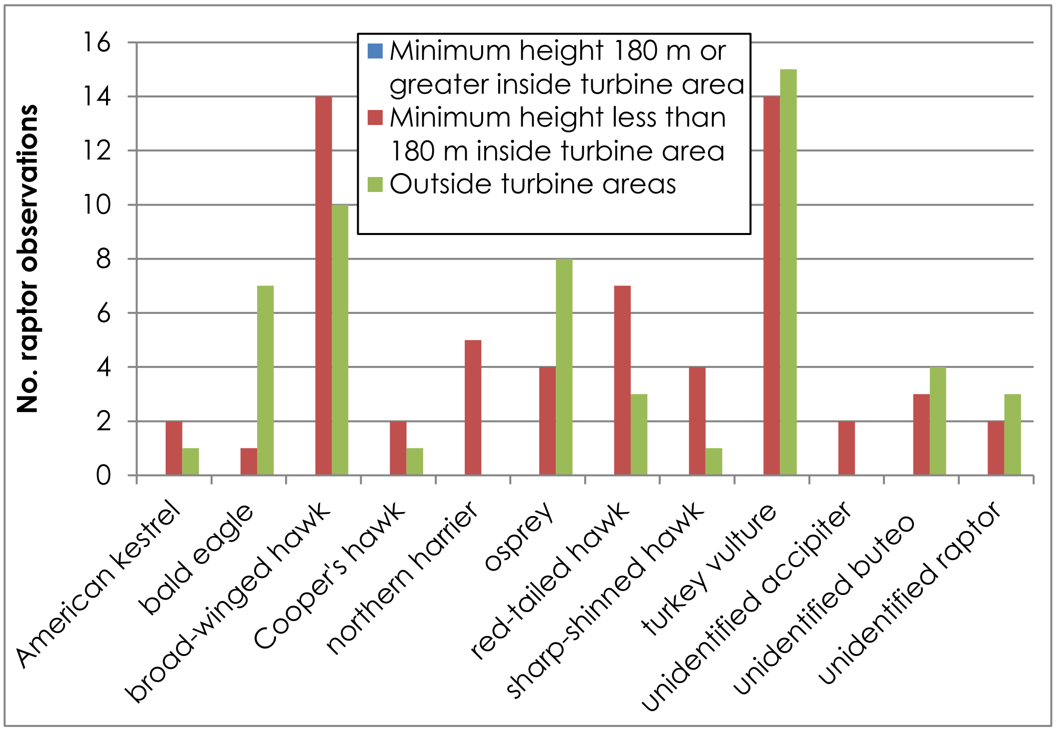


Figure 5-10. Number of raptor observations within turbine areas at heights above and below 180 m, Weaver Wind Project, spring 2014.

5.4.5 Spring 2014 Behaviors

Some raptors exhibited multiple behaviors while inside and outside turbine areas; therefore, there are more behavior observations than total raptor observations (Table 5-9). Soaring and/or gliding was the most commonly observed behavior both inside and outside turbine areas (Table 5-9). Minimal foraging and no perched behaviors were observed in turbine areas.

Table 5-9. Number of raptor observations by behavior in study area, Weaver Wind Project, spring 2014.

Behavior	OUTSIDE turbine area	INSIDE turbine area
soaring, gliding	93	51
powered flight	8	9
foraging	2	1
perched	0	0

5.4.6 Spring 2014 Incidental Species

Surveyors recorded 35 non-raptor avian species incidental to surveys (Table 5-10). None were federally or state-threatened or endangered species.

Table 5-10. Non-raptor avian species observed incidentally during raptor surveys, Weaver Wind Project, spring 2014.

Common name	Species name
alder flycatcher	*Empidonax alnorum*
American crow	*Corvus brachyrhynchos*
American redstart	*Setophaga ruticilla*
American robin	*Turdus migratorius*
barred owl	*Strix varia*
black-and-white warbler	*Mniotilta varia*
blackburnian warbler	*Dendroica fusca*
black-capped chickadee	*Poecile atricapillus*
black-throated blue warbler	*Setophaga caerulescens*
black-throated green warbler	*Dendroica virens*
blue jay	*Cyanocitta cristata*
chestnut-sided warbler	*Setophaga pensylvanica*
chimney swift	*Chaetura pelagica*
common raven	*Corvus corax*
dark-eyed junco	*Junco hyemalis*
double-crested cormorant	*Phalacrocorax auritus*
eastern phoebe	*Sayornis phoebe*
golden-crowned kinglet	*Regulus satrapa*
hairy woodpecker	*Picoides villosus*
hermit thrush	*Catharus guttatus*
least flycatcher	*Empidonax minimus*
magnolia warbler	*Setophaga magnolia*
mourning dove	*Oporornis philadelphia*
Nashville warbler	*Oreothlypis ruficapilla*
northern flicker	*Colaptes auratus*
northern parula	*Setophaga americana*
palm warbler	*Dendroica palmarum*
pileated woodpecker	*Dryocopus pileatus*
rose-breasted grosbeak	*Pheucticus ludovicianus*
ruby-throated hummingbird	*Archilochus colubris*
song sparrow	*Melospiza melodia*
tree swallow	*Spizella arborea*
unidentified vireo	*n/a*
unidentified waterfowl	*n/a*
white-throated sparrow	*Zonotrichia albicollis*
yellow-bellied sapsucker	*Sphyrapicus varius*
yellow-rumped warbler	*Dendroica coronata*

5.5 FALL 2014 RESULTS

5.5.1 Fall 2014 Survey Effort and Timing

Ten surveys were completed from 18 September to 11 November for a total of 70 survey hours (Table 5-11).

Table 5-11. Survey effort and results summary, Weaver Wind Project, fall 2014.

Range of survey dates	**9/18–11/11**
No. survey days	10
No. survey hours	70
No. raptor species observed	11
Raptor species observed (common name)	**Scientific name**
American kestrel	*Falco sparverius*
bald eagle	*Haliaeetus leucocephalus*
broad-winged hawk	*Buteo platypterus*
Cooper's hawk	*Accipiter cooperii*
golden eagle	*Aquila chrysaetos*
merlin	*Falco columbarius*
osprey	*Pandion haliaetus*
peregrine falcon	*Falco peregrinus*
red-tailed hawk	*Buteo jamaicensis*
sharp-shinned hawk	*Accipiter striatus*
turkey vulture	*Cathartes aura*
unidentified buteo	NA
unidentified falcon	NA
unidentified raptor	NA
unidentified accipiter	NA
Total no. observations of raptors	88
No. raptor observations/hour	1.26
Total no. observations of raptors within turbine area (1/4 mile buffer)	59 (67%)
Total no. of observations of raptors seen in turbine area and below 180 m height (percent of obs. in turbine areas)	57 (97%)

The fall 2014 survey timeframe overlapped with the known migration window for the 15 raptor species which typically occur in the northeast during migration (Figure 5-11).

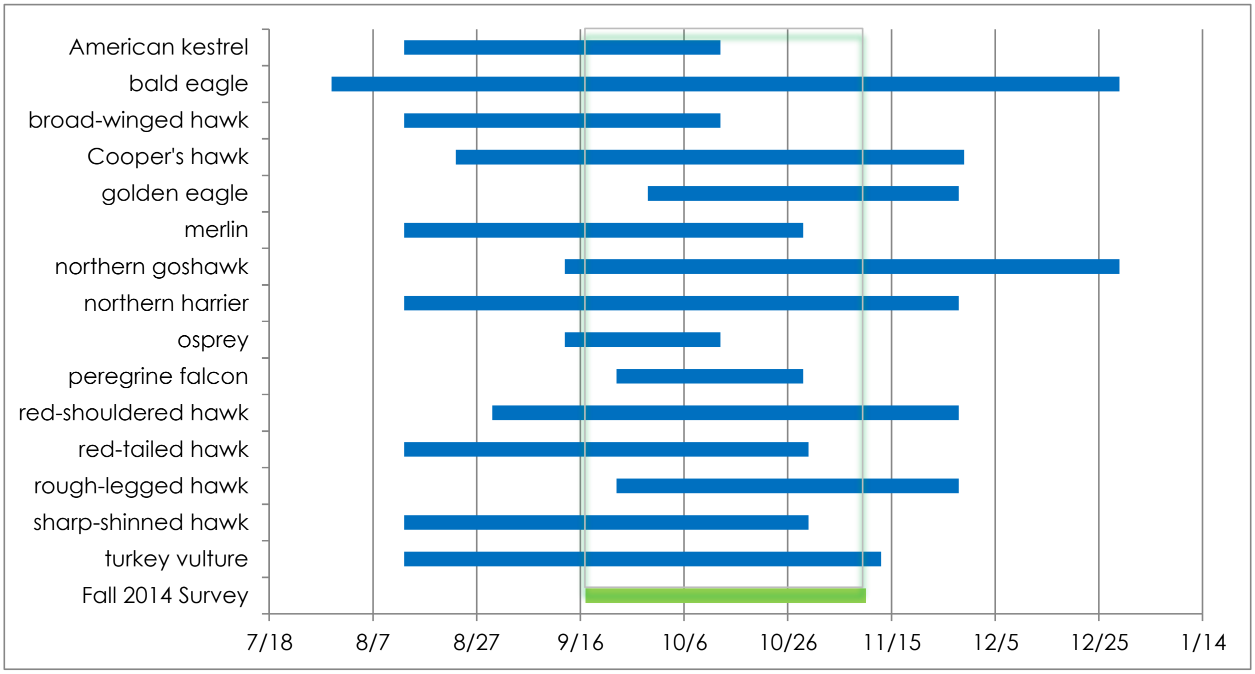


Figure 5-11. Fall 2014 survey timeframe (green box) and raptor species' migration window in the Northeast U.S. (species dates as reported by Wheeler 2003).

5.5.2 Fall 2014 Weather

Wind direction during the fall 2014 surveys was generally variable (Table 5-12). Wind speeds ranged from calm (0 miles per hour [mph]) to strong (13-18 mph). Sky conditions ranged from clear to cloudy; with one day characterized by clouds and a couple hours of drizzle (Table 5-12).

Table 5-12. Wind and sky conditions, Weaver Wind Project, fall 2014.

Date	Wind direction	Wind speed code (s)	General Weather Description and Pressure
9/18/2014	NW	2, 3, 4	clear; high pressure passing
9/21/2014	SE	2, 3	cloudy with some drizzle from 9 to 11; high pressure passing
10/2/2014	NE	2	clear to partly cloudy; no pressure
10/6/2014	S, W	2, 3	clear to partly cloudy; no pressure
10/13/2014	W, SW	2	clear; high pressure leaving
10/20/2014	NW	2, 3, 4	clear to partly cloudy; high pressure approaching
10/28/2014	variable	0, 1	clear to cloudy; low pressure approaching
10/30/2014	NW	1, 2	clear to cloudy; high pressure approaching
11/4/2014	W	0, 1	cloudy; pressure data unavailable
11/11/2014	S	2, 3	clear; presure data unavailable
Wind Speed codes 1 = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph			

5.5.3 Fall 2014 Raptor Observations

Eighty-eight raptor observations were documented in fall 2014 (Table 5-11). The seasonal passage rate was 1.26 raptor observations per hour (raptors/hr). Daily passage rates ranged from 0.29 raptors/hr on 4 November, to 3.00 raptors/hr on 18 September (Figure 5-12; Appendix D Table 7).

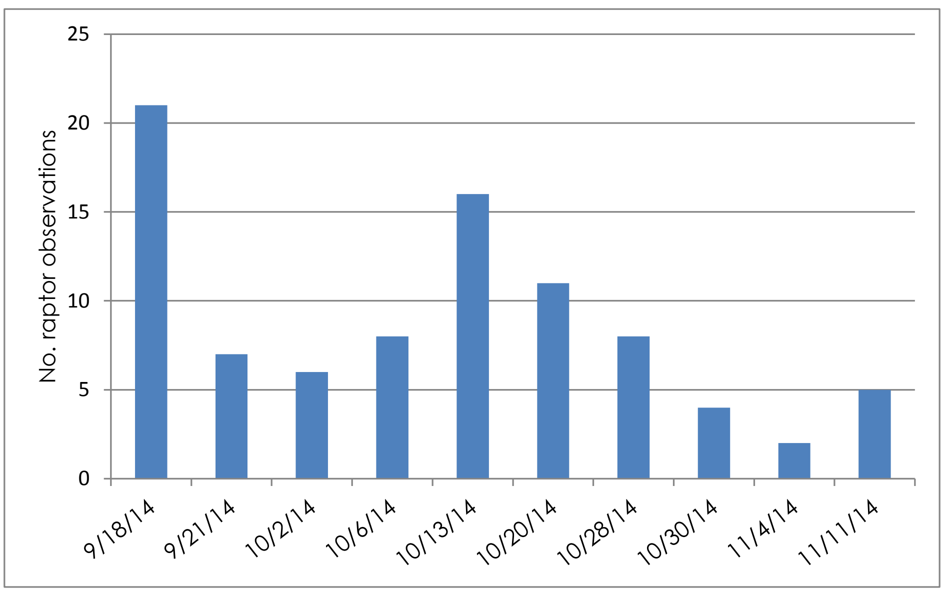


Figure 5-12. Daily raptor observations, Weaver Wind Project, fall 2014.

There were 11 raptor species documented (Table 5-11, Figure 5-13). In addition, there were individuals (unidentified raptor, unidentified accipiter, unidentified buteo, and unidentified falcon) that could not be identified to species due to the bird being too far from the observer or the bird flying within sight of the observer, but passing too quickly to identify. Broad-winged hawk (n = 16, 18%) and red-tailed hawk (n = 15, 17%) were the species most commonly observed.

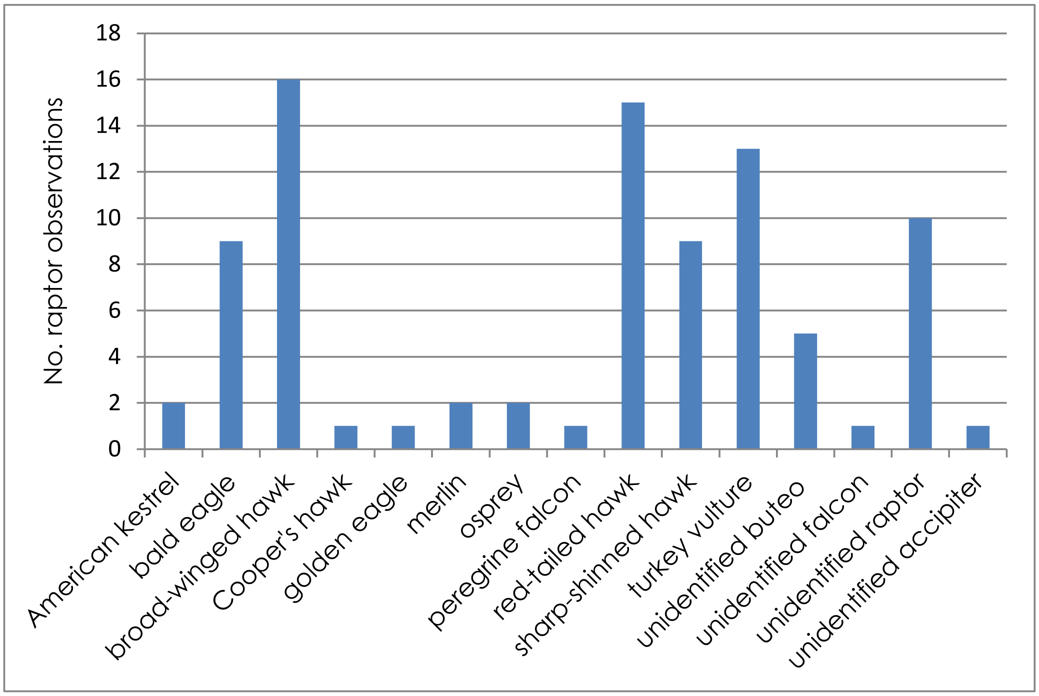


Figure 5-13. Number of raptor observations by species, Weaver Wind Project, fall 2014.

Raptor observations were highest between the hours of 10:00 am and 3:00 pm (Figure 5-14; Appendix D Table 8).

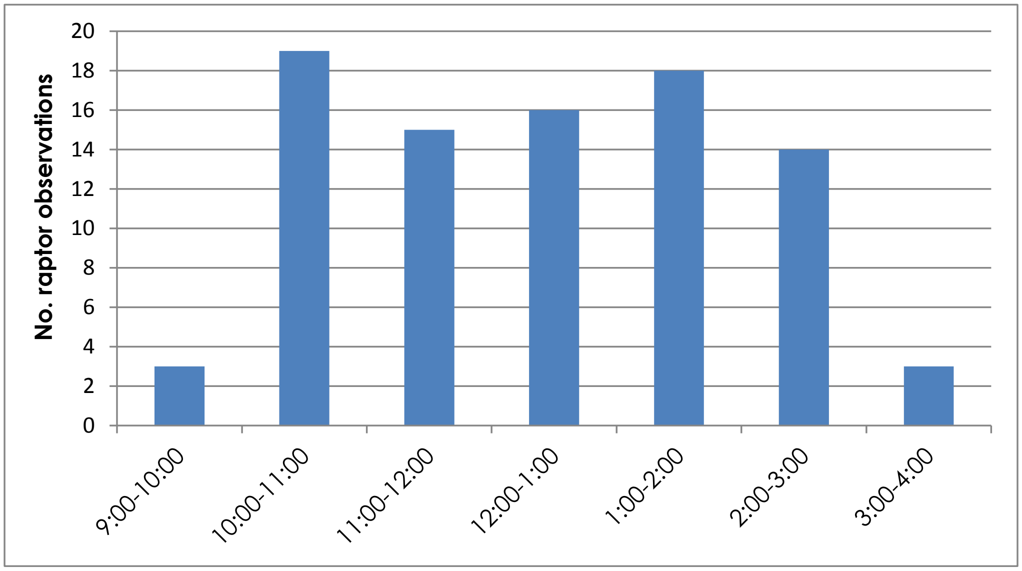


Figure 5-14. Number of observations of raptors per survey hour, Weaver Wind Project, fall 2014.

5.5.4 Fall 2014 Flight Paths and Flight Heights

Of the 88 raptor observations, 59 (67%) occurred within turbine areas. Of the 59 raptor observations in turbine areas, 57 (97% of those in turbine areas) occurred at flight heights below the proposed maximum turbine height (180 m) for at least a portion of their flight (Table 5-13, Figure 5-15; Appendix D Table 9). The average minimum flight height of those observed within turbine areas was 72 m (236 ft). Of the 59 raptors observed within turbine areas, 46 (78%) crossed a ridge in the Project area (Table 5-13). The average minimum flight height of those raptors that crossed a ridge in the Project area was 73 m (240 ft).

Table 5-13. Summary of raptor locations and average minimum flight heights, Weaver Wind Project, fall 2014.

Species	No. outside of turbine areas	No. inside turbine area	No. inside crossed ridge
American kestrel		2	2
bald eagle	4	5	6
broad-winged hawk	10	6	5
Cooper's hawk		1	1
golden eagle		1	1
merlin		2	2
osprey	2		
peregrine falcon		1	1
red-tailed hawk	1	14	10
sharp-shinned hawk		9	8
turkey vulture	5	8	5
unidentified buteo	4	1	1
unidentified falcon		1	
unidentified raptor	2	8	4
unidentified accipiter	1		
Total	**29**	**59**	**46**
Observations	**33%**	**67%**	**78%**
Average minimum flight height (m)	**113**	**72**	**73**

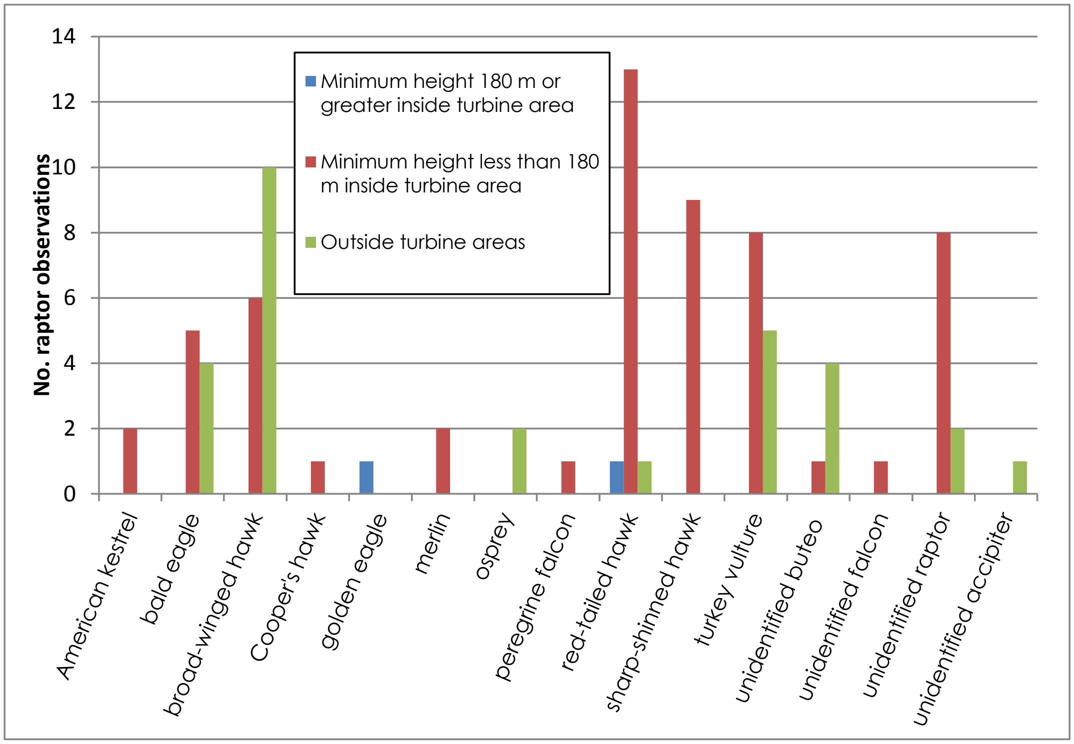


Figure 5-15. Number of raptor observations within turbine areas at heights above and below 180 m, Weaver Wind Project, fall 2014.

5.5.5 Fall 2014 Behaviors

Some raptors exhibited multiple behaviors while inside and outside turbine areas; therefore there are more behavior observations than total raptor observations (Table 5-14). Soaring and/or gliding was the most commonly observed behavior both inside and outside turbine areas (Table 5-14). Few foraging and perched behaviors were observed in turbine areas.

Table 5-14. Number of raptor observations by behavior in study area, Weaver Wind Project, fall 2014.

Behavior	OUTSIDE turbine area	INSIDE turbine area
soaring, gliding	60	56
powered flight	4	8
foraging	2	1
perched	0	2

5.5.6 Fall 2014 Incidental Species

Surveyors recorded 21 non-raptor avian species incidental to surveys (Table 5-15). None were federally or state-threatened or endangered species.

Table 5-15. Non-raptor avian species observed incidentally during raptor surveys, Weaver Wind Project, fall 2014.

Common name	Scientific name
American crow	*Corvus brachyrhynchos*
American goldfinch	*Spinus tristis*
American robin	*Turdus migratorius*
black-capped chickadee	*Poecile atricapillus*
black-throated green warbler	*Dendroica virens*
blue jay	*Cyanocitta cristata*
common grackle	*Quiscalus quiscula*
common raven	*Corvus corax*
dark-eyed junco	*Junco hyemalis*
downy woodpecker	*Picoides pubescens*
European starling	*Sturnus vulgaris*
hairy woodpecker	*Picoides villosus*
magnolia warbler	*Setophaga magnolia*
northern cardinal	*Cardinalis cardinalis*
northern flicker	*Colaptes auratus*
pileated woodpecker	*Dryocopus pileatus*
red-breasted nuthatch	*Sitta canadensis*
ruffed grouse	*Bonasa umbellus*
unidentified gull	*NA*
unidentified waterfowl	*NA*
white-breasted nuthatch	*Sitta carolinensis*
white-throated sparrow	*Zonotrichia albicollis*
yellow-rumped warbler	*Setophaga coronata*

5.6 DISCUSSION

Fall 2013 and spring and fall 2014 raptor migration surveys followed standard protocols used in the region for sampling raptor species composition and activity at proposed wind developments. Each seasonal survey overlapped with the migration window of the 15 raptor species that typically occur in the northeast during migration. The species detected during each seasonal survey are species regularly observed in the region, with turkey vulture and broad-winged hawk being the 2 most commonly observed species during the fall 2013 and spring 2014 survey seasons. Broad-winged hawk and red-tailed hawk were the species most commonly observed during the fall 2014 survey.

In addition to documenting migrating raptors, raptor migration surveys also targeted the potential use of the Project area by great blue herons (*Ardea herodias)* as described in the Weaver Work Plan (June 2014). No great blue herons were observed using the areas within the proposed turbine locations during any on-site surveys.

Methods and results were similar to pre-construction surveys conducted at the nearby Bull Hill Wind and Hancock Wind Projects (Table 5-16).

Table 5-16. Seasonal passage rates at the Bull Hill, Hancock, and Weaver wind Projects.

Season	Average passage rate (raptors/hr)
Bull Hill	
Summer 2009	0.52
Fall 2009	1.43
Spring 2010	0.53
Hancock	
Fall 2012	2.28
Weaver	
Fall 2013	0.86
Spring 2014	1.61
Fall 2014	1.26

In general, raptor migration activity is highest on fair days with thermal development, winds generally from a following direction, and can be most pronounced for a few days following the passage of a weather front (Stantec unpublished). However, activity of migrant and local raptors can occur over a range of weather conditions, and flight heights and flight paths may vary in different conditions (Stantec unpublished). At Weaver, raptor activity and passage rates varied daily and seasonally, and were likely influenced by stochastic factors including weather and visibility. Raptor passage rates at the Project were comparable to those documented at Bull Hill Wind Project and Hancock Wind Project, and other projects in the northeast.

Flight heights and flight paths of migrant raptors making long-distance flights are affected by wind speed and direction, air temperature and cloud cover which influence updraft and thermal development. The flight paths and flight heights of local raptors are also affected by these variables as local raptors will fly lower in strong head winds, and will also take advantage of thermal development for more localized movements (Stantec unpublished). Raptor behaviors in the Project area during each survey season generally consisted of soaring and/or gliding or powered flight, with minimal foraging or perching behaviors observed.

6.0 EAGLE USE SURVEYS

6.1 INTRODUCTION

The closest occupied bald eagle (*Haliaeetus leucocephalus*) nest to the nearest proposed turbine location at the Project is nest #360A on Molasses Pond. This nest is approximately 3.2 miles from the nearest turbine location (Stantec 2014). There are 4 occupied bald eagle nests located within 10 miles of the Weaver turbine locations (Stantec 2014). The single historical nest on Spectacle Pond (#221C) was not located in 2014, was assumed to have fallen down, and no new nest location around the perimeter of the pond was found (Stantec 2014).

Because the Project has 4 occupied bald eagle nests within 10 miles of proposed turbine locations, Stantec conducted eagle point count surveys consistent with the Work Plan (18 June 2014) and the USFWS Eagle Conservation Plan (ECP) Guidance.

6.2 METHODS

Point count surveys consisted of 2-hour visual surveys at 6 locations[6] within the Project area. Each location surveyed an area of 2 square kilometers (800-m radius circle). To date, Stantec has conducted 9 surveys from 22 April to 9 October; surveys are on-going and Stantec will complete18 surveys in 1 year with surveys ending in April 2015. Surveys are conducted once approximately every 3 weeks. This report includes results of the first 9 surveys.

Point count locations were chosen based on view shed and proximity to proposed turbines (all point count locations are within 1 km of proposed turbines). Each location was mapped using a Global Positioning Systems (GPS) unit. Since eagles are active in a range of weather conditions, surveys occurred in all weather conditions except when visibility was very poor. Survey efforts targeted all hours of daylight. The starting location changed each survey cycle to enable sampling of each plot during a range of daylight hours. During each 2-hour point count survey a Stantec biologist scanned the sky by eye and with binoculars to search for any flying eagles. If an eagle was observed, biologists recorded on Stantec datasheets information including location of the eagle, age and sex if known, time of observation, and for each minute of observation, the bird's flight height, behavior, and location (i.e., inside or outside the survey area).

Though eagles were the target species, Stantec biologists recorded all raptors observed during eagle point count surveys. Stantec also recorded any incidental observations of eagles observed outside of survey hours such as while traveling between survey points or while conducting other biological surveys.

6.3 RESULTS

Between 22 April and 9 October, Stantec conducted 9 surveys and 108 hours of observation for eagles. All 6 point count locations were surveyed each survey cycle. Weather conditions ranged from clear to overcast with periods of drizzle. Surveys were conducted in a range of pressure conditions (e.g., stalled high, low to high, stalled low).

Stantec recorded 25 total eagle minutes and 17 eagle minutes inside the survey areas AND in the approximate rotor-swept zone of the turbines (i.e., 45 –180 m; Table 6-1). The total eagle passage rate (eagle minutes per hour) was 0.004. The eagle passage rate for eagle minutes observed in the survey areas and in the approximate rotor-swept zone was 0.003.

[6] Per the April 2013 ECP Guidelines, the number of proposed point count locations was determined by calculating the entire turbine area including a 1-km buffer around turbines, calculating 30% of the area, and dividing by 2 (to account for the 2 square-kilometer plots). Point count locations were based on consultation with USFWS on 16 April 2014 and approved by USFWS on 28 April 2014.

Table 6-1. Summary of eagle minutes and eagle exposure-minutes, Weaver Wind Project, spring 2014

Range of survey dates	4/22–10/9
Number of point count plots	6
Number of surveys completed	9
Number of survey hours (min)	108 (6,480)
Total eagle-minutes observed	25
Total eagle passage rate (eagle minutes per hour)	0.004
Total eagle exposure-minutes observed in rotor-swept area (RSA)* inside plot boundaries (% of total eagle minutes)	17 (68%)
Average eagle passage rate in RSA (exposure-minutes per hour)	0.003
*Includes flight heights of 40–180 m agl and those observations within the 800 m survey plot area.	

Stantec recorded 9 eagle observations: 7 bald eagles and 2 eagles that could not be identified to species (i.e., it could not be determined if the eagle was a bald or golden eagle (*Aquila chrysaetos*)due to the distance of the bird from the observer, lighting, or short duration of the observation).

Eagles were observed at 3 out of the 6 survey locations: Points 7, 32, and 39 (Table 6-2). The greatest number of eagle minutes was recorded at Point 32 (15 minutes), which is the raptor and radar survey location. Observations at this location occurred in each month surveyed except June and August.

Table 6-2. Summary of eagle minutes, eagle exposure-minutes and passage rates by survey plot, Weaver Wind Project, 2014

Point count number	# of survey hours	Total eagle minutes observed	Number of eagle exposure-minutes observed inside RSA*	Total passage rate (eagle minutes/hr)	Passage rate within RSA (exposure-minutes/hr)	Dates of eagle observations
7	18	6	2	0.006	0.002	6 Aug, 9 Oct
26	18	0	0	0	0	NA
32	18	15	14	0.014	0.013	25 Apr, 12 May, 18 July, 17 Sep (2 indvs.)
34	18	0	0	0	0	NA
39	18	4	1	0.004	0.001	24 Apr, 17 Sep
44	18	0	0	0	0	NA
Total	**108**	**25**	**17**	**0.004**	**0.003**	8 days (9 indvs.)
* Includes flight heights of 45–180 m agl and those observations within the 800-m survey plot area						

6.4 DISCUSSION

Eagle use at the Project from 22 April to 9 October has been greatest at point count 32. Sixty-eight percent of total eagle minutes have been observed within survey areas and the rotor-swept zone. Relative to the total hours of survey, eagle use at the Project during the period from April to October 2014 has been low.

7.0 REFERENCES

Able, K.P. 1973. The role of weather variables and flight direction in determining the magnitude of nocturnal migration. Ecology 54(5):1031–1041.

Alerstam, T. 1990. Bird Migration. Cambridge University Press, Cambridge, United Kingdom.

Arnett, E. B., J. P. Hayes, and M. M. P. Huso. 2006. An evaluation of the use of acoustic monitoring to predict bat fatality at a proposed wind facility in south central Pennsylvania. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Bingman, V.P., K.P. Able, and P. Kerlinger. 1982. Wind drift, compensation, and the use of landmarks by nocturnal bird migrants. Animal Behavior 30:49–53.

Cooper, B.A., R.H. Day, R.J. Ritchie, and C.L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 62:367–377.

Fiedler, J. K. 2004. Assessment of bat mortality and activity at Buffalo Mountain Windfarm, eastern Tennessee. Thesis, University of Tennessee, Knoxville, Tennessee, USA.

Gauthreaux, S.A., Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187–204.

Gauthreaux, S.A., Jr., and K.P. Able. 1970. Wind and the direction of nocturnal songbird migration. Nature 228:476–477.

Harmata, A., K. Podruzny, J. Zelenak, and M. Morrison. 1999. Using marine surveillance radar to study bird movements and impact assessment. Wildlife Society Bulletin 27(1):44–52.

Hassler, S.S., R.R. Graber, and F.C. Bellrose. 1963. Fall migration and weather, a radar study. The Wilson Bulletin 75(1):56–77.

Hayes, J. P. 1997. Temporal variation in activity of bats and the design of echolocation-monitoring studies. Journal Of Mammalogy 78:514-524.

Hayes, J.P. 2000. Assumptions and practical considerations in the design and interpretation of echolocation-monitoring studies. Acta Chiropterologica 2(2):225-236.

Kunz, T.H., E.B. Arnett, B.P. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. Journal of Wildlife Management 71:2449-2486.

Maine Department of Inland Fisheries and Wildlife. 2005. Maine's Comprehensive Wildlife Conservation Strategy. Augusta, Maine.

Maine Department of Inland Fisheries and Wildlife. 2014. Curtailment Policy and Wind Power Preconstruction Study Recommendations. April 2014.

Maine Department of Fisheries and Wildlife (MDIFW). 2014. Endangered and threatened Wildlife. <http://www.maine.gov/ifw/wildlife/endangered>. Accessed 16 October 2014.

Reynolds, D.S. 2006. Monitoring the potential impacts of a wind development site on bats in the Northeast. Journal of Wildlife Management 70(5):1219 – 1227.

Richardson, W.J.1972. Autumn migration and weather in eastern Canada: a radar study. American Birds 26(1):10–16.

Stantec 2014. Spring 2014 Aerial Bald Eagle Nest Survey – Bull Hill, Hancock, and Weaver Wind Projects. Prepared for First Wind. 2 September 2014.

Wheeler, Brian K. 2003. Raptors of Eastern North America. Princeton University Press, Princeton, New Jersey.

Whitaker, J. O., and W. J. Hamilton. 1998. Mammals of the Eastern United States. Cornell University Press, U.S.A.

Appendix A BAT ACOUSTIC SURVEY DETECTOR TABLES

Appendix A Table 1. Summary of acoustic bat data and weather during each survey night at the Met 1 High detector, Weaver Wind Project, 2014.

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
04/22/13	1												**0**	5	7
04/23/13	1												**0**	11	2
04/24/13	1												**0**	9	1
04/25/13	1												**0**	5	3
04/26/13	1												**0**	4	3
04/27/13	1												**0**	8	4
04/28/13	1												**0**	8	2
04/29/13	1												**0**	4	1
04/30/13	1												**0**	5	3
05/01/13	1												**0**	4	7
05/02/13	1												**0**	5	8
05/03/13	1												**0**	6	8
05/04/13	1												**0**	7	5
05/05/13	1												**0**	6	6
05/06/13	1												**0**	6	6
05/07/13	1												**0**	5	8
05/08/13	1												**0**	6	7
05/09/13	1												**0**	9	9
05/10/13	1												**0**	7	13
05/11/13	1		1										**1**	5	10
05/12/13	1												**0**	5	6
05/13/13	1												**0**	5	6
05/14/13	1												**0**	5	8
05/15/13	1												**0**	7	13
05/16/13	1												**0**	8	12
05/17/13	1												**0**	4	10
05/18/13	1												**0**	4	9
05/19/13	1												**0**	7	10
05/20/13	1												**0**	4	11
05/21/13	1												**0**	3	11
05/22/13	1			1									**1**	4	10
05/23/13	1												**0**	5	9
05/24/13	1												**0**	2	9
05/25/13	1												**0**	6	10

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
05/26/13	1				1								**1**	5	11
05/27/13	1												**0**	6	6
05/28/13	1												**0**	3	7
05/29/13	1												**0**	6	7
05/30/13	1												**0**	3	6
05/31/13	1					1							**1**	5	13
06/01/13	1												**0**	6	12
06/02/13	1	1											**1**	6	11
06/03/13	1												**0**	5	12
06/04/13	1												**0**	3	11
06/05/13	1												**0**	7	14
06/06/13	1												**0**	7	14
06/07/13	1	1											**1**	2	18
06/08/13	1												**0**	5	17
06/09/13	1												**0**	5	19
06/10/13	1				1						1		**2**	5	12
06/11/13	1												**0**	4	14
06/12/13	1												**0**	8	10
06/13/13	1												**0**	8	13
06/14/13	1												**0**	7	15
06/15/13	1												**0**	9	14
06/16/13	1				1						1		**2**	3	16
06/17/13	1			1									**1**	6	14
06/18/13	1	1									1		**2**	6	17
06/19/13	1												**0**	7	11
06/20/13	1												**0**	7	11
06/21/13	1												**0**	5	14
06/22/13	1												**0**	4	15
06/23/13	1												**0**	7	14
06/24/13	1												**0**	7	15
06/25/13	1												**0**	7	15
06/26/13	1												**0**	7	13
06/27/13	1												**0**	4	17
06/28/13	1				1								**1**	5	18
06/29/13	1												**0**	6	18
06/30/13	1												**0**	5	19
07/01/13	1												**0**	6	19

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
07/02/13	1	1											**1**	5	20
07/03/13	1				6	2					4		**12**	4	18
07/04/13	1												**0**	11	16
07/05/13	1									1			**1**	9	16
07/06/13	1					1							**1**	7	18
07/07/13	1									1			**1**	4	17
07/08/13	1				1								**1**	7	19
07/09/13	1				2						1		**3**	5	18
07/10/13	1				2								**2**	5	16
07/11/13	1									1			**1**	4	17
07/12/13	1												**0**	6	17
07/13/13	1												**0**	8	18
07/14/13	1												**0**	5	20
07/15/13	1												**0**	7	19
07/16/13	1												**0**	4	18
07/17/13	1		1										**1**	6	16
07/18/13	1				1								**1**	4	17
07/19/13	1				1						2		**3**	3	18
07/20/13	1												**0**	2	17
07/21/13	1					1					1		**2**	5	16
07/22/13	1	1			4								**5**	5	18
07/23/13	1												**0**	5	18
07/24/13	1	1											**1**	5	15
07/25/13	1				2				1		5		**8**	5	17
07/26/13	1				7						2		**9**	4	17
07/27/13	1				1						1		**2**	5	17
07/28/13	1												**0**	7	17
07/29/13	1			1						2			**3**	4	16
07/30/13	1										1		**1**	3	15
07/31/13	1				1						1		**2**	4	16
08/01/13	1				1				1	1			**3**	4	17
08/02/13	1	1			1						1		**3**	3	15
08/03/13	1				2								**2**	3	16
08/04/13	1									2			**2**	4	18
08/05/13	1												**0**	4	18
08/06/13	1		2								5		**7**	5	16
08/07/13	1												**0**	6	15

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
08/08/13	1												**0**	6	16
08/09/13	1	1	2				1						**4**	4	17
08/10/13	1				1					1	1		**3**	5	16
08/11/13	1												**0**	4	15
08/12/13	1	1					1						**2**	6	14
08/13/13	1												**0**	11	16
08/14/13	1									1			**1**	3	15
08/15/13	1												**0**	3	15
08/16/13	1												**0**	4	15
08/17/13	1						1						**1**	5	14
08/18/13	1												**0**	7	14
08/19/13	1	3		1							2		**6**	5	16
08/20/13	1						1						**1**	4	17
08/21/13	1			1									**1**	4	15
08/22/13	1									1	1		**2**	4	15
08/23/13	1	2		1									**3**	4	15
08/24/13	1			3									**3**	5	17
08/25/13	1	1		1									**2**	4	17
08/26/13	0												**0**	7	17
08/27/13	0												**0**	5	18
08/28/13	0												**0**	8	13
08/29/13	0												**0**	4	12
08/30/13	0												**0**	7	15
08/31/13	0												**0**	5	19
09/01/13	0												**0**	4	17
09/02/13	0												**0**	6	18
09/03/13	0												**0**	6	17
09/04/13	0												**0**	5	16
09/05/13	0												**0**	7	19
09/06/13	0												**0**	5	14
09/07/13	0												**0**	6	12
09/08/13	0												**0**	3	10
09/09/13	1												**0**	3	11
09/10/13	1												**0**	5	12
09/11/13	1												**0**	8	13
09/12/13	1												**0**	6	8
09/13/13	1												**0**	6	11

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
09/14/13	1												**0**	5	6
09/15/13	1												**0**	5	9
09/16/13	1												**0**	5	10
09/17/13	1												**0**	6	10
09/18/13	1	1											**1**	7	4
09/19/13	1												**0**	8	5
09/20/13	1												**0**	10	14
09/21/13	1												**0**	4	17
09/22/13	1												**0**	7	8
09/23/13	1	1											**1**	6	8
09/24/13	1												**0**	7	7
09/25/13	1												**0**	5	9
09/26/13	1												**0**	6	14
09/27/13	1												**0**	5	15
09/28/13	1												**0**	6	15
09/29/13	1												**0**	6	8
09/30/13	1												**0**	6	11
10/01/13	1												**0**	6	9
10/02/13	1												**0**	7	8
10/03/13	1												**0**	5	12
10/04/13	1												**0**	9	16
10/05/13	1												**0**	4	7
10/06/13	1												**0**	7	9
10/07/13	1												**0**	9	15
10/08/13	1												**0**	6	10
10/09/13	1												**0**	8	6
10/10/13	1												**0**	5	5
10/11/13	1												**0**	5	5
10/12/13	1												**0**	4	6
10/13/13	1												**0**	7	10
10/14/13	1												**0**	9	15
10/15/13	1												**0**	5	16
By Species		**17**	**6**	**10**	**37**	**5**	**4**	**0**	**2**	**11**	**31**	**0**	**123**		
By Guild		**33**			**37**	**5**	**6**			**42**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix A Table 2. Summary of acoustic bat data and weather during each survey night at the Met 1 Low detector, Weaver Wind Project, 2014.

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (Celsius)**
04/22/13	1												**0**	5	7
04/23/13	1												**0**	11	2
04/24/13	1												**0**	9	1
04/25/13	1												**0**	5	3
04/26/13	1												**0**	4	3
04/27/13	1												**0**	8	4
04/28/13	1												**0**	8	2
04/29/13	1												**0**	4	1
04/30/13	1												**0**	5	3
05/01/13	1												**0**	4	7
05/02/13	1												**0**	5	8
05/03/13	1												**0**	6	8
05/04/13	1												**0**	7	5
05/05/13	1												**0**	6	6
05/06/13	1												**0**	6	6
05/07/13	1												**0**	5	8
05/08/13	1												**0**	6	7
05/09/13	1												**0**	9	9
05/10/13	1												**0**	7	13
05/11/13	1		1										**1**	5	10
05/12/13	1												**0**	5	6
05/13/13	1												**0**	5	6
05/14/13	1												**0**	5	8
05/15/13	1												**0**	7	13
05/16/13	1												**0**	8	12
05/17/13	1												**0**	4	10
05/18/13	1												**0**	4	9
05/19/13	1												**0**	7	10
05/20/13	1												**0**	4	11
05/21/13	1												**0**	3	11
05/22/13	1												**0**	4	10
05/23/13	1												**0**	5	9
05/24/13	1												**0**	2	9
05/25/13	1												**0**	6	10

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
05/26/13	1	1									1		**2**	5	11
05/27/13	1												**0**	6	6
05/28/13	1												**0**	3	7
05/29/13	1												**0**	6	7
05/30/13	1												**0**	3	6
05/31/13	1										1		**1**	5	13
06/01/13	1												**0**	6	12
06/02/13	1	5									1		**6**	6	11
06/03/13	1												**0**	5	12
06/04/13	1												**0**	3	11
06/05/13	1												**0**	7	14
06/06/13	1												**0**	7	14
06/07/13	1				1								**1**	2	18
06/08/13	1												**0**	5	17
06/09/13	1										1		**1**	5	19
06/10/13	1				2						2		**4**	5	12
06/11/13	1												**0**	4	14
06/12/13	1												**0**	8	10
06/13/13	1												**0**	8	13
06/14/13	1												**0**	7	15
06/15/13	1												**0**	9	14
06/16/13	1												**0**	3	16
06/17/13	1												**0**	6	14
06/18/13	1										1		**1**	6	17
06/19/13	1												**0**	7	11
06/20/13	1												**0**	7	11
06/21/13	1												**0**	5	14
06/22/13	1												**0**	4	15
06/23/13	1												**0**	7	14
06/24/13	1												**0**	7	15
06/25/13	1												**0**	7	15
06/26/13	1												**0**	7	13
06/27/13	1												**0**	4	17
06/28/13	1												**0**	5	18
06/29/13	1												**0**	6	18
06/30/13	1												**0**	5	19
07/01/13	1												**0**	6	19

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
07/02/13	1										1		**1**	5	20
07/03/13	1												**0**	4	18
07/04/13	1												**0**	11	16
07/05/13	1												**0**	9	16
07/06/13	1												**0**	7	18
07/07/13	1												**0**	4	17
07/08/13	1												**0**	7	19
07/09/13	1												**0**	5	18
07/10/13	1												**0**	5	16
07/11/13	1												**0**	4	17
07/12/13	1												**0**	6	17
07/13/13	1												**0**	8	18
07/14/13	1												**0**	5	20
07/15/13	1												**0**	7	19
07/16/13	1												**0**	4	18
07/17/13	1												**0**	6	16
07/18/13	1												**0**	4	17
07/19/13	1												**0**	3	18
07/20/13	1												**0**	2	17
07/21/13	1												**0**	5	16
07/22/13	1												**0**	5	18
07/23/13	1												**0**	5	18
07/24/13	1												**0**	5	15
07/25/13	1												**0**	5	17
07/26/13	1												**0**	4	17
07/27/13	1												**0**	5	17
07/28/13	1												**0**	7	17
07/29/13	1												**0**	4	16
07/30/13	1												**0**	3	15
07/31/13	1									1			**1**	4	16
08/01/13	1												**0**	4	17
08/02/13	1												**0**	3	15
08/03/13	1												**0**	3	16
08/04/13	1									1			**1**	4	18
08/05/13	1												**0**	4	18
08/06/13	1										2		**2**	5	16
08/07/13	1												**0**	6	15

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
08/08/13	1												**0**	6	16
08/09/13	1												**0**	4	17
08/10/13	1												**0**	5	16
08/11/13	1												**0**	4	15
08/12/13	1												**0**	6	14
08/13/13	1												**0**	11	16
08/14/13	1												**0**	3	15
08/15/13	1												**0**	3	15
08/16/13	1												**0**	4	15
08/17/13	1												**0**	5	14
08/18/13	1												**0**	7	14
08/19/13	1												**0**	5	16
08/20/13	1												**0**	4	17
08/21/13	1												**0**	4	15
08/22/13	1												**0**	4	15
08/23/13	1												**0**	4	15
08/24/13	1												**0**	5	17
08/25/13	1												**0**	4	17
08/26/13	1												**0**	7	17
08/27/13	1												**0**	5	18
08/28/13	1												**0**	8	13
08/29/13	1										1		**1**	4	12
08/30/13	1												**0**	7	15
08/31/13	1												**0**	5	19
09/01/13	1												**0**	4	17
09/02/13	1												**0**	6	18
09/03/13	1												**0**	6	17
09/04/13	1												**0**	5	16
09/05/13	1												**0**	7	19
09/06/13	1												**0**	5	14
09/07/13	1												**0**	6	12
09/08/13	1												**0**	3	10
09/09/13	1												**0**	3	11
09/10/13	1												**0**	5	12
09/11/13	1												**0**	8	13
09/12/13	1												**0**	6	8
09/13/13	1												**0**	6	11

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
09/14/13	1												**0**	5	6
09/15/13	1												**0**	5	9
09/16/13	1												**0**	5	10
09/17/13	1												**0**	6	10
09/18/13	1	1											**1**	7	4
09/19/13	1												**0**	8	5
09/20/13	1												**0**	10	14
09/21/13	1												**0**	4	17
09/22/13	1												**0**	7	8
09/23/13	1										1		**1**	6	8
09/24/13	1												**0**	7	7
09/25/13	1												**0**	5	9
09/26/13	1												**0**	6	14
09/27/13	1												**0**	5	15
09/28/13	1												**0**	6	15
09/29/13	1												**0**	6	8
09/30/13	1												**0**	6	11
10/01/13	1												**0**	6	9
10/02/13	1												**0**	7	8
10/03/13	1												**0**	5	12
10/04/13	1												**0**	9	16
10/05/13	1												**0**	4	7
10/06/13	1												**0**	7	9
10/07/13	1												**0**	9	15
10/08/13	1												**0**	6	10
10/09/13	1												**0**	8	6
10/10/13	1												**0**	5	5
10/11/13	1												**0**	5	5
10/12/13	1												**0**	4	6
10/13/13	1												**0**	7	10
10/14/13	1												**0**	9	15
10/15/13	1												**0**	5	16
By Species		**7**	**1**	**0**	**3**	**0**	**0**	**0**	**0**	**2**	**12**	**0**	**25**		
By Guild		**8**			**3**	**0**	**0**			**14**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix A Table 3. Summary of acoustic bat data and weather during each survey night at the Met 2 High detector, Weaver Wind Project, 2014.

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
04/22/13	1												**0**	5	7
04/23/13	1												**0**	11	2
04/24/13	1												**0**	9	1
04/25/13	1												**0**	5	3
04/26/13	1												**0**	4	3
04/27/13	1												**0**	8	4
04/28/13	1												**0**	8	2
04/29/13	1												**0**	4	1
04/30/13	1												**0**	5	3
05/01/13	1												**0**	4	7
05/02/13	1												**0**	5	8
05/03/13	1												**0**	6	8
05/04/13	1												**0**	7	5
05/05/13	1												**0**	6	6
05/06/13	1												**0**	6	6
05/07/13	1												**0**	5	8
05/08/13	1												**0**	6	7
05/09/13	1												**0**	9	9
05/10/13	1												**0**	7	13
05/11/13	1												**0**	5	10
05/12/13	1												**0**	5	6
05/13/13	1												**0**	5	6
05/14/13	1												**0**	5	8
05/15/13	1												**0**	7	13
05/16/13	1	1											**1**	8	12
05/17/13	1												**0**	4	10
05/18/13	1												**0**	4	9
05/19/13	1												**0**	7	10
05/20/13	1												**0**	4	11
05/21/13	1												**0**	3	11
05/22/13	1			1									**1**	4	10
05/23/13	1												**0**	5	9
05/24/13	1												**0**	2	9
05/25/13	1												**0**	6	10

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
05/26/13	1												**0**	5	11
05/27/13	1												**0**	6	6
05/28/13	1												**0**	3	7
05/29/13	1												**0**	6	7
05/30/13	1												**0**	3	6
05/31/13	1												**0**	5	13
06/01/13	1												**0**	6	12
06/02/13	1												**0**	6	11
06/03/13	1												**0**	5	12
06/04/13	1												**0**	3	11
06/05/13	1												**0**	7	14
06/06/13	1												**0**	7	14
06/07/13	1												**0**	2	18
06/08/13	1												**0**	5	17
06/09/13	1												**0**	5	19
06/10/13	1												**0**	5	12
06/11/13	1												**0**	4	14
06/12/13	0												**0**	8	10
06/13/13	0												**0**	8	13
06/14/13	0												**0**	7	15
06/15/13	0												**0**	9	14
06/16/13	0												**0**	3	16
06/17/13	0												**0**	6	14
06/18/13	0												**0**	6	17
06/19/13	0												**0**	7	11
06/20/13	0												**0**	7	11
06/21/13	0												**0**	5	14
06/22/13	0												**0**	4	15
06/23/13	0												**0**	7	14
06/24/13	0												**0**	7	15
06/25/13	0												**0**	7	15
06/26/13	0												**0**	7	13
06/27/13	1												**0**	4	17
06/28/13	1												**0**	5	18
06/29/13	1												**0**	6	18
06/30/13	1												**0**	5	19
07/01/13	1												**0**	6	19

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
07/02/13	1												**0**	5	20
07/03/13	1										1		**1**	4	18
07/04/13	1												**0**	11	16
07/05/13	1												**0**	9	16
07/06/13	1												**0**	7	18
07/07/13	1												**0**	4	17
07/08/13	1												**0**	7	19
07/09/13	1	2											**2**	5	18
07/10/13	1												**0**	5	16
07/11/13	1												**0**	4	17
07/12/13	1												**0**	6	17
07/13/13	1												**0**	8	18
07/14/13	1												**0**	5	20
07/15/13	1												**0**	7	19
07/16/13	1												**0**	4	18
07/17/13	1		1										**1**	6	16
07/18/13	1										1		**1**	4	17
07/19/13	1												**0**	3	18
07/20/13	1												**0**	2	17
07/21/13	1												**0**	5	16
07/22/13	1												**0**	5	18
07/23/13	1				1								**1**	5	18
07/24/13	1												**0**	5	15
07/25/13	1									1			**1**	5	17
07/26/13	1				1								**1**	4	17
07/27/13	1												**0**	5	17
07/28/13	1												**0**	7	17
07/29/13	1		1							1	1		**3**	4	16
07/30/13	1												**0**	3	15
07/31/13	1										1		**1**	4	16
08/01/13	1										1		**1**	4	17
08/02/13	1												**0**	3	15
08/03/13	1												**0**	3	16
08/04/13	1												**0**	4	18
08/05/13	1												**0**	4	18
08/06/13	1	1									1		**2**	5	16
08/07/13	1												**0**	6	15

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
08/08/13	1												**0**	6	16
08/09/13	1												**0**	4	17
08/10/13	1												**0**	5	16
08/11/13	1												**0**	4	15
08/12/13	1												**0**	6	14
08/13/13	1												**0**	11	16
08/14/13	1												**0**	3	15
08/15/13	1												**0**	3	15
08/16/13	1												**0**	4	15
08/17/13	1												**0**	5	14
08/18/13	1				1					1			**2**	7	14
08/19/13	1										1		**1**	5	16
08/20/13	1	2											**2**	4	17
08/21/13	1	3		2							2		**7**	4	15
08/22/13	1												**0**	4	15
08/23/13	1												**0**	4	15
08/24/13	1			1									**1**	5	17
08/25/13	1												**0**	4	17
08/26/13	1												**0**	7	17
08/27/13	1	1											**1**	5	18
08/28/13	1												**0**	8	13
08/29/13	1												**0**	4	12
08/30/13	1												**0**	7	15
08/31/13	1												**0**	5	19
09/01/13	1												**0**	4	17
09/02/13	1												**0**	6	18
09/03/13	1										1		**1**	6	17
09/04/13	1										1		**1**	5	16
09/05/13	1												**0**	7	19
09/06/13	1												**0**	5	14
09/07/13	1												**0**	6	12
09/08/13	1	2											**2**	3	10
09/09/13	1						1						**1**	3	11
09/10/13	1												**0**	5	12
09/11/13	1												**0**	8	13
09/12/13	1												**0**	6	8
09/13/13	1												**0**	6	11

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
09/14/13	1												**0**	5	6
09/15/13	1												**0**	5	9
09/16/13	1												**0**	5	10
09/17/13	1												**0**	6	10
09/18/13	1												**0**	7	4
09/19/13	1												**0**	8	5
09/20/13	1												**0**	10	14
09/21/13	1												**0**	4	17
09/22/13	1												**0**	7	8
09/23/13	1												**0**	6	8
09/24/13	1	1											**1**	7	7
09/25/13	1					1							**1**	5	9
09/26/13	1												**0**	6	14
09/27/13	1	1									1		**2**	5	15
09/28/13	1												**0**	6	15
09/29/13	1												**0**	6	8
09/30/13	1												**0**	6	11
10/01/13	1												**0**	6	9
10/02/13	1												**0**	7	8
10/03/13	1												**0**	5	12
10/04/13	1												**0**	9	16
10/05/13	1												**0**	4	7
10/06/13	1												**0**	7	9
10/07/13	1												**0**	9	15
10/08/13	1												**0**	6	10
10/09/13	1												**0**	8	6
10/10/13	1												**0**	5	5
10/11/13	1												**0**	5	5
10/12/13	1												**0**	4	6
10/13/13	1												**0**	7	10
10/14/13	1												**0**	9	15
10/15/13	1												**0**	5	16
By Species		**14**	**2**	**4**	**3**	**1**	**1**	**0**	**0**	**3**	**12**	**0**	**40**		
By Guild		**20**			**3**	**1**	**1**			**15**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix A Table 4. Summary of acoustic bat data and weather during each survey night at the Met 2 Low detector, Weaver Wind Project, 2014.

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
04/22/13	1												**0**	5	7
04/23/13	0												**0**	11	2
04/24/13	0												**0**	9	1
04/25/13	0												**0**	5	3
04/26/13	0												**0**	4	3
04/27/13	0												**0**	8	4
04/28/13	0												**0**	8	2
04/29/13	0												**0**	4	1
04/30/13	0												**0**	5	3
05/01/13	0												**0**	4	7
05/02/13	0												**0**	5	8
05/03/13	0												**0**	6	8
05/04/13	0												**0**	7	5
05/05/13	0												**0**	6	6
05/06/13	1												**0**	6	6
05/07/13	1												**0**	5	8
05/08/13	1												**0**	6	7
05/09/13	1												**0**	9	9
05/10/13	1												**0**	7	13
05/11/13	1												**0**	5	10
05/12/13	1												**0**	5	6
05/13/13	1												**0**	5	6
05/14/13	1												**0**	5	8
05/15/13	1												**0**	7	13
05/16/13	1												**0**	8	12
05/17/13	1												**0**	4	10
05/18/13	1												**0**	4	9
05/19/13	1												**0**	7	10
05/20/13	1												**0**	4	11
05/21/13	1												**0**	3	11
05/22/13	1												**0**	4	10
05/23/13	1												**0**	5	9
05/24/13	1												**0**	2	9
05/25/13	1												**0**	6	10

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
05/26/13	1												**0**	5	11
05/27/13	1												**0**	6	6
05/28/13	1												**0**	3	7
05/29/13	1												**0**	6	7
05/30/13	1												**0**	3	6
05/31/13	1												**0**	5	13
06/01/13	1												**0**	6	12
06/02/13	1												**0**	6	11
06/03/13	1												**0**	5	12
06/04/13	1												**0**	3	11
06/05/13	1												**0**	7	14
06/06/13	1					1							**1**	7	14
06/07/13	1												**0**	2	18
06/08/13	1												**0**	5	17
06/09/13	1									1	1		**2**	5	19
06/10/13	1												**0**	5	12
06/11/13	1												**0**	4	14
06/12/13	1	1											**1**	8	10
06/13/13	1												**0**	8	13
06/14/13	1												**0**	7	15
06/15/13	1												**0**	9	14
06/16/13	1								1				**1**	3	16
06/17/13	1												**0**	6	14
06/18/13	1												**0**	6	17
06/19/13	1												**0**	7	11
06/20/13	1												**0**	7	11
06/21/13	1	1									1		**2**	5	14
06/22/13	1												**0**	4	15
06/23/13	1												**0**	7	14
06/24/13	1												**0**	7	15
06/25/13	1												**0**	7	15
06/26/13	1												**0**	7	13
06/27/13	1												**0**	4	17
06/28/13	1												**0**	5	18
06/29/13	1												**0**	6	18
06/30/13	1					1							**1**	5	19
07/01/13	1												**0**	6	19

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
07/02/13	1										1		**1**	5	20
07/03/13	1												**0**	4	18
07/04/13	1												**0**	11	16
07/05/13	1												**0**	9	16
07/06/13	1	1											**1**	7	18
07/07/13	1												**0**	4	17
07/08/13	1												**0**	7	19
07/09/13	1	2											**2**	5	18
07/10/13	1												**0**	5	16
07/11/13	1	1											**1**	4	17
07/12/13	1												**0**	6	17
07/13/13	1												**0**	8	18
07/14/13	1												**0**	5	20
07/15/13	1												**0**	7	19
07/16/13	1												**0**	4	18
07/17/13	1	1											**1**	6	16
07/18/13	1										1		**1**	4	17
07/19/13	1												**0**	3	18
07/20/13	1												**0**	2	17
07/21/13	1										1		**1**	5	16
07/22/13	1										1		**1**	5	18
07/23/13	1	1											**1**	5	18
07/24/13	1	1				1				2	3		**7**	5	15
07/25/13	1												**0**	5	17
07/26/13	1												**0**	4	17
07/27/13	1												**0**	5	17
07/28/13	1												**0**	7	17
07/29/13	1										2		**2**	4	16
07/30/13	1										1		**1**	3	15
07/31/13	1										3		**3**	4	16
08/01/13	1										2		**2**	4	17
08/02/13	1										2		**2**	3	15
08/03/13	1												**0**	3	16
08/04/13	1										1		**1**	4	18
08/05/13	1	1											**1**	4	18
08/06/13	1				24		1						**25**	5	16
08/07/13	1									1	1		**2**	6	15

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
08/08/13	1						3		1				**4**	6	16
08/09/13	1	1								2	2		**5**	4	17
08/10/13	1						1			8	2		**11**	5	16
08/11/13	1					1					1		**2**	4	15
08/12/13	1												**0**	6	14
08/13/13	1												**0**	11	16
08/14/13	1												**0**	3	15
08/15/13	1										1		**1**	3	15
08/16/13	1												**0**	4	15
08/17/13	1									3			**3**	5	14
08/18/13	1									5	3		**8**	7	14
08/19/13	1	1							1	1			**3**	5	16
08/20/13	1	1								1	2		**4**	4	17
08/21/13	1	2									1		**3**	4	15
08/22/13	1					1				1			**2**	4	15
08/23/13	1									8			**8**	4	15
08/24/13	1	1								4	1		**6**	5	17
08/25/13	1												**0**	4	17
08/26/13	1												**0**	7	17
08/27/13	1									1			**1**	5	18
08/28/13	1									1	1		**2**	8	13
08/29/13	1												**0**	4	12
08/30/13	1												**0**	7	15
08/31/13	1												**0**	5	19
09/01/13	1												**0**	4	17
09/02/13	1												**0**	6	18
09/03/13	1									2			**2**	6	17
09/04/13	1					1					1		**2**	5	16
09/05/13	1												**0**	7	19
09/06/13	1												**0**	5	14
09/07/13	1	1								2	1		**4**	6	12
09/08/13	1												**0**	3	10
09/09/13	1						1						**1**	3	11
09/10/13	1									1			**1**	5	12
09/11/13	1										1		**1**	8	13
09/12/13	1												**0**	6	8
09/13/13	1									1			**1**	6	11

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (Celsius)
09/14/13	1												**0**	5	6
09/15/13	1												**0**	5	9
09/16/13	1												**0**	5	10
09/17/13	1												**0**	6	10
09/18/13	1										2		**2**	7	4
09/19/13	1												**0**	8	5
09/20/13	1												**0**	10	14
09/21/13	1												**0**	4	17
09/22/13	1												**0**	7	8
09/23/13	1												**0**	6	8
09/24/13	1												**0**	7	7
09/25/13	1								1				**1**	5	9
09/26/13	1									1	2		**3**	6	14
09/27/13	1												**0**	5	15
09/28/13	1												**0**	6	15
09/29/13	1									1			**1**	6	8
09/30/13	1												**0**	6	11
10/01/13	1												**0**	6	9
10/02/13	1												**0**	7	8
10/03/13	1												**0**	5	12
10/04/13	1												**0**	9	16
10/05/13	1												**0**	4	7
10/06/13	1												**0**	7	9
10/07/13	1												**0**	9	15
10/08/13	1												**0**	6	10
10/09/13	1												**0**	8	6
10/10/13	1												**0**	5	5
10/11/13	1												**0**	5	5
10/12/13	1												**0**	4	6
10/13/13	1												**0**	7	10
10/14/13	1												**0**	9	15
10/15/13	1												**0**	5	16
By Species		**17**	**0**	**0**	**24**	**6**	**6**	**0**	**4**	**47**	**42**	**0**	**146**		
By Guild		**17**			**24**	**6**	**10**			**89**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B NOCTURNAL RADAR SURVEY TABLES

Appendix B Table 1. Survey dates, results, level of effort, and weather - Weaver Wind Project, spring 2014

Date	Sunset	Sunrise	# of Hours Analyzed	Passage rate	Flight Direction (°)	Flight Height (m)	% below 180 m	Temperature (C)	Wind Speed (m/s)	Wind Direction (degrees)
4/28	19:34	5:27	10	49	249	173	64%	2	8	40
4/29	19:35	5:25	10	162	70	306	44%	1	4	64
5/2	19:39	5:21	10	1101	71	336	39%	8	5	279
5/3	19:40	5:19	10	783	58	508	14%	8	6	171
5/4	19:41	5:18	10	152	141	114	83%	5	7	6
5/5	19:42	5:17	10	1011	80	211	55%	6	6	314
5/6	19:44	5:15	10	598	87	212	53%	6	6	334
5/7	19:45	5:14	10	1277	75	353	44%	8	5	324
5/8	19:46	5:13	10	306	163	500	28%	7	6	47
5/9	19:47	5:11	9	567	54	422	17%	9	9	190
5/10	19:48	5:10	9	1112	61	387	23%	13	7	276
5/12	19:51	5:08	9	475	129	291	40%	6	5	41
5/13	19:52	5:07	9	1126	69	297	30%	6	5	223
5/14	19:53	5:05	9	708	58	473	10%	8	5	185
5/15	19:54	5:04	9	668	56	466	11%	13	7	191
5/20	20:00	4:59	9	1036	100	177	72%	11	4	359
5/21	20:01	4:58	9	2586	76	240	48%	11	3	311
5/26	20:06	4:54	8	938	94	293	47%	11	5	48
5/28	20:08	4:53	9	822	47	177	66%	7	3	73
5/29	20:09	4:52	9	855	61	302	27%	7	6	217
Entire Season			**188**	**806**	**72**	**365**	**29%**	**8**	**6**	**338**

Appendix B Table 2. Summary of passage rates by hour, night, and for entire season - Weaver Wind Project, spring 2014

Night of	Passage Rate (targets/km/hr) by hour after sunset										Entire Night			
	1	2	3	4	5	6	7	8	9	10	Mean	Median	Stdev	SE
4/28	11	43	43	39	64	39	82	36	89	47	49	43	23	7
4/29	18	193	525	261	125	129	93	43	132	103	162	127	145	46
5/2	168	1143	1364	1218	1586	1286	1232	1182	1261	573	1101	1225	415	131
5/3	500	596	700	829	907	818	993	1346	975	161	783	823	321	101
5/4	18	25	218	118	246	300	118	50	386	43	152	118	128	41
5/5	279	1414	1875	1739	1521	1193	732	671	668	14	1011	963	630	199
5/6	236	950	1607	1229	686	532	329	189	186	36	598	430	517	164
5/7	257	1536	2214	2171	2261	1643	1232	682	761	14	1277	1384	824	260
5/8	493	500	386	250	307	264	282	339	243	0	306	295	143	45
5/9	132	775	1214	1239	857	371	307	75	136	N/A	567	371	464	155
5/10	168	629	900	921	1204	1632	1796	1600	1161	N/A	1112	1161	524	175
5/12	300	1050	943	582	500	368	254	150	132	N/A	475	368	331	110
5/13	868	1986	2107	1586	1200	804	775	504	304	N/A	1126	868	640	213
5/14	143	250	379	686	661	1157	1475	1057	564	N/A	708	661	443	148
5/15	179	1268	1250	1004	1004	504	407	279	118	N/A	668	504	463	154
5/20	204	950	464	1764	1925	2011	1639	264	104	N/A	1036	950	801	267
5/21	596	2357	4143	4204	5161	2096	1696	1914	1107	N/A	2586	2096	1555	518
5/26	914	1814	Rain	1475	1582	846	496	314	64	N/A	938	880	636	225
5/28	168	811	1439	1246	925	1050	1143	607	13	N/A	822	925	482	161
5/29	189	1150	1354	882	1143	918	882	925	252	N/A	855	918	393	131
Entire Season	**292**	**972**	**1217**	**1172**	**1193**	**898**	**798**	**611**	**433**	**110**	**806**	**664**	**767**	**56**

0 indicates no targets counted for that hour N/A indicates no or only partial data for that hour

Appendix B Table 3. Mean nightly flight direction - Weaver Wind Project, spring 2014

Night of	Mean Flight Direction (°)	Circular Stdev (°)
4/28	249	78
4/29	70	74
5/2	71	22
5/3	58	44
5/4	141	45
5/5	80	23
5/6	87	32
5/7	75	27
5/8	163	123
5/9	54	34
5/10	61	26
5/12	129	84
5/13	69	23
5/14	58	43
5/15	56	45
5/20	100	41
5/21	76	28
5/26	94	83
5/28	47	36
5/29	61	25
Entire Season	**72**	**42**

Appendix B Table 4. Summary of mean flight heights by hour, night, and for entire season - Weaver Wind Project, spring 2014

Night of	Mean Flight Height (m) by hour after sunset										Entire Night				# of targets below 180 meters	% of targets below 180 meters
	1	2	3	4	5	6	7	8	9	10	Mean	Median	STDV	SE		
4/28	123	310	207	169	38.5	178	142	162	103	80	173	115	168	26	27	64%
4/29	401	407	317	243	235	213	223	61.3	259	209	306	205	288	18	110	44%
5/2	179	499	389	339	245	330	275	266	232	162	336	241	283	7	668	39%
5/3	231	442	451	396	432	527	516	514	656	596	508	457	303	6	389	14%
5/4	119	221	Rain	93.3	99.7	89	49.9	46	146	151	114	93	92	10	66	83%
5/5	189	323	189	179	206	190	154	139	89.8	403	211	164	187	6	538	55%
5/6	130	223	200	211	232	252	162	162	205	172	212	172	175	7	288	53%
5/7	270	440	381	381	272	225	270	277	355	666	353	223	337	9	559	44%
5/8	239	351	344	423	521	515	601	623	593	700	500	331	403	13	270	28%
5/9	236	472	441	396	393	370	343	Rain	Rain	N/A	422	380	257	7	227	17%
5/10	368	485	456	441	296	301	226	198	174	N/A	387	359	256	5	598	23%
5/12	189	290	273	385	346	206	263	222	179	N/A	291	230	252	11	210	40%
5/13	288	368	283	252	250	239	203	235	298	N/A	297	259	192	4	553	30%
5/14	360	436	507	506	513	430	494	462	431	N/A	473	431	251	4	332	10%
5/15	380	486	479	545	449	398	447	407	281	N/A	466	416	263	6	202	11%
5/20	107	Rain	Rain	177	164	131	187	396	441	N/A	177	81	228	9	462	72%
5/21	279	261	194	194	164	167	296	299	343	N/A	240	190	196	5	841	48%
5/26	198	357	Rain	212	256	348	421	359	403	N/A	293	205	295	10	372	47%
5/28	300	192	192	183	163	151	148	157	337	N/A	177	131	177	7	464	66%
5/29	341	424	311	263	251	283	268	271	348	N/A	302	266	184	4	701	27%
Entire Season	**246**	**368**	**330**	**299**	**276**	**277**	**284**	**277**	**309**	**349**	**365**	**299**	**276**	**2**	**7877**	**29%**

-- indicates no targets counted for that hour   N/A indicates no or only partial data for that hour

Appendix B Table 5. Survey dates, results, level of effort, and weather - Weaver Wind Project, fall 2014

Date	Sunset	Sunrise	# of Hours Analyzed	Passage rate	Flight Direction (°)	Flight Height (m)	% below 180 m	Temperature (C)	Wind Speed (m/s)	Wind Direction (degrees)
8/18	19:36	5:40	10	486	155	387	21%	14	7	318
8/19	19:35	5:41	9	672	128	354	26%	16	5	306
8/20	19:33	5:42	10	755	193	387	25%	17	4	317
8/25	19:25	5:48	10	370	30	269	38%	17	4	215
8/26	19:23	5:49	11	396	22	267	35%	17	7	217
8/27	19:21	5:50	9	667	203	307	26%	18	5	344
9/4	19:07	6:00	11	716	332	252	41%	16	5	253
9/6	19:03	6:02	9	994	211	384	21%	14	5	346
9/8	18:59	6:05	11	1122	302	529	18%	10	3	197
9/9	18:57	6:06	11	1057	275	302	39%	11	3	151
9/17	18:42	6:15	11	535	4	497	17%	10	6	218
9/20	18:37	6:19	12	283	14	374	20%	14	10	204
9/25	18:27	6:25	12	367	183	575	15%	9	5	289
9/26	18:25	6:26	12	679	150	573	13%	14	6	293
9/28	18:21	6:28	7	1059	321	309	38%	15	6	309
10/1	18:16	6:32	8	1041	241	455	25%	9	6	47
10/2	18:14	6:33	12	1113	233	451	16%	8	7	49
10/3	18:12	6:35	12	556	257	339	27%	12	5	92
10/6	18:07	6:38	12	410	325	306	36%	9	7	176
10/8	18:03	6:41	12	239	103	315	25%	10	6	257
Entire Season			**211**	**657**	**259**	**412**	**23%**	**13**	**6**	**270**

Appendix B Table 6. Summary of passage rates by hour, night, and for entire season - Weaver Wind Project, fall 2014

Night of	Passage Rate (targets/km/hr) by hour after sunset												Entire Night			
	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Median	Stdev	SE
8/18	257	682	679	629	596	600	414	489	343	168	N/A	N/A	486	543	183	58
8/19	379	696	714	757	554	550	686	793	918	N/A[1]	N/A	N/A	672	696	158	53
8/20	564	661	839	861	793	696	746	804	811	775	N/A	N/A	755	784	91	29
8/25	293	532	579	564	543	432	439	121	86	114	N/A	N/A	370	436	200	63
8/26	339	539	504	475	432	389	414	357	429	379	100	N/A	396	414	116	35
8/27	257	621	1064	793	1061	Rain	Rain	700	471	693	343	N/A	667	693	284	95
9/4	532	1018	1059	1029	832	707	657	625	493	546	373	N/A	716	657	237	71
9/6	Rain	Rain	1011	1479	1275	1218	1021	764	1018	836	329	N/A	994	1018	333	111
9/8	300	1986	1918	1382	839	1000	850	957	1129	1229	754	N/A	1122	1000	497	150
9/9	536	1646	1661	1407	1421	1586	1257	796	604	536	175	N/A	1057	1257	537	162
9/17	407	686	1479	964	471	418	396	346	268	236	218	N/A	535	407	380	115
9/20	268	364	436	596	400	307	289	225	168	175	150	21	283	279	153	44
9/25	164	446	461	400	339	279	329	414	400	386	393	396	367	395	81	23
9/26	171	879	900	939	714	989	1014	832	618	361	414	311	679	773	295	85
9/28	554	875	1064	1111	1107	1393	1311	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	1059	1107	280	106
10/1	464	1025	1521	1179	1164	1146	918	907	N/A[1]	N/A[1]	N/A[1]	N/A[1]	1041	1086	303	107
10/2	932	1739	1721	1411	1411	1650	1486	1204	793	407	268	339	1113	1307	550	159
10/3	179	571	861	1104	1275	1021	711	450	293	161	11	32	556	511	437	126
10/6	11	511	825	679	504	457	450	475	364	336	204	107	410	454	228	66
10/8	96	325	332	264	529	514	200	114	82	136	132	139	239	170	157	45
Entire Season	**353**	**832**	**981**	**901**	**813**	**808**	**715**	**599**	**516**	**439**	**276**	**192**	**657**	**554**	**416**	**29**

0 indicates no targets counted for that hour   N/A indicates no or only partial data for that hour

N/A[1] indicates equipment failure during that hour

Appendix B Table 7. Mean nightly flight direction - Weaver Wind Project, fall 2014

Night of	Mean Flight Direction (°)	Circular Stdev (°)
8/18	155	51
8/19	128	90
8/20	193	98
8/25	30	46
8/26	22	47
8/27	203	47
9/4	332	66
9/6	211	44
9/8	302	59
9/9	275	44
9/17	4	59
9/20	14	52
9/25	183	113
9/26	150	72
9/28	321	88
10/1	241	32
10/2	233	28
10/3	257	42
10/6	325	42
10/8	103	72
Entire Season	**259**	**92**

Appendix B Table 8. Summary of mean flight heights by hour, night, and for entire season - Weaver Wind Project, fall 2014

Night of	Mean Flight Height (m) by hour after sunset												Entire Night				# of targets below 180 meters	% of targets below 180 meters
	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Median	STDV	SE		
8/18	277	348	405	414	445	456	401	344	338	304	N/A	N/A	387	347	241	5	549	21%
8/19	256	379	380	340	319	385	448	354	318	N/A[1]	N/A	N/A	354	279	260	6	425	26%
8/20	279	431	424	363	417	414	399	419	377	278	N/A	N/A	387	311	275	6	508	25%
8/25	245	296	281	283	244	266	267	278	282	243	N/A	N/A	269	230	193	6	375	38%
8/26	247	250	275	304	288	268	261	273	264	189	225	N/A	267	248	174	5	372	35%
8/27	299	339	285	275	245	264	Rain	357	372	305	296	N/A	307	274	181	4	670	26%
9/4	217	295	284	283	232	234	227	216	234	269	229	N/A	252	211	213	6	607	41%
9/6	Rain	Rain	372	360	413	431	430	409	337	308	340	N/A	384	344	240	4	717	21%
9/8	318	489	555	556	551	628	605	535	481	372	348	N/A	529	479	344	6	516	18%
9/9	320	357	395	338	225	215	235	213	235	281	225	N/A	302	234	248	6	579	39%
9/17	200	511	598	484	372	317	309	262	269	214	212	N/A	497	600	250	4	547	17%
9/20	315	428	393	360	346	350	360	386	404	383	348	336	374	338	222	6	241	20%
9/25	236	573	574	621	599	608	517	548	635	631	547	466	575	569	342	8	299	15%
9/26	363	666	656	676	574	502	583	570	535	519	491	424	573	535	348	6	481	13%
9/28	198	301	258	275	331	362	353	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	309	229	254	6	679	38%
10/1	311	398	300	316	386	471	607	526	440	N/A[1]	N/A[1]	N/A[1]	455	366	313	7	496	25%
10/2	299	494	487	501	510	411	389	357	345	290	316	N/A[1]	451	379	294	4	803	16%
10/3	261	385	343	357	355	312	400	227	227	274	191	295	339	282	232	6	447	27%
10/6	260	331	329	315	351	375	282	245	206	217	235	N/A[1]	306	248	254	9	296	36%
10/8	347	377	277	354	314	274	223	209	302	336	262	279	315	288	182	6	234	25%
Entire Season	**276**	**403**	**393**	**389**	**376**	**377**	**384**	**354**	**347**	**318**	**305**	**360**	**412**	**337**	**288**	**1**	**9841**	**23%**

-- indicates no targets counted for that hour   N/A indicates no or only partial data for that hour

N/A[1] indicates equipment failure during that hour

Appendix B Table 9. Summary of publically available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2005-present).

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Spring 2005									
Alabama, Genesee Cty, NY	40	n/a	Agricultural plateau	111	n/a	35	413	(125 m) 14%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns. 2007. Avian and Bat Studies for the Proposed Alabama Ledge Wind Project, Genesee County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Noble C/E/A, Clinton Cty, NY	40	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(125 m) 20%	Mabee, T. J., J. H. Plissner, B. A. Cooper, J. B. Barna. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Clinton County Windparks, New York, Spring and Fall 2005. Final Report prepared by ABR, Inc. for Ecology and Environment, Inc. and Noble Environmental Power, LLC.
Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	422	(120 m) 6%	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Sheffield, Caledonia Cty, VT	20	180	Forested ridge	166	12-440	40	552	(125 m) 6%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Stamford, Delaware Cty, NY	35	301	Forested ridge	210	10-785	46	431	(110 m) 8%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(100 m) 4%	Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
Franklin, Pendleton Cty, NY	21	204	Forested ridge	457	34-1240	53	492	(125 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	460	71-1769	30	443	(150 m) 14%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Dans Mountain, Allegany Cty, MD	23	189	Forested ridge	493	63-1388	38	541	(125 m) 15%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(145 m) 16%[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
Spring 2006									
Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Kibby, Franklin Cty, ME (Valley)	2	14	Forested ridge	443	45-1242	61	334	(120 m) n/a	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Kibby, Franklin Cty, ME (Mountain)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Spring 2007									
Stetson, Washington Cty, ME	21	138	Forested ridge	147	3-434	55	210	(120 m) 22%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Cape Vincent, Jefferson Cty, NY	50	300	Great Lakes plain	166	n/a	34	441	(125 m) 14%	Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America.
Arkwright, Chautauqua County, NY	41	n/a	Great Lakes plain	175	n/a	18	450	(125 m) 13%	Kerns, J., D. P. Young, C. S. Nations, V. K. Poulton. 2008. Avian and Bat Studies for the Proposed New Grange Wind Project, Chautauqua County, New York. Final Report prepared by WEST, Inc. for New Grange Wind Farm LLC.
Laurel Mountain, Barbour Cty, WV	20	197	Forested ridge	277	13-646	27	533	(130 m) 3%	Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Granite Reliable Power, Coos County, NH	30	212	Forested ridge	342	2 to 870	76	332	(125 m) 14%	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Villenova, Chautauqua Cty, NY	40	n/a	Great Lakes plain	419	22-1190	10	493	(120 m) 3%	Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
Roxbury, Oxford Cty, ME	20	n/a	Forested ridge	539	137-1256	52	312	(130 m) 18%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Lempster, Sullivan Cty, NH	30	277	Forested ridge	542	49-1094	49	358	(125 m) 18%	Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Spring 2008									
Allegany, Cattaraugus Cty, NY	30	275	Forested ridge	268	53-755	18	316	(150 m) 19%	Stantec Consulting Services Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report, Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project in Allegany, New York. Prepared for Allegany Wind, LLC. October 2008
Oakfield, Penobscot Cty, ME	20	194	Forested ridge	498	132-899	33	276	(120 m) 21%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Hounsfield, Jefferson Cty, NY	42	379	Great Lakes island	624	74-1630	51	319	(125 m) 19%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird and Bat Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
New Creek, Grant Cty, WV	20	n/a	Forested ridge	1020	289-2610	30	354	(130 m) 13%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Groton Wind, Grafton Cty, NH	40	373	Forested ridge	234	35-549	77	321	(125 m) 12%	Stantec Consulting Services Inc. 2008. Spring 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Rollins, Penobscot Cty, ME	20	189	Forested ridge	247	40 - 766	75	316	(120 m) 13%	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Spring 2009									
Sisk (Kibby Expansion), Franklin Cty, ME	21	193	Forested ridge	207	50-452	28	293	(125 m) 18%	Stantec Consulting Services Inc. 2009. Spring 2009 Nocturnal Migration Survey Report for the Kibby Expansion Wind Project. Prepared for TRC Engineers LLC.
Moresville, Delaware Cty, NY	30	275	Forested ridge	230	30-575	53	314	(125 m) 12%	Stantec Consulting Services Inc. 2009. 2009 Spring Nocturnal Radar Survey Report for the Moresville Energy Center. Prepared for Moresville Energy LLC.
Highland, Somerset Cty, ME (location 1)	21	192	Forested ridge	496	10-1262	47	287	(130.5m) 26%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC.
Highland, Somerset Cty, ME (location 2)	19	161	Forested ridge	511	8-1735	53	314	(130.5m) 23%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC.
Spring 2010									
Bowers, Carroll Plantation, ME	20	188	Forested ridge	289	20-589	56	243	(131 m) 26%	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy LLC.
Bull Hill, T16 MD, ME	20	184	Forested ridge	387	43-879	48	217	(175 m) 45%	Stantec Consulting Services Inc. 2014. Hancock Wind Project avian and bat migration data – reanalyzed for a turbine height of 175 m - MEMO. Prepared for First Wind.
Bingham, Somerset Cty, ME	20	184	Forested ridge	543	51-1231	43	355	(152 m) 21%	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Wild Meadows, Grafton and Merrimack Ctys, NH	33	285	Forested ridge	467	10-1379	56	387	(150 m) 19%	Stantec Consulting Services Inc. 2013. Spring 2010 Avian and Bat Survey Report for the Wild Meadows Wind Project in Grafton and Merrimack Counties, New Hampshire. Prepared for Atlantic Wind LLC.
Spring 2011									
Antrim, Hillsborough Cty, NH	30	284	Forested ridge	223	6-1215	44	305	(150 m) 30%	Stantec Consulting Services. 2011. Spring 2011 Radar and Acoustic Bat Survey Report for the Antrim Wind Energy Project in Antrim, New Hampshire. Prepared for Eolian Renewable Energy.
Passadumkeag, Grand Falls Township, ME	20	179	Forested ridge	476	Mar-50	67	321	(140 m) 28%	Stantec Consulting Services. 2011. Spring and Summer 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Bull Hill, T16 MD, ME	10	94	Forested ridge	519	88-1108	98	371	(175 m) 27%	Stantec Consulting Services Inc. 2014. Hancock Wind Project avian and bat migration data – reanalyzed for a turbine height of 175 m - MEMO. Prepared for First Wind.
Spring 2013									
Groton Wind, Grafton Cty, NH	19	167	Forested ridge	368	60-832	23	461	(121 m) 3%	Stantec Consulting Services Inc., Western EcoSystems Technology Inc. 2014. 2013 Post Construction Avian and Bat Survey Report Groton Wind Plant Grafton County New Hampshire. Prepared for Groton Wind LLC.
Spring 2014									
Weaver Wind, T28 MD & T34 MD & T22 MD, ME	20	188	Forested ridge	806	49-2586	72	365	(180 m) 29%	*this report*

Note:
[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix B Table 10. Summary of publically available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present).

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Fall 2004									
Maple Ridge, Lewis Cty, NY	57	n/a	Agricultural plateau	158	n/a	181	415	(125 m) 8%	Mabee, T. J., J. H. Plissner, B. A. Cooper. 2005. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Flat Rock Wind Power Project, New York, Fall 2004. Prepared by ABR, Inc. for Atlantic Renewable Energy Coorporation
Sheffield, Caledonia Cty, VT	18	176	Forested ridge	91	19-320	200	566	(125 m) 1%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Dans Mountain, Allegany Cty, MD	34	318	Forested ridge	188	2-633	193	542	(125 m) 11%	Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Prattsburgh, Steuben Cty, NY	30	315	Agricultural plateau	193	12-474	188	516	(125 m) 3%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Franklin, Pendleton Cty, WV	34	349	Forested ridge	229	7-926	175	583	(125 m) 8%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Fall 2005									
Dairy Hills, Wyoming Cty, NY	57	n/a	Agricultural plateau	64	n/a	180	466	(125 m) 10%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns, L. Pavalonis. 2006. Avian and Bat Studies for the Proposed Dairy Hills Wind Project, Wyoming County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Alabama, Genesee Cty, NY	59	n/a	Agricultural plateau	67	n/a	219	489	(125 m) 11%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns. 2007. Avian and Bat Studies for the Proposed Alabama Ledge Wind Project, Genesee County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Churubusco, Clinton Cty, NY	38	414	Great Lakes plain/ADK foothills	152	9-429	193	438	(120 m) 5%	Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Sheldon, Wyoming Cty, NY	36	347	Agricultural plateau	197	43-529	213	422	(120 m) 3%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
Noble C/E/A, Clinton Cty, NY	57	n/a	Great Lakes plain/ADK foothills	197	n/a	162	333	(125 m) 12%	Mabee, T. J., J. H. Plissner, B. A. Cooper, J. B. Barna. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Clinton County Windparks, New York, Spring and Fall 2005. Final Report prepared by ABR, Inc. for Ecology and Environment, Inc. and Noble Environmental Power, LLC.
Prattsburgh, Steuben Cty (Ecogen), NY	45	n/a	Agricultural plateau	200	n/a	177	365	(125 m) 9%	Mabee, T. J., Plissner, J. H., Cooper, B. A. 2004. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Prattsbugh-Italy Wind Power Project, New York, Fall 2004. Final Report prepared by ABR, Inc. for Ecogen, LLC.
Kibby, Franklin Cty, ME (Range 1)	12	101	Forested ridge	201	12-783	196	352	(125 m) 12%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Stamford, Delaware Cty, NY	48	418	Forested ridge	315	22-784	251	494	(110 m) 3%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
Preston Cty, WV	26	n/a	Forested ridge	379	n/a	n/a	420	(125 m) 10%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Jordanville, Herkimer Cty, NY	38	404	Agricultural plateau	380	26-1019	208	440	(125 m) 6%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Stark and Warren, NY. Fall 2005 Final Report prepared for Community Energy, Inc.
Highland, VA	58	n/a	Forested ridge	385	n/a	n/a	442	(125 m) 12%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Clayton, Jefferson Cty, NY	37	385	Agricultural plateau	418	83-877	168	475	(150 m) 10%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Bliss, Wyoming Cty, NY	8	n/a	Agricultural plateau	444	n/a	n/a	411	(125 m) 13%	Ecology and Environment, Inc. 2006. Avian and Bat Risk Assessment Bliss Windpark Town of Eagle, Wyoming County, New York. Prepared for Noble Environmental Power, LLC.
Kibby, Franklin Cty, ME (Valley)	5	13	Forested ridge	452	52-995	193	391	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Mars Hill, Aroostook Cty, ME	18	117	Forested ridge	512	60-1092	228	424	(120 m) 8%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Howard, Steuben Cty, NY	39	405	Agricultural plateau	481	18-1434	185	491	(125 m) 5%	Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Deerfield, Bennington Cty, VT	32	324	Forested ridge	559	3-1736	221	395	(100 m) 13%	Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Kibby, Franklin Cty, ME (Mountain)	12	115	Forested ridge	565	109-1107	167	370	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Fairfield, Herkimer Cty, NY	38	423	Agricultural plateau	691	116-1351	198	516	(145 m) 6%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
Munnsville, Madison Cty, NY	31	292	Agricultural plateau	732	15-1671	223	644	(118 m) 2%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Fall 2006									
Villenova, Chautauqua Cty, NY	36	n/a	Great Lakes plain	189	16-604	216	353	(120 m) 9%	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
Wethersfield, Wyoming Cty, NY	56	n/a	Agricultural plateau	256	31-701	203	344	(125 m) 11%	Mabee, T. J., J. H. Plissner, J. B. Barna, B. A. Cooper. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield windparks, New York, Fall 2006. Final Report prepared by ABR, Inc. for Ecology and Environment and Noble Environmental Power, LLC
Centerville, Allegany Cty, NY	57	n/a	Agricultural plateau	259	12-877	208	305	(125 m) 12%	Mabee, T. J., J. H. Plissner, J. B. Barna, B. A. Cooper. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield windparks, New York, Fall 2006. Final Report prepared by ABR, Inc. for Ecology and Environment and Noble Environmental Power, LLC
Cape Vincent, Jefferson Cty, NY	60	n/a	Great Lakes plain	346	n/a	209	490	(125 m) 8%	Young, D. P., J. J. Kerns, C. S. Nations, V. K. Poulton. 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Project Jefferson County, New York. Final Report prepared by WEST, Inc. for BP Alternative Energy.
Stetson, Washington Cty, ME	12	77	Forested ridge	476	131-1192	227	378	(125 m) 13%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Dutch Hill, Steuben Cty, NY	21	n/a	Agricultural plateau	535	n/a	215	358	(125 m) 11%	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Dutch Hill Wind Project Cohocton, New York. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan Cty, NH	32	290	Forested ridge	620	133-1609	206	387	(125 m) 8%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Chateaugay, Franklin Cty, NY	35	327	Agricultural plateau	643	38-1373	212	431	(120 m) 8%	Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
Granite Reliable Power, Coos Cty, NH	30	328	Forested ridge	469	22-1098	223	455	(125 m) 1%	Stantec Consulting Inc. 2007. Fall 2006 Radar Surveys of Nighttime Migration Activity at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Fall 2007									
Arkwright, Chautauqua Cty, NY	57	n/a	Great Lakes plain	112	n/a	208	458	(125 m) 10%	Kerns, J., D. P. Young, C. S. Nations, V. K. Poulton. 2008. Avian and Bat Studies for the Proposed New Grange Wind Project, Chautauqua County, New York. Final Report prepared by WEST, Inc. for New Grange Wind Farm LLC.
Laurel Mountain, Barbour Cty, WV	20	212	Forested ridge	321	76-513	209	533	(130 m) 6%	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Granite Reliable Power, Coos County, NH	29	232	Forested ridge	366	54 to 1234	223	343	(125 m) 15%	Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Rollins, Lincoln, Penobscot Cty, ME	22	231	Forested ridge	368	82-953	284	343	(120 m) 13%	Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Record Hill, Oxford Cty, ME	20	220	Forested ridge	420	88-1006	227	365	(130 m) 14%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Allegany, Cattaraugus Cty, NY	46	n/a	Forested ridge	451	n/a	230	382	(150 m) 10%	Stantec Consulting. 2008. Fall Bird and Bat Migration Survey Report, Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project in Allegany, New York. Prepared for Allegany Wind, LLC. March 2008 (updated January 2010).
New Creek, Grant Cty, WV	20	n/a	Forested ridge	811	263-1683	231	360	(130 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Fall 2008									
Hounsfield, Jefferson Cty, NY	60	674	Great Lakes island	281	64-835	207	298	(125 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
Georgia Mountain, VT	21	n/a	Forested ridge	326	56-700	230	371	(120 m) 7%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind.
Oakfield, Penobscot Cty, ME	20	n/a	Forested ridge	501	116-945	200	309	(125 m) 18%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Groton Wind, Grafton Cty, NH	45	509	Forested ridge	470	94-1174	260	342	(125m) 13%	Stantec Consulting Services Inc. 2008. Fall 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Highland, Somerset Cty, ME	20	216	Forested ridge	549	68-1201	227	348	(130.5m) 17%	Stantec Consulting. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC
Fall 2009									
Sisk (Kibby Expansion) Franklin Cty, ME	20	210	Forested ridge	458	44-1067	206	287	(125m) 23%	Stantec Consulting Services. 2009. Fall 2009 Nocturnal Migration Survey Report. Prepared for TRC Engineers LLC.
Bull Hill, Hancock Cty, ME	20	232	Forested ridge	614	188-1500	260	357	(175m) 20%	Stantec Consulting Services Inc. 2014. Hancock Wind Project avian and bat migration data – reanalyzed for a turbine height of 175 m - MEMO. Prepared for First Wind.
Bowers, Washington Cty, ME	22	249	Forested ridge	344	95-844	231	453	(119m) 14%	Stantec Consulting Services Inc. 2010. Fall 2009 Avian and Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Wild Meadows, Grafton and Merrimack Ctys, NH	35	380	Forested ridge	980	384-2442	225	362	(150m) 19%	Stantec Consulting Services Inc. 2013. Fall 2009 Radar and Acoustic Surveys, Wild Meadows Wind Project in Grafton and Merrimack Counties, New Hampshire. Prepared for Atlantic Wind LLC.
Fall 2010									
Bingham, Somerset Cty, ME	20	232	Forested ridge	803	194-2463	234	378	(152m) 20%	Stantec Consulting Services Inc. 2012. Fall 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind, LLC.
Fall 2011									
Antrim, Hillsborough Cty, NH	30	327	Forested ridge	138	4-538	217	203	(150m) 40%	Stantec Consulting Services. 2011. Summer and Fall 2011 Radar and Acoustic Bat Survey Report for the Antrim Wind Energy Project in Antrim, New Hampshire. Prepared for Antrim Wind Energy, LLC.
Passadumkeag, Grand Falls Township, ME	20	222	Forested ridge	394	65-1281	251	325	(140m) 22%	Stantec Consulting Services. 2011. Summer and Fall 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Bull Hill, T16 MD, ME	10	112	Forested ridge	431	111-747	282	279	(175m) 35%	Stantec Consulting Services Inc. 2014. Hancock Wind Project avian and bat migration data – reanalyzed for a turbine height of 175 m - MEMO. Prepared for First Wind.
Fall 2013									
Groton Wind, Grafton Cty, NH	20	219	Forested ridge	483	73-1061	214	480	(121 m) 3%	Stantec Consulting Services Inc., Western EcoSystems Technology Inc. 2014. 2013 Post Construction Avian and Bat Survey Report Groton Wind Plant Grafton County New Hampshire. Prepared for Groton Wind LLC.
Fall 2014									
Weaver Wind, T28 MD & T34 MD & T22 MD, ME	20	211	Forested ridge	657	239-1122	259	412	(180 m) 23%	*this report*

Note:
[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix C BREEDING BIRD SURVEY TABLES

Appendix C Table 1. Total number of species and individuals detected and distance from observer at point count locations during 3 site visits, Weaver Wind Project, spring 2014.

Common name	Scientific name	0-50 m	50-100 m	> 100 m	Flyovers	Total
alder flycatcher	*Empidonax alnorum*	7	11			18
American crow	*Corvus brachyrhynchos*			2	1	3
American goldfinch	*Spinus tristis*		1	1	4	6
American redstart	*Setophaga ruticilla*	10	4			14
American robin	*Turdus migratorius*	10	8	4		22
American woodcock	*Scolopax minor*	1				1
black-and-white warbler	*Mniotilta varia*	11	9	1		21
black-billed cuckoo	*Coccyzus erythropthalmus*			1		1
blackburnian warbler	*Setophaga fusca*	4	7			11
black-capped chickadee	*Poecile atricapillus*	5	5	6		16
black-throated blue warbler	*Setophaga caerulescens*	8	4	3		15
black-throated green warbler	*Setophaga virens*	22	16	15		53
blue jay	*Cyanocitta cristata*	2	2	4		8
blue-headed vireo	*Vireo solitarius*	11	11	1		23
brown creeper	*Certhia americana*	3				3
cedar waxwing	*Bombycilla cedrorum*	3	1			4
chestnut-sided warbler	*Setophaga pensylvanica*	17	14	5		36
chipping sparrow	*Spizella passerina*	1		1		2
common loon	*Gavia immer*			1		1
common raven	*Corvus corax*			5	1	6
common yellowthroat	*Geothlypis trichas*	9	17	5		31
dark-eyed junco	*Junco hyemalis*	7	4			11
downy woodpecker	*Picoides pubescens*	1				1
eastern towhee	*Pipilo erythrophthalmus*			2		2
eastern wood-pewee	*Contopus virens*			3		3
golden-crowned kinglet	*Regulus satrapa*	11	5	3		19
hairy woodpecker	*Picoides villosus*		2			2
hermit thrush	*Catharus guttatus*	5	8	13		26
least flycatcher	*Empidonax minimus*	1				1
magnolia warbler	*Setophaga magnolia*	14	8	3		25
mourning dove	*Zenaida macroura*			3		3
Nashville warbler	*Oreothlypis ruficapilla*	9	9	1		19
northern flicker	*Colaptes auratus*	1		3		4
northern parula	*Setophaga americana*	4	4	1		9
ovenbird	*Seiurus aurocapilla*	13	14	20		47
palm warbler	*Setophaga palmarum*	1				1
pileated woodpecker	*Dryocopus pileatus*			2		2
red-breasted nuthatch	*Sitta canadensis*		2	3		5
red-eyed vireo	*Vireo olivaceus*	10	18	6		34
red-shouldered hawk	*Buteo lineatus*				1	1
rose-breasted grosbeak	*Pheucticus ludovicianus*	1		1		2
ruby-crowned kinglet	*Regulus calendula*			2		2
ruffed grouse	*Bonasa umbellus*	2		2		4
scarlet tanager	*Piranga olivacea*	1		1		2
Swainson's thrush	*Catharus ustulatus*		1	2		3
tufted titmouse	*Baeolophus bicolor*	1				1
veery	*Catharus fuscescens*	1				1
white-breasted nuthatch	*Sitta carolinensis*			1		1
white-throated sparrow	*Zonotrichia albicollis*	6	11	17		34
winter wren	*Troglodytes hiemalis*	2	1	8		11
yellow warbler	*Setophaga petechia*		1			1
yellow-rumped warbler	*Setophaga coronata*	6	7	4		17
unidentified bird	*n/a*	1				1
unidentified songbird	*n/a*	3			2	5
unidentified thrush	*Turdidae (gen, sp)*	1				1
unidentified warbler	*Parulidae (gen, sp)*	1				1
unidentified woodpecker	*Picadae (gen, sp)*	1	1			2
Total		**228**	**206**	**156**	**9**	**599**

*Numbers largely represent singing males but also include male and some female individuals that were visually detected.

Appendix C Table 2. Total number of observations, relative abundance, and frequency of species at point count locations during 3 site visits, Weaver Wind Project, spring 2014[1].

Acronym	Definition
USGS BBS	United States Geological Survey Breeding Bird Survey
SR	Species Richness
RA	Relative Abundance
FR	Frequency
SDI	Shannon Diversity Index

Species	Species Totals	hardwood forest, recently disturbed (10–15 yrs) (2 pts)					hardwood forest, mature (2 pts)				
		Count		Total[a]	RA[b]	FR[c]	Count		Total[a]	RA[b]	FR[c]
		5	8				33	34			
alder flycatcher	18	3		3	0.50	50%					
American goldfinch	1										
American redstart	14	2		2	0.33	50%		3	3	0.50	50%
American robin	18	2		2	0.33	50%					
American woodcock	1							1	1	0.17	50%
black-and-white warbler	20	1	3	4	0.67	100%	2	1	3	0.50	100%
blackburnian warbler	11										
black-capped chickadee	10	1		1	0.17	50%		1	1	0.17	50%
black-throated blue warbler	12		2	2	0.33	50%		1	1	0.17	50%
black-throated green warbler	38		2	2	0.33	50%	1		1	0.17	50%
blue jay	4							1	1	0.17	50%
blue-headed vireo	22		2	2	0.33	50%		1	1	0.17	50%
brown creeper	3										
cedar waxwing	4	1		1	0.17	50%					
chestnut-sided warbler	31	1	3	4	0.67	100%		3	3	0.50	50%
chipping sparrow	1										
common yellowthroat	26	1		1	0.17	50%		2	2	0.33	50%
dark-eyed junco	11										
downy woodpecker	1										
golden-crowned kinglet	16	1		1	0.17	50%					
hairy woodpecker	2	1		1	0.17	50%	1		1	0.17	50%
hermit thrush	13	1	2	3	0.50	100%	1		1	0.17	50%
least flycatcher	1										
magnolia warbler	22		1	1	0.17	50%		1	1	0.17	50%
Nashville warbler	18	1	2	3	0.50	100%	1		1	0.17	50%
northern flicker	1										
northern parula	8	2		2	0.33	50%					
ovenbird	27	4	1	5	0.83	100%	2		2	0.33	50%
palm warbler	1										
red-breasted nuthatch	2										
red-eyed vireo	28	5		5	0.83	50%	4		4	0.67	50%
rose-breasted grosbeak	1										
ruffed grouse	2										
scarlet tanager	1						1		1	0.17	50%
Swainson's thrush	1										
tufted titmouse	1										
veery	1	1		1	0.17	50%					
white-throated sparrow	17		2	2	0.33	50%					
winter wren	3										
yellow warbler	1										
yellow-rumped warbler	13										
unidentified bird	1										
unidentified songbird	3	2		2	0.33	50%					
unidentified thrush	1										
unidentified warbler	1										
unidentified woodpecker	2										
Total	**434**	**50**					**28**				
Mean RA	**0.32 ± 0.03**	**0.38 ± 0.03**					**0.27 ± 0.02**				
SR[2]	**41**	**21**					**17**				
SDI	**3.29**	**0.59**					**0.35**				

Species	mixed forest, recently disturbed (15–30 yrs) (6 pts)									forest edge, man-made clearing (3 pts)					
	Count						Total[a]	RA[b]	FR[c]	Count			Total[a]	RA[b]	FR[c]
	10	12	24	30	36	39				7	26	44			
alder flycatcher	3						3	0.17	17%	4		1	5	0.56	67%
American goldfinch										1			1	0.11	33%
American redstart	1		2				3	0.17	33%	1			1	0.11	33%
American robin	1		1				2	0.11	33%	2	2		4	0.44	67%
American woodcock															
black-and-white warbler	3	1		1		1	6	0.33	67%	1	2		3	0.33	67%
blackburnian warbler					5	2	7	0.39	33%	2		2	4	0.44	67%
black-capped chickadee		1		1	1	1	4	0.22	67%						
black-throated blue warbler					1	2	3	0.17	33%			3	3	0.33	33%
black-throated green warbler	1	2	3	2		3	11	0.61	83%		2	3	5	0.56	67%
blue jay				1			1	0.06	17%		2		2	0.22	33%
blue-headed vireo					1	3	4	0.22	33%		5	4	9	1.00	67%
brown creeper						3	3	0.17	17%						
cedar waxwing												3	3	0.33	33%
chestnut-sided warbler	6						6	0.33	17%	6	1	1	8	0.89	100%
chipping sparrow										1			1	0.11	33%
common yellowthroat	4	1			2	2	9	0.50	67%	2		3	5	0.56	67%
dark-eyed junco			1		1		2	0.11	33%	1			1	0.11	33%
downy woodpecker											1		1	0.11	33%
golden-crowned kinglet			1	1	1		3	0.17	50%		1		1	0.11	33%
hairy woodpecker															
hermit thrush	1	1	4	2			8	0.44	67%						
least flycatcher		1					1	0.06	17%						
magnolia warbler	2	2				3	7	0.39	50%	1		1	2	0.22	67%
Nashville warbler	3		1				4	0.22	33%	3	2	1	6	0.67	100%
northern flicker			1				1	0.06	17%						
northern parula	1	1			2	1	5	0.28	67%			1	1	0.11	33%
ovenbird	1	1		2	3	1	8	0.44	83%	4	2	1	7	0.78	100%
palm warbler															
red-breasted nuthatch	1				1		2	0.11	33%						
red-eyed vireo	3				3		6	0.33	33%	3	2	3	8	0.89	100%
rose-breasted grosbeak										1			1	0.11	33%
ruffed grouse	1	1					2	0.11	33%						
scarlet tanager															
Swainson's thrush						1	1	0.06	17%						
tufted titmouse															
veery															
white-throated sparrow	2	1					3	0.17	33%	1		2	3	0.33	67%
winter wren		1			1	1	3	0.17	50%						
yellow warbler												1	1	0.11	33%
yellow-rumped warbler	1	1	1	1			4	0.22	67%			2	2	0.22	33%
unidentified bird					1		1	0.06	17%						
unidentified songbird		1					1	0.06	17%						
unidentified thrush											1		1	0.11	33%
unidentified warbler															
unidentified woodpecker										1			1	0.11	33%
Total	**124**									**90**					
Mean RA	**0.22 ± 0.02**									**0.36 ± 0.04**					
SR[2]	**29**									**26**					
SDI	**1.28**									**0.96**					

Species	wetland, recently disturbed (5–40 yrs) (2 pts)					softwood plantation (5 pts)							
	Count		Total[a]	RA[b]	FR[c]	Count					Total[a]	RA[b]	FR[c]
	37	45				28	31	32	41	43			
alder flycatcher								2		5	7	0.47	40%
American goldfinch													
American redstart								1	3	1	5	0.33	60%
American robin		1	1	0.17	50%		3	4		2	9	0.60	60%
American woodcock													
black-and-white warbler		3	3	0.50	50%					1	1	0.07	20%
blackburnian warbler													
black-capped chickadee	1		1	0.17	50%	1		1		1	3	0.20	60%
black-throated blue warbler		2	2	0.33	50%				1		1	0.07	20%
black-throated green warbler	1	5	6	1.00	100%	1	7	2	2	1	13	0.87	100%
blue jay													
blue-headed vireo	1	1	2	0.33	100%		1		1	2	4	0.27	60%
brown creeper													
cedar waxwing													
chestnut-sided warbler		1	1	0.17	50%		1	5		3	9	0.60	60%
chipping sparrow													
common yellowthroat		2	2	0.33	50%	1	1	3	1	1	7	0.47	100%
dark-eyed junco						1	2	3	1	1	8	0.53	100%
downy woodpecker													
golden-crowned kinglet	3		3	0.50	50%	3	4		1		8	0.53	60%
hairy woodpecker													
hermit thrush		1	1	0.17	50%								
least flycatcher													
magnolia warbler		2	2	0.33	50%	1	4	1	2	1	9	0.60	100%
Nashville warbler						3			1		4	0.27	40%
northern flicker													
northern parula													
ovenbird		2	2	0.33	50%		1		1	1	3	0.20	60%
palm warbler						1					1	0.07	20%
red-breasted nuthatch													
red-eyed vireo		1	1	0.17	50%		1	1	1	1	4	0.27	80%
rose-breasted grosbeak													
ruffed grouse													
scarlet tanager													
Swainson's thrush													
tufted titmouse	1		1	0.17	50%								
veery													
white-throated sparrow	2		2	0.33	50%		1	3	1	2	7	0.47	80%
winter wren													
yellow warbler													
yellow-rumped warbler	2		2	0.33	50%		2	2		1	5	0.33	60%
unidentified bird													
unidentified songbird													
unidentified thrush													
unidentified warbler	1		1	0.17	50%								
unidentified woodpecker		1	1	0.17	50%								
Total	**34**					**108**							
Mean RA	**0.31 ± 0.03**					**0.38 ± 0.03**							
SR[2]	**16**					**19**							
SDI	**0.41**					**1.04**							

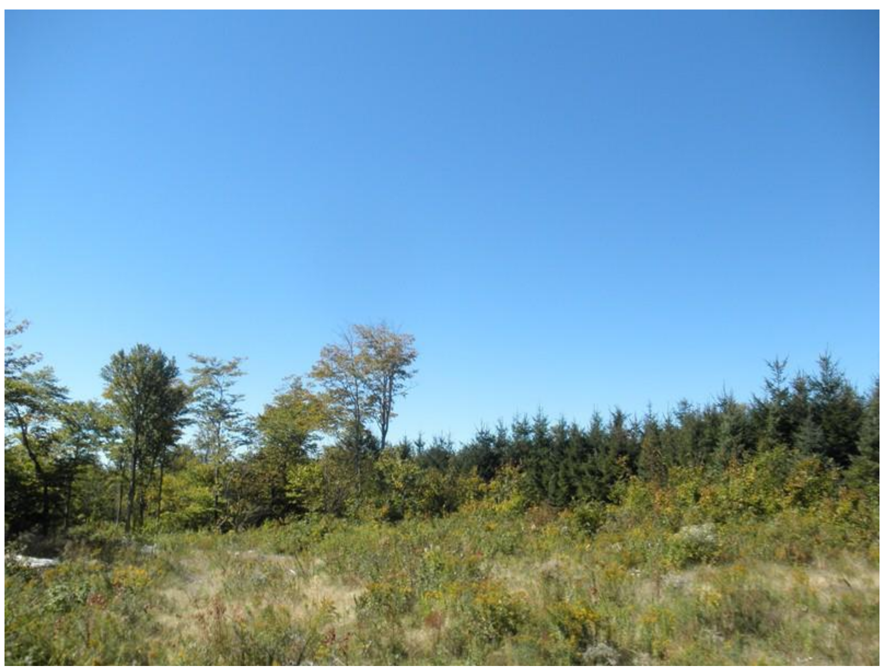
[1] Excluding birds detected at distances greater than 100m and flyovers
a Total number of individuals detected (mainly singing males, also males and females that were visually observed).
b Mean number of birds observed.
c Percentage of survey points at which the species was observed.
[2] Not including unidentified genera of birds (e.g., unidentified warbler, *Parulidae*)

Appendix D DIURNAL RAPTOR MIGRATION SURVEY PHOTOS AND TABLES

Appendix D Figure 1. View to the north from the observation site on Een Ridge, Weaver Wind Project.

Appendix D Figure 2. View to the east from the observation site on Een Ridge, Weaver Wind Project.

Appendix D Figure 3. View to the south from the observation site on Een Ridge, Weaver Wind Project.



Appendix D Figure 4. View to the west from the observation site on Een Ridge, Weaver Wind Project.

Appendix D Table 1. Daily observations of raptor species and daily passage rates at Weaver Wind Project, fall 2013**.**

Species	9/11	9/18	9/19	9/25	10/6	10/8	10/9	10/19	10/20	10/21	Total
American kestrel	1					1	1				3
bald eagle		1								2	3
broad-winged hawk	10	1	2								13
Cooper's hawk		2									2
merlin						1					1
northern harrier							1				1
red-shouldered hawk	2										2
red-tailed hawk										1	1
sharp-shinned hawk	3			4	2	1					10
turkey vulture	5		3	1	2	1	6				18
unidentified raptor	3										3
unidentified accipiter				4							4
unidentified buteo							1				1
Total	**24**	**4**	**5**	**9**	**4**	**4**	**9**	**0**	**0**	**3**	**62**
Passage rate	**3.56**	**0.57**	**0.71**	**1.29**	**0.57**	**0.57**	**1.29**	**0.00**	**0.00**	**0.43**	**0.90**

Appendix D Table 2. Hourly summary of raptor observations at Weaver Wind Project, fall 2013.

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00
American kestrel				1	1	1	
bald eagle	1			1			1
broad-winged hawk			3	7		1	2
Cooper's hawk		1				1	
merlin		1					
northern harrier						1	
red-shouldered hawk			2				
red-tailed hawk				1			
sharp-shinned hawk	4	2		1	2	1	
turkey vulture		2	2	5		8	1
unidentified raptor				2	1		
unidentified accipiter							4
unidentified buteo				1			
Total	**5**	**6**	**7**	**19**	**4**	**13**	**8**

Appendix D Table 3. Number of individuals of species observed inside turbine areas (400 m buffer) above or below 180 m, Weaver Wind Project, fall 2013.

Species	Minimum height 180 m or greater inside turbine area	Minimum height less than 180 m inside turbine area	outside turbine areas
American kestrel		2	1
bald eagle			3
broad-winged hawk	5	8	
Cooper's hawk		2	
merlin		1	
northern harrier			1
red-shouldered hawk		2	
red-tailed hawk		1	
sharp-shinned hawk		10	
turkey vulture	2	9	7
unidentified raptor		2	1
unidentified accipiter		4	
unidentified buteo			1
Total	**7**	**41**	**14**
Percent	**11%**	**66%**	**23%**

Appendix D Table 4. Daily observations of raptor species and daily passage rates at Weaver Wind Project, spring 2014.

Species	4/21	4/25	5/7	5/8	5/9	5/12	5/13	5/21	5/28	5/29	Total
American kestrel				2		1					3
bald eagle		1	1	2	1	3					8
broad-winged hawk	11	1	2	4	2	2	1			1	24
Cooper's hawk	1					1				1	3
northern harrier	1			2	2						5
osprey	7	2				3					12
red-tailed hawk	1	2	1		5		1				10
sharp-shinned hawk	1			2	1		1				5
turkey vulture	6	1		1	2	7	7			5	29
unidentified accipiter		1		1							2
unidentified buteo	2	1	1		1	1		1			7
unidentified raptor	2		1	1		1					5
Total	**32**	**9**	**6**	**15**	**14**	**19**	**10**	**1**	**0**	**7**	**113**
Passage rate	**4.57**	**1.29**	**0.86**	**2.14**	**2.00**	**2.71**	**1.43**	**0.14**	**0.00**	**1.00**	**1.61**

Appendix D Table 5. Hourly summary of raptor observations at Weaver Wind Project, spring 2014.

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00
American kestrel			1				2
bald eagle			5	1	1		1
broad-winged hawk	5	1	4	1	6	5	2
Cooper's hawk				1	1		1
northern harrier	1		1		2	1	
osprey	3	3	1		1	2	2
red-tailed hawk	4	2		2			2
sharp-shinned hawk	2	1		1			1
turkey vulture		5	3	5	7	6	3
unidentified accipiter	1					1	
unidentified buteo	1		1	1	2	2	
unidentified raptor	2		2	1			
Total	**19**	**12**	**18**	**13**	**20**	**17**	**14**

Appendix D Table 6. Number of individuals of species observed inside turbine areas (400 m buffer) above or below 180 m, Weaver Wind Project, spring 2014.

Species	Minimum height 180 m or greater inside turbine area	Minimum height less than 180 m inside turbine area	Outside turbine areas
American kestrel		2	1
bald eagle		1	7
broad-winged hawk		14	10
Cooper's hawk		2	1
northern harrier		5	
osprey		4	8
red-tailed hawk		7	3
sharp-shinned hawk		4	1
turkey vulture		14	15
unidentified accipiter		2	
unidentified buteo		3	4
unidentified raptor		2	3
Total	**0**	**60**	**53**

Appendix D Table 7. Daily observations of raptor species and daily passage rates at Weaver Wind Project, fall 2014.

Species	9/18	9/21	10/2	10/6	10/13	10/20	10/28	10/30	11/4	11/11	Total
American kestrel					2						2
bald eagle			2		1	4	1	1			9
broad-winged hawk	14	1		1							16
Cooper's hawk					1						1
golden eagle					1						1
merlin					2						2
osprey			2								2
peregrine falcon									1		1
red-tailed hawk			1	2	3	3	2			4	15
sharp-shinned hawk		2	1	1			1	2	1	1	9
turkey vulture	1	3		2	5	2					13
unidentified buteo	3	1		1							5
unidentified falcon					1						1
unidentified raptor	3			1		1	4	1			10
unidentified accipiter						1					1
TOTAL	**21**	**7**	**6**	**8**	**16**	**11**	**8**	**4**	**2**	**5**	**88**
PASSAGE RATE	**3.00**	**1.00**	**0.86**	**1.14**	**2.29**	**1.57**	**1.14**	**0.57**	**0.29**	**0.71**	**1.26**

Appendix D Table 8. Hourly summary of raptor observations at Weaver Wind Project, fall 2014.

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00
American kestrel					1	1	
bald eagle			2	4	2	1	
broad-winged hawk		8	2	3	1	2	
Cooper's hawk					1		
golden eagle							1
merlin		2					
osprey		2					
peregrine falcon						1	
red-tailed hawk		1	4	2	5	2	1
sharp-shinned hawk	1	2	1	2	2	1	
turkey vulture	1			3	4	4	1
unidentified buteo		3			1	1	
unidentified falcon						1	
unidentified raptor	1	1	5	2	1		
unidentified accipiter			1				
TOTAL	**3**	**19**	**15**	**16**	**18**	**14**	**3**

Appendix D Table 9. Number of individuals of species observed inside turbine areas (400 m buffer) above or below 180 m, Weaver Wind Project, fall 2014.

Species	Minimum height 180 m or greater inside turbine area	Minimum height less than 180 m inside turbine area	Outside turbine areas
American kestrel		2	
bald eagle		5	4
broad-winged hawk		6	10
Cooper's hawk		1	
golden eagle	1		
merlin		2	
osprey			2
peregrine falcon		1	
red-tailed hawk	1	13	1
sharp-shinned hawk		9	
turkey vulture		8	5
unidentified buteo hawk		1	4
unidentified falcon		1	
unidentified raptor2		8	2
unidentified accipiter			1
Total	**2**	**57**	**29**

Exhibit 7-4

Spring 2014 Aerial Bald Eagle Nest Survey Report

Stantec — Memo

To:	Robert Roy First Wind	From:	Bryan Emerson Stantec
File:	195600884	Date:	October 21, 2014

Reference: **Spring 2014 Aerial Bald Eagle Nest Survey - Revised**
Bull Hill, Hancock, and Weaver Wind Projects

Stantec Consulting Services, Inc. (Stantec) conducted aerial surveys for bald eagle (*Haliaeetus leucocephalus*) nests in the vicinity of the existing Bull Hill Wind Project, Hancock Wind Project (permitted but not yet constructed), and the proposed Weaver Wind Project (Projects). The 2014 aerial bald eagle survey included inland waterbodies and a portion of Taunton Bay within 10 miles of the turbine locations for the Projects (per the U.S. Fish and Wildlife Service [USFWS] 2013)[1] (Figure 1). Prior to the survey, Stantec reviewed information provided by the Maine Department of Inland Fisheries and Wildlife (MDIFW) regarding known active and historic bald eagle nest locations in the vicinity of the Projects. Following protocol previously established by the USFWS (2007)[2], on April 15, 2014 Stantec notified Mark McCollough of the USFWS Maine Field Office that flights were planned in the area and that Stantec was coordinating with MDIFW on the timing and methods of the flights. Mr. McCullough responded on April 15, 2014 and confirmed that the notification was received.

Stantec's aerial survey also included a survey for large raptor nests within 1 mile and great blue heron (*Ardea herodias*) rookeries within 4 miles of the proposed Weaver turbines. These surveys were recommended by MDIFW[3] and were consistent with Stantec's work plan dated June 14, 2014 for Weaver[4].

SURVEY METHODS

Stantec conducted 2 phases of aerial flights within the survey area as depicted on Figure 1. The aerial surveys were conducted in a Cessna 172 fixed-wing aircraft piloted by Frank Craig of Aerial Photo Service of Maine, Inc. The first phase of flights consisted of 2 flights that were conducted on April 30 and May 9, 2014. The timing of the first phase of flights was chosen to correspond with the time period when eagles are actively incubating eggs in the nests. The purpose of the first phase of flights was to check the mapped bald eagle nests within the survey area and to search potential nesting habitat to identify any new bald eagle nests within 10 miles of the existing and proposed turbine locations at the Projects. The surveys for new bald eagle nests consisted of low altitude passes, approximately 500 feet above ground level, along the shoreline of 30 waterbodies and a portion of Taunton Bay (Figure 1). The second phase of flights consisted of a single flight on July 11, 2014. The purpose of this flight was to check the status of active nests within 10 miles of the Projects.

[1] U.S. Fish and Wildlife Service. 2013. *Eagle Conservation Plan Guidance*. U.S. Fish and Wildlife Service, Washington, DC.
[2] U.S. Fish and Wildlife Service, 2007. *National Bald Eagle Management Guidelines*. U.S. Fish and Wildlife Service, Washington, DC.
[3] Maine Department of Inland Fisheries and Wildlife. 2014. *Curtailment Policy and Wind Power Preconstruction Study Recommendations*. Maine Department of Inland Fisheries and Wildlife, April 2014.
[4] The work plan for the Weaver Project was based on MDIFW's 2014 *Curtailment Policy and Wind Power Preconstruction Study Recommendations* and discussions held with MDIFW during a meeting with First Wind and Stantec on June 2, 2014 at MDIFW's Bangor Office.

Reference: Spring 2014 Aerial Bald Eagle Nest Survey
Bull Hill, Hancock, and Weaver Wind Projects

The timing of this flight was chosen to correspond with the time period when eaglets have hatched and are visible in the nest (to determine hatching success).

Stantec conducted surveys for raptor nests within 1 mile of the proposed Weaver turbines during the April 30 survey flight. Stantec flew transects spaced approximately 0.5-mile apart along the length of the turbine strings and out to 1 mile from turbines. We made low-altitude passes, approximately 500 feet above ground level, to search for any large stick nests that could be used by raptors.

Stantec conducted surveys for great blue heron nests within 4 miles of the proposed Weaver turbines during the July 11 survey flight. Stantec surveyed large wetland complexes (marshes, bogs, etc.) that were not otherwise surveyed during the eagle or raptor nest survey. The survey also included any mapped rookeries within 4 miles of the Weaver turbines. The survey consisted of low altitude passes over the identified habitats. The timing of the great blue heron survey flight was chosen to correspond with the time period when great blue herons are actively incubating eggs or brooding chicks in their nests.

During the 3 flights, we recorded incidental observations of bald eagles, osprey (*Pandion haliaetus*), other raptors, and great blue heron.

SURVEY RESULTS

Stantec located all historically mapped nests except for #221C on Spectacle Pond and #700A near Horseshoe Pond; these were assumed to have fallen down. Seven occupied bald eagle nests and 6 unoccupied nests were identified within the survey area. Of the 7 occupied nests, 6 were found to have successfully hatched at least 1 eaglet at the time of the second flight. The remaining occupied nest, #663A on Lower Middle Branch Pond, was empty during the second flight and most likely failed. The closest occupied nest to the nearest turbine location for the Projects is nest #360A on Molasses Pond. This nest is approximately 3.16 miles from the nearest Weaver turbine location, 2.9 miles from the nearest Bull Hill turbine, and 5.8 miles from the nearest Hancock turbine. Of the 7 total occupied nests observed, only 4 were located within 10 miles of the Weaver turbine locations. The results of the survey flights are presented in Table 1 below and shown on the attached Figure 1.

Table 1. Results of Aerial Survey Flights – Bull Hill, Hancock, and Weaver Wind Projects.

MDIFW Nest #	Waterbody / Location	First Flight Status	Second Flight Status	Approx. Distance to Nearest Weaver Turbine (mi)	Notes
701A	Great Pond	Occupied – adult incubating	1 fledgling in nest	10.14	
239B	Alligator Lake	Unoccupied	Unoccupied	8.69	1 adult eagle near nest on second flight
663A	Lower Middle Branch Pond	Occupied – adult brooding at least 1 chick	Empty – possible nest failure	4.02	

Reference: **Spring 2014 Aerial Bald Eagle Nest Survey**
Bull Hill, Hancock, and Weaver Wind Projects

MDIFW Nest #	Waterbody / Location	First Flight Status	Second Flight Status	Approx. Distance to Nearest Weaver Turbine (mi)	Notes
437A	Lower Lead Mountain Pond	Unoccupied	Unoccupied	3.08	
142D	Bog Brook Flowage	Unoccupied	Unoccupied	9.82	
360A	Molasses Pond	Occupied – adult brooding at least 1 chick	2 fledglings in nest	3.16	
511B	Webb Lake	Occupied – 2 chicks in nest	1 fledgling in nest	5.08	
030C	Graham Lake	Occupied – 1 chick in nest	1 fledgling in nest	8.15	
503A	Spring River Lake	Unoccupied	Unoccupied	10.66	
034D	Taunton Bay	Unoccupied	Unoccupied	10.22	
631A	Taunton Bay	Occupied – adult incubating	1 fledgling in nest	10.52	
417B	Taunton Bay	Occupied – adult brooding	1 fledgling in nest	11.56	
699A	Donnell Pond	Unoccupied	Unoccupied	9.09	
221C	Spectacle Pond	Unoccupied - nest not located	Unoccupied - nest not located	--	1 adult on eastern shore of lake on 2nd flight
700A	Horseshoe Pond	Unoccupied – nest down	Unoccupied – nest down	--	Active great blue heron rookery observed at nest location

During the first phase of flights in April and May, Stantec observed an adult bald eagle perched at the north end of Beddington Lake and a sub-adult bald eagle flying over Bog Brook Flowage. Stantec observed adult ospreys on Lower Lead Mountain Pond, Scammon Pond, and Webb Pond.

An active osprey nest was observed on Bog Brook Flowage south of bald eagle nest #142D and an active osprey nest was observed on a set of powerlines south of Great Pond in Franklin. Both nests were greater than 4 miles from the turbine locations. Stantec also did not identify any raptor nests during the transect surveys within 1 mile of the proposed Weaver turbines.

During the July flight, Stantec identified an active great blue heron rookery in a small wetland northwest of Horseshoe Pond in Beddington. This rookery was located near the location of bald eagle nest #700A and is mostly likely a relocation of the previously mapped great blue heron rookery #125. Stantec observed 3 great blue heron nests in the rookery, 2 of which were active with

Reference: Spring 2014 Aerial Bald Eagle Nest Survey
Bull Hill, Hancock, and Weaver Wind Projects

at least 2 chicks in each active nest. No adult great blue herons were observed near the nests. This rookery is greater than 4 miles from the nearest existing or proposed turbine. Since nest status was confirmed during eagle flights, ground surveys were not performed. No active or historic nests or great blue herons were observed at the location of rookery #125.

During the July flight, Stantec also attempted to locate great blue heron rookery #770 in Osborn. Stantec took several passes over this location and did not observe any great blue herons or evidence of any current or historic nests. However, during a flight in the spring of 2014, MDIFW was able to locate the rookery and identified 12 active nests. Therefore, this rookery is shown as active on Figure 1. No other great blue herons or rookeries were observed within 4 miles of the Weaver turbine locations.

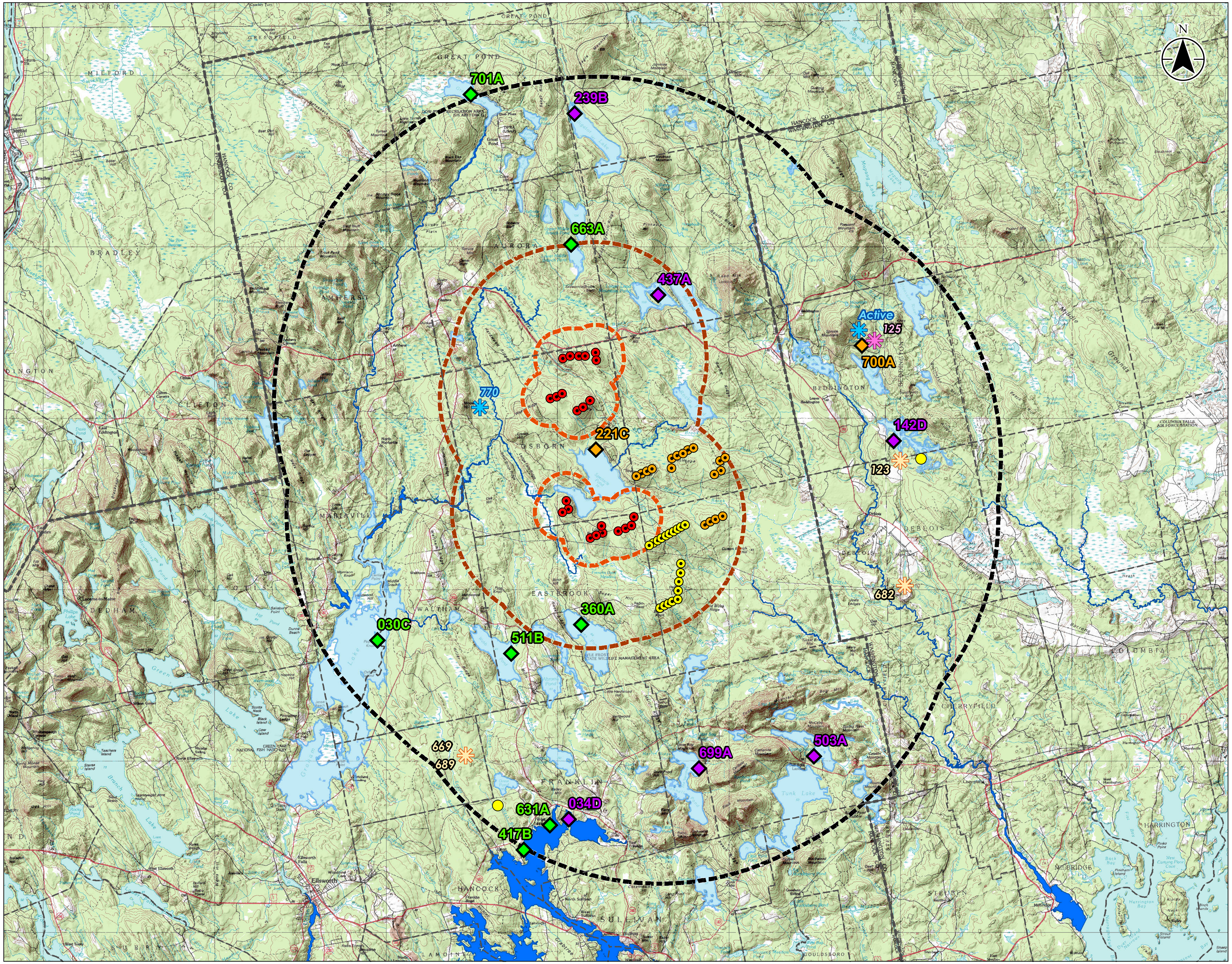
Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING SERVICES INC.

Bryan Emerson
Phone: (207) 729-1199 x113
Fax: (207) 729-2715
bryan.emerson@stantec.com

Attachment: Figure 1 – 2014 Bald Eagle Survey Map

c. Brooke Barnes, Stantec
Adam Gravel, Stantec



Stantec

Legend

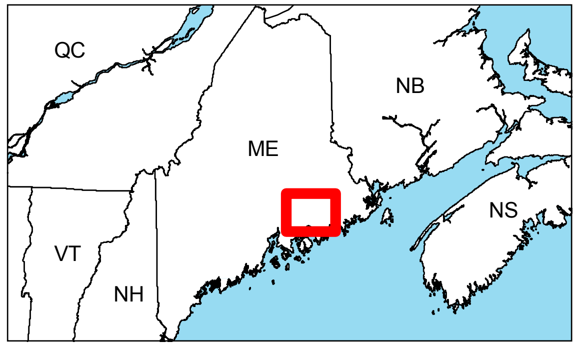
- Occupied Bald Eagle Nest (7)
- Unoccupied Bald Eagle Nest (6)
- Bald Eagle Nest Not Found (2)
- Active Osprey Nest
- Active Great Blue Heron Rookery
- Great Blue Heron Rookery Not Found
- Great Blue Heron Rookery Not Surveyed
- Hancock Turbine Layout
- Weaver Turbine Layout
- Bull Hill Turbine Layout
- Waterbody Surveyed
- River/Stream
- 1 Mile From Weaver Turbines
- 4 Miles From Weaver Turbines
- 10 Miles From Bull Hill, Hancock and Weaver Turbines
- Town Boundary
- County Boundary

0 4 Miles

1:230,354 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Base features provided by the Stantec & Maine Office of GIS (MEGIS).



Project Location 195600884

Hancock County, Maine

Prepared by DLJ on 2014-10-21

Reviewed by BPE on 2014-10-21

Client/Project

Weaver Wind Project

Hancock County, Maine

Figure No.

1

Title

Bald Eagle Nest Survey

Exhibit 7-5

2015 Eagle Use Survey Report

2015 Pre-Construction Aerial Bald Eagle Nest Surveys and 2014–2015 Eagle Point Count Surveys

Weaver Wind Project
Hancock County, Maine

Stantec

Prepared for:
Longroad Energy Management, LLC
133 Federal Street, 12th Floor
Boston, MA 02110

Prepared by:
Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

195601223

September 7, 2018

Table of Contents

EXECUTIVE SUMMARY ..... **II**

1.0 INTRODUCTION **1**
1.1 PROJECT BACKGROUND 1
1.2 PROJECT DESCRIPTION 1

2.0 AERIAL BALD EAGLE NEST SURVEYS **3**
2.1 INTRODUCTION 3
2.2 METHODS 3
2.3 RESULTS 4
2.3.1 Bald Eagle Nest Results 4
2.3.2 Incidental Bald Eagle Observations 7
2.3.3 Incidental Osprey Observations 7
2.3.4 Great Blue Heron Rookery Results 7

3.0 EAGLE POINT COUNT SURVEYS **8**
3.1 INTRODUCTION 8
3.2 METHODS 8
3.3 RESULTS 10
3.3.1 Survey Effort 10
3.3.2 Location, Behavior, and Exposure Minutes 10
3.3.3 Incidental Raptor and Waterbird Observations During Eagle Point Count Surveys 12

4.0 REFERENCES **14**

LIST OF TABLES

Table 2-1. 2015 Results of Aerial Bald Eagle Nest Survey, Weaver Wind Project. 6
Table 3-1. Survey effort results and weather conditions during eagle point count surveys, Weaver Wind Project, April 2014 – April 2015. 10
Table 3-2. Location and flight data for eagles observed during eagle point count surveys, Weaver Wind Project, April 2014 – April 2015. 11
Table 3-3. Summary of eagle minutes, eagle exposure-minutes, and passage rates by survey plot, Weaver Wind Project, April 2014 – April 2015. 12
Table 3-4. Raptor and waterbird species observed incidentally during eagle point count surveys, Weaver Wind Project, April 2014 – April 2015. 13

LIST OF FIGURES

Figure 1-1. Weaver Wind Project Location Map, Hancock County, 2015. 2
Figure 2-1. 2015 Aerial Bald Eagle Nest Survey, Weaver Wind Project, 2015. 5
Figure 3-1. Eagle Point Count Location Map, Weaver Wind Project, April 2014 – April 2015. 9

Executive Summary

Stantec Consulting Services Inc. (Stantec) conducted pre-construction aerial bald eagle (*Haliaeetus leucocephalus*) nest surveys in 2015 and eagle use point count surveys in 2014-2015 at the proposed Weaver Wind Project (Project) in Hancock County, Maine. Surveys followed methods described in the Maine Department of Inland Fisheries and Wildlife's Wind Power Preconstruction Study Recommendations (April 2014), the U.S. Fish and Wildlife Service *Eagle Conservation Plan Guidance* (ECP Guidance; April 2013), and the Project Work Plan (Stantec 2014).

Aerial Bald Eagle Nest Surveys

During the aerial bald eagle nest surveys Stantec searched inland waterbodies and a portion of Taunton Bay within 10 miles of the proposed Project turbines for bald eagle nests. The aerial surveys also targeted great blue heron (*Ardea herodias*) rookeries within 4 miles of the proposed Project.

Stantec conducted the aerial surveys on 22 April and 24 June 2015. Stantec identified 8 occupied and 5 unoccupied bald eagle nests within the survey area. At the time of the second flight, of the 8 occupied nests, 3 were found to have successfully hatched at least 1 eaglet and 2 were determined to have failed. Of the 8 occupied bald eagle nests in the survey area, 5 were located within 10 miles of the nearest Project turbine. The closest occupied nest to a proposed Project turbine was #437A on Lower Lead Mountain Pond. This nest was not successful in 2015.

Eagle Point Count Surveys

The objective of the eagle use point count surveys was to fulfill requirements of the final eagle rule. Stantec conducted eagle point count surveys approximately every 3 weeks resulting in 18 rounds between 22 April 2014 and 16 April 2015. Each round of surveys consisted of 2-hour visual surveys at 6 point count locations[1], Each location surveyed an area of 2 square kilometers (km^2) (800-meter radius circle).

Eighteen eagles were recorded during surveys: 16 bald eagles and 2 eagles that could not be identified to species (i.e., it could not be determined whether the eagle was a bald or golden eagle (*Aquila chrysaetos*) due to the distance of the bird from the observer, lighting, or short duration of the observation). Eagles were observed at all 6 point count locations. The greatest number of eagle minutes was recorded at Point 32 (17 minutes), which is centrally located. Stantec recorded 47 total eagle minutes inside the survey areas and 31 total eagle minutes

[1] Per the Project Work Plan (Stantec 2014), the number of point count locations was determined by calculating the entire turbine area including a 1-km buffer around turbines, calculating 30% of the area, and dividing by 2 (to account for the 2 km^2 plots).

inside the approximate turbine rotor-sweep zone (i.e., 45–80 meters). The total eagle passage rate was 0.2 eagle minutes per hour.

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Stantec Consulting Services Inc. (Stantec) conducted pre-construction aerial bald eagle (*Haliaeetus leucocephalus*) nest surveys and eagle use point count surveys at Weaver Wind LLC's proposed Weaver Wind Project (Project) located in Hancock County, Maine (Figure 1-1). The Project will include 22 V126 3.45 megawatt (MW) turbines and associated infrastructure (i.e., access roads, transmission lines, and electrical substation). The proposed turbines are expected to have a maximum height of 180 meters (m; 591 feet [ft]). Surveys were conducted based on the following recommendations and discussions:

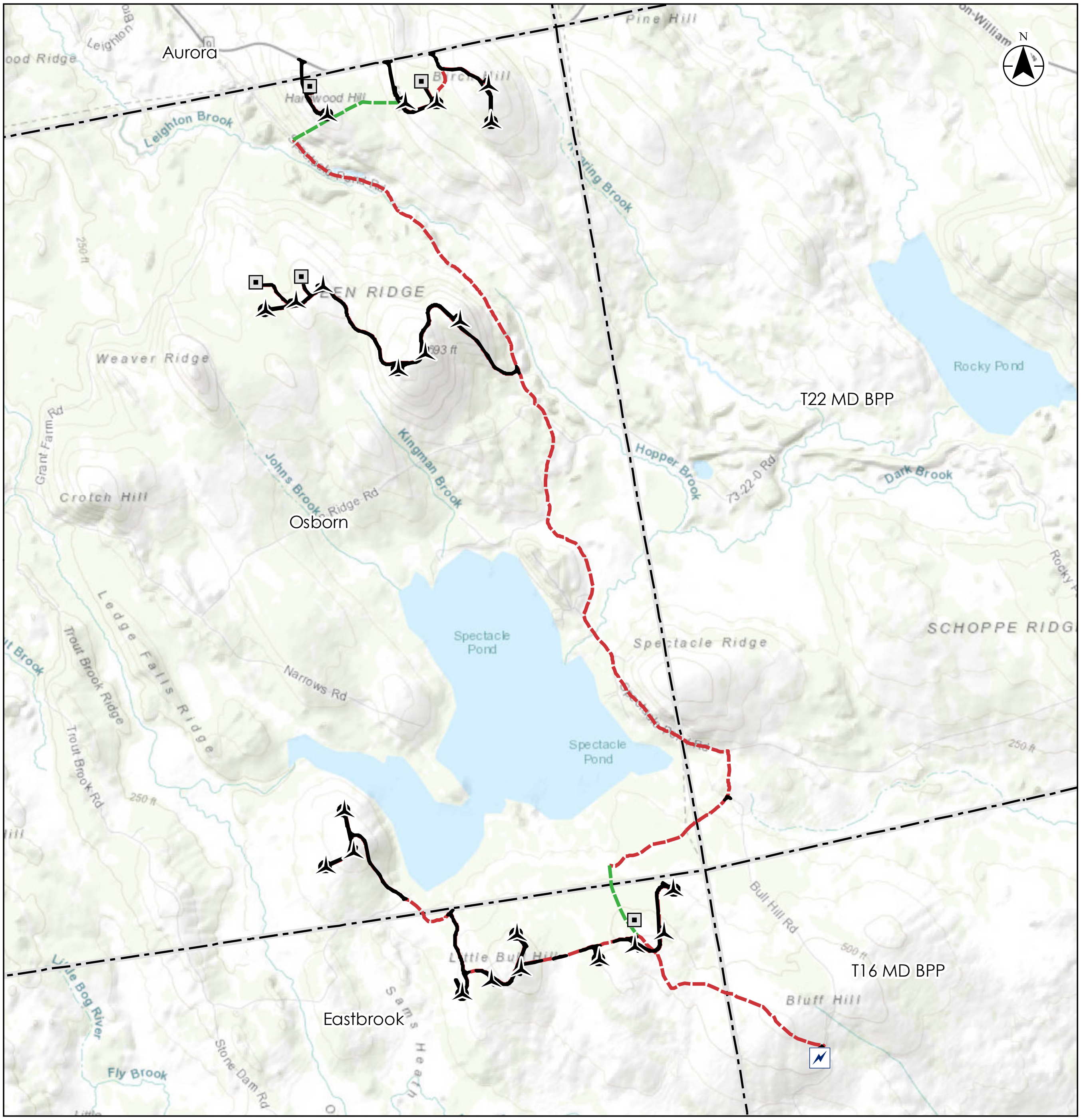
1. Maine Department of Inland Fisheries and Wildlife's (MDIFW) Wind Power Preconstruction Study Recommendations (April 2014) available at the time of surveys;
2. US Fish and Wildlife Service's (USFWS) *Eagle Conservation Plan Guidance* (April 2013; ECP Guidance;
3. Discussions held with MDIFW during a meeting with SunEdison and Stantec on 2 June 2014 at MDIFW's Bangor Office;
4. Phone conversation on 14 April 2014 between Stantec and Sarah Nystrom, the former USFWS Northeast Region Eagle Coordinator at the time of surveys, which confirmed use survey level of effort and survey locations;
5. The Work Plan prepared by Stantec dated 18 June 2014 that was submitted to MDIFW and USFWS; and
6. Consultation with USFWS on 16 April 2014 regarding eagle point count surveys (the Work Plan was later approved by USFWS on 28 April 2014).

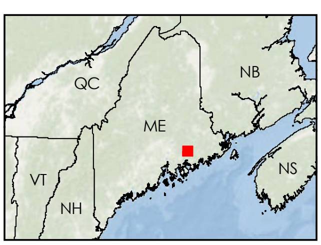
1.2 PROJECT DESCRIPTION

The Project is located within the Downeast Maine Ecoregion as defined in Maine's Comprehensive Wildlife Conservation Strategy (Griffith et al. 2009). The Downeast Maine Ecoregion extends from coastal areas from Ellsworth to Eastport and inland to north of Route 9. This ecoregion is characterized by low acidic summits, blueberry barrens, coastal spruce-fir forests, and industrial timberlands.

The turbine area includes Hardwood Hill, Birch Hill, Een Ridge, Little Bull Hill, and other unnamed hills nearby (Figure 1-1). Peak elevations i range from approximately 152 m (500 ft) to 213 m (700 ft). The turbine area is dominated by mixed forest including paper birch (*Betula papyrifera*), American beech (*Fagus grandifolia*), balsam fir (*Abies balsamea*), and red spruce (*Picea rubens*); multiple spruce and fir plantations are present. Forest management activities and logging in the area are ongoing. Evidence of these activities, including active logging roads, skidder trails, and managed plantations, is present throughout the turbine area.

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\AvianBat\Eagle Survey\01223_1-1_EagleLocation.mxd Revised: 2018-09-06 By: gcarpentier





Legend
- Turbine Layout
- MET Tower
- Substation
- Overhead Collector
- Underground Collector
- Access Road

0 6,000 Feet
1:72,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Base map: ESRI Wowrld Topographic Map

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants, and agents, from any and all claims arising in any way from the content or provision of the data.

Stantec

Project Location 195601223
Hancock County, Maine
Prepared by GAC on 2018-09-06
Reviewed by SBG on 2018-09-07

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
1-1

Title
Weaver Wind Project Location Map

2.0 AERIAL BALD EAGLE NEST SURVEYS

2.1 INTRODUCTION

During the aerial bald eagle nest surveys, Stantec searched inland waterbodies and a portion of Taunton Bay within 10 miles of the Project turbines for nests (survey area). Prior to surveys, Stantec reviewed information provided by the MDIFW regarding known active and historic bald eagle nest locations. Following protocol previously established by the USFWS (2007), Stantec notified Mark McCollough of the USFWS Maine Field Office that flights were being conducted in the area and that Stantec was coordinating with MDIFW on the timing and methods of the flights. Mr. McCullough confirmed that the notification was received.

Aerial surveys also targeted great blue heron (*Ardea herodias*) rookeries within 4 miles of the Project turbines. These surveys were recommended by MDIFW and were consistent the Work Plan (Stantec 2014).

2.2 METHODS

Stantec conducted 2 flights within the survey area as depicted on Figure 2-1. The aerial bald eagle nest surveys were conducted in a Cessna 206 fixed-wing aircraft piloted by Mr. Tomas Sowles (first flight) and Mr. Roger Wolverton (second flight) of Penobscot Island Air. The first flight was conducted on 22 April 2015. The timing of the first flight was chosen to correspond with the time period when eagles are actively incubating eggs in the nests. The purpose of the first flight was to check the mapped bald eagle nests within the survey area and to search potential nesting habitat to survey for new bald eagle nests within 10 miles of the Project. The surveys for new bald eagle nests consisted of low altitude passes, approximately 300–500 ft above ground level, along the shoreline of 30 waterbodies and a portion of Taunton Bay (Figure 2-1). The second flight was conducted on 24 June 2015 and was performed to check the status of active bald eagle nests within 10 miles of the Project. The timing of this flight was chosen to correspond with the time period when eaglets have hatched and are visible in the nest to help determine hatching success.

Stantec conducted surveys for great blue heron nests within 4 miles of the proposed Weaver turbines during the 24 June survey flight. Stantec surveyed large wetland complexes (marshes, bogs, etc.) that were not otherwise surveyed during the aerial bald eagle nest survey. The surveys also included any mapped rookeries within 4 miles of the Project turbines. The survey consisted of low altitude passes over the identified habitats. The timing of the great blue heron survey flight was chosen to correspond with the time period when great blue herons are actively incubating eggs or brooding chicks in their nests.

During the 2 flights, incidental observations of bald eagles, osprey (*Pandion haliaetus*), and great blue heron were recorded.

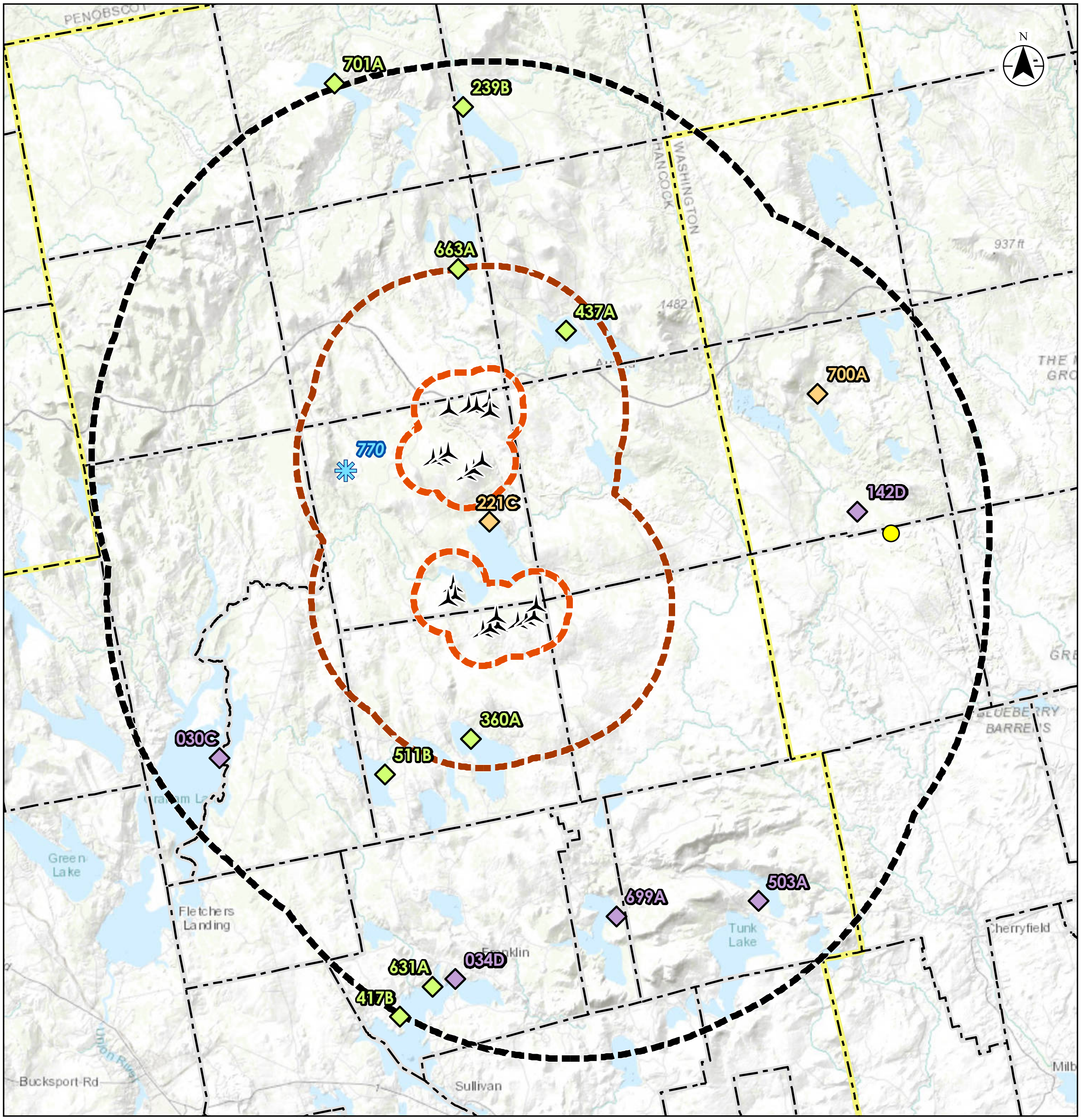
2.3 RESULTS

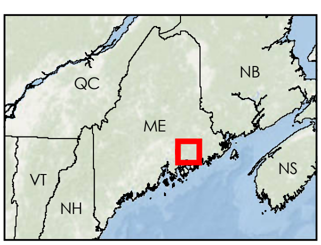
2.3.1 Bald Eagle Nest Results

Eight occupied bald eagle nests and 5 unoccupied nests were identified within the survey area. Two historically mapped nests, #700A near Horseshoe Pond and #221C on Spectacle Pond, were not located during the 2015 surveys. Of these 15 nest locations, 8 are located within 10 miles of the Project, 5 of which were unoccupied.

Of the 8 occupied nests in the survey area, 3 were found to have successfully hatched at least 1 eaglet at the time of the second flight. Two of the occupied nests, #239B on Alligator Lake and #511B on Webb Pond, were apparent nest failures, as these nests contained incubating adults during the first flight but were empty on the second flight. The remaining 3 occupied nests, #360A on Molasses Pond, #437A on Lower Lead Mountain Pond, and #417B on Taunton Bay, were considered occupied because adult bald eagles were observed at the nest during one or both of the flights and the nests were in good condition. As detailed in the ECP Guidance, the occurrence of a pair of adult eagles at or near a nest during the normal incubation time period constitutes the nest being considered "occupied."

The closest occupied nest to the nearest turbine location for the Projects is nest #437A on Lower Lead Mountain Pond. This nest is approximately 3.08 miles from the nearest Project turbine. This nest was unoccupied on the first flight, but 2 adult bald eagles were observed standing at the nest during the second flight. As shown on Table 2-1, this nest is considered occupied but has been historically inactive and did not appear to be successful in 2015. Of the 8 occupied nests observed during the flights, 5 were located within 10 miles of the Project turbines. The results of the survey flights are presented in Table 2-1 below and shown in the Figure 2-1.





Legend

- Turbine Layout
- Occupied Bald Eagle Nest (8)
- Unoccupied Bald Eagle Nest (5)
- Bald Eagle Nest Not Found (2)
- Active Great Blue Heron Rookery
- Active Osprey Nest
- 1 Mile From Turbines
- 4 Miles From Turbines
- 10 Mile Survey Area

0 4.5 Miles

1:285,120 (at original document size of 8.5x11)

Stantec

Project Location 195601223
Hancock County, Maine
Prepared by GAC on 2018-09-06
Reviewed by SBG on 2018-09-07

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
2-1

Title
2015 Aerial Bald Eagle Nest Survey

Notes
1. Coordinate System: NAD 1983 UTM Zone 19N
2. Base map: ESRI Wowrld Topographic Map

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\AvianBat\Eagle Survey\01223_2-1_EagleNestSurvey.mxd Revised: 2018-09-06 By: gcarpentier

Table 2-1. 2015 Results of Aerial Bald Eagle Nest Survey, Weaver Wind Project.

MDIFW Nest #	Location	Flight 1 Nest Status	Flight 2 Nest Status	Approx. Distance to Nearest Proposed Weaver Turbine (mi)	Notes
030C	Graham Lake	Unoccupied	Unoccupied	8.15	
701A	Great Pond	Occupied, 1 adult incubating	Active – at least 1 eaglet in nest	10.14	1 adult at nest on second flight
239B	Alligator Lake	Occupied, 1 adult incubating	Not active – nest failure	8.69	
663A	Lower Middle Branch Pond	Occupied, 1 adult incubating	Active - 1 eaglet in nest	4.02	
437A	Lower Lead Mountain Pond	Unoccupied	2 adults perched at nest, no eaglets - consider occupied	3.08	Nest in good condition
700A	Horseshoe Pond	Nest down	Nest down	--	
142D	Bog Brook Flowage	Unoccupied	Unoccupied	9.82	
511B	Webb Pond	Occupied, 1 adult incubating	Not active – nest failure	5.08	1 adult flying around nest and second adult on peninsula during second flight
221C	Spectacle Pond	Nest down	Nest down	--	1 adult observed on lake at opposite end from former 221C location during first flight
360A	Molasses Pond	Possible abandoned egg in nest, 2 adults observed on lake - consider occupied	Unoccupied	3.16	Nest in good condition
503A	Spring River Lake	Unoccupied	Unoccupied	10.66	Nest in good condition
699A	Donnell Pond	Unoccupied	Unoccupied	9.09	Nest in fair condition
034D	Hog Bay	Unoccupied	Unoccupied	10.22	
631A	Taunton Bay	Occupied, 1 adult standing in nest, 2 eggs seen in nest	Active - 1 eaglet	10.52	2nd adult at nest during first flight
417B	Taunton Bay	Adult at nest, not incubating, consider occupied	Unoccupied	11.56	

2.3.2 Incidental Bald Eagle Observations

During the first flight, Stantec recorded the following incidental bald eagle observations: 2 adult and 1 sub-adult on Graham Lake; 1 adult along the West Branch Union River; 1 adult on Upper Lead Mountain Pond; 1 adult on Beddington Lake; 1 sub-adult on Bog Brook Flowage; and 1 adult on Spectacle Pond.

2.3.3 Incidental Osprey Observations

During the first flight, Stantec observed a single osprey flying near 3 locations: nest #030C on Graham Lake, the West Branch Union River, and Scammon Pond. Additionally, an active osprey nest was observed on the large island in the Bog Brook Flowage

2.3.4 Great Blue Heron Rookery Results

During the first flight, Stantec surveyed active great blue heron rookery #770 in a large wetland at the confluence of Giles Pond Brook and the East Branch Union River. This rookery is less than 4 miles from the nearest Project turbine. Nine nests observed but no great blue herons were observed. During the second flight, 1 adult heron was observed in a nest. Because nest status was confirmed during eagle flights, ground surveys were not performed.

3.0 EAGLE POINT COUNT SURVEYS

3.1 INTRODUCTION

Stantec conducted eagle point count surveys consistent with the Work Plan (Stantec 2014) and the ECP Guidance. Eagle point count locations were chosen based on an initial turbine layout in 2014 and review of aerial imagery; points were located within approximately 1 kilometer (km) of proposed turbines in non-forested areas such as clearings and roads at elevations greater than the surrounding area. Point counts were refined in the field based on current site conditions and situated in areas with a view of proposed turbine locations and with the greatest viewshed extent possible. Each location was mapped using a Global Positioning Systems unit.

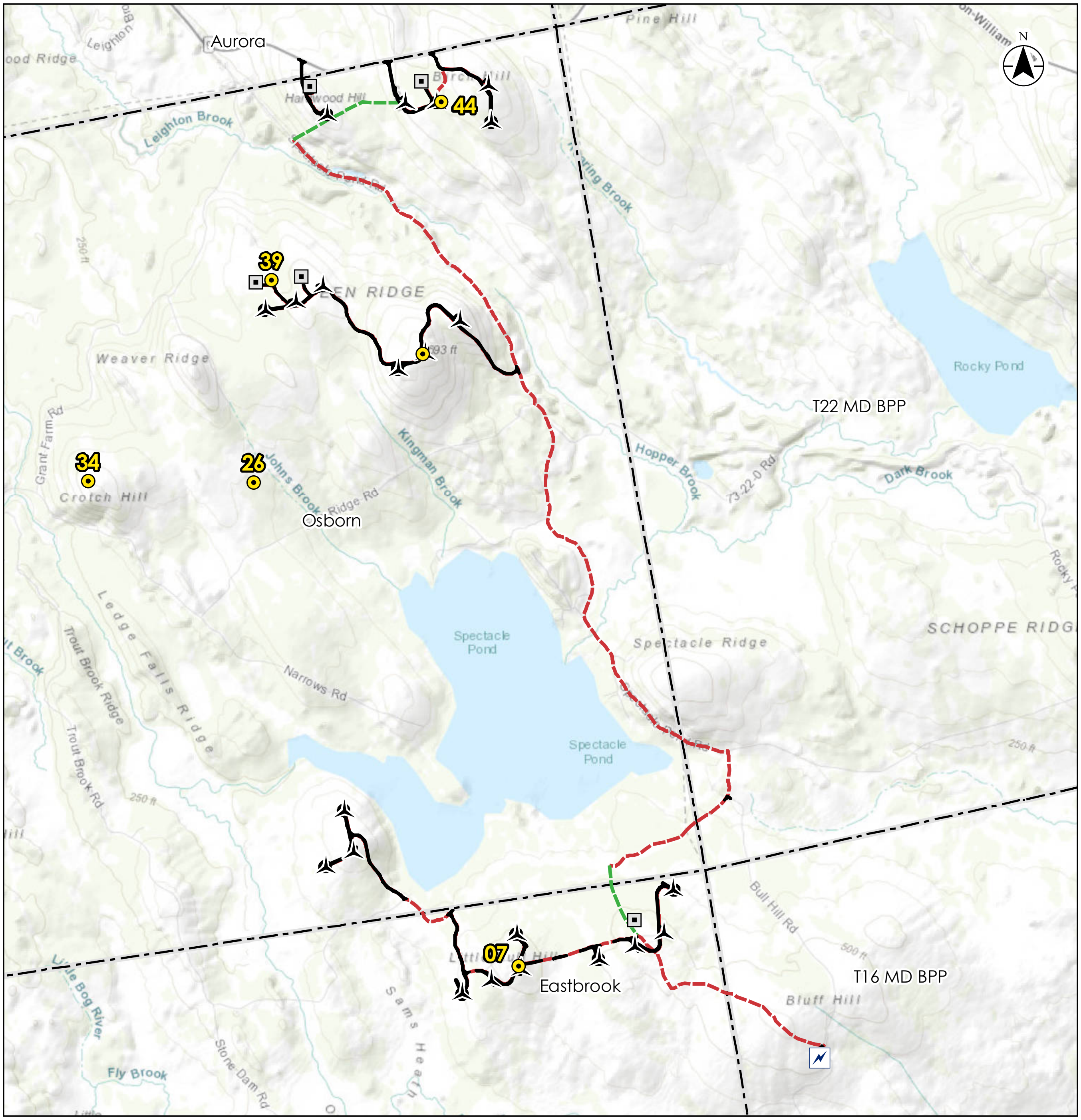
3.2 METHODS

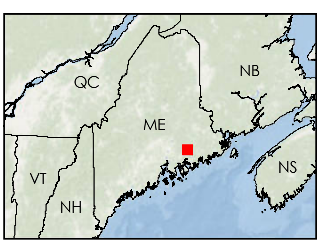
Point count surveys consisted of rounds consisting of 2-hour visual surveys at each of 6 point count locations (Figure 3-1). Each point count location surveyed an area up to 2 km^2 (800-m-radius circle). Stantec completed 18 surveys in 1 year, with 1 survey approximately every 3 weeks from April 2014 to April 2015.

Since eagles are active in a range of weather conditions, surveys occurred in all weather conditions except when visibility was very poor, such as during heavy rain, snow, or fog. Survey efforts targeted all hours of daylight. The starting point location changed each survey round to enable sampling of each plot during a range of daylight hours. During each point count survey a Stantec biologist scanned the sky by eye and with binoculars to search for eagles. If an eagle was observed, biologists recorded information on Stantec datasheets including location of the eagle, age and sex if known, time of observation, and for each minute of observation, the bird’s behavior, location, and flight height. Flight heights were visually estimated in 25-m increments and the observer used features with known heights, such as the meteorological towers and Bull Hill turbines, to gauge flight height.

Though eagles were the target species, Stantec biologists recorded all raptors and waterbirds observed during eagle point count surveys. Stantec also recorded any incidental observations of eagles observed outside of survey hours, i.e., eagles observed while traveling between survey points.

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\AvianBat\Eagle Survey\01223_3-1_EPC.mxd Revised: 2018-09-06 By: gcarpentier





Legend

- Eagle Point Count Location
- Turbine Layout
- MET Tower
- Substation
- Overhead Collector
- Underground Collector
- Access Road

0 6,000 Feet

1:72,000 (at original document size of 8.5x11)

Stantec

Project Location
Hancock County, Maine

195601223
Prepared by GAC on 2018-09-06
Reviewed by SBG on 2018-09-07

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
3-1

Title
Eagle Point Count Location Map

Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Base map: ESRI Wowrld Topographic Map

3.3 RESULTS

3.3.1 Survey Effort

Between 22 April 2014 and 16 April 2015, Stantec completed 216 hours of observation. All 6 point count locations were surveyed each survey round, except round 15, which occurred in February 2015. Snow depth prevented access to 4 of the point count locations so the 2 accessible point count locations were surveyed twice, maintaining the 12 hours of survey for the round[2].

Weather conditions ranged from clear to overcast with periods of drizzle and light snow. Surveys were conducted in a range of pressure conditions (e.g., stalled high, low to high, stalled low (Table 3-1).

Table 3-1. Survey effort results and weather conditions during eagle point count surveys, Weaver Wind Project, April 2014 – April 2015.

Survey Round	Sky Condition	Cloud Height (m)	Avg Temp (°C)	Avg Wind Speed (kph)	Wind Direction	Eagles Observed?
2014						
1 (4/22-4/25)	cloudy, some drizzle, showers	200 < x < 800; > 800	10	13-19	N, NW, SE	Y
2 (5/12-5/15)	cloudy, some fog, drizzle	200 < x < 800	13	6-12	S, SE, SW, variable	Y
3 (6/2-6/3)	clear to partly cloudy	200 < x < 800	25	6-12	S, SE, variable	N
4 (6/27)	clear	NA	25	6-12	SW, S, variable	N
5 (7/18)	clear	200 < x < 800; < 200	23	6-12	NW	Y
6 (8/6-8/7)	partly cloudy, some drizzle, showers	200 < x < 800	22	2	NW, N	Y
7 (8/27-8/29)	clear to cloudy	200 < x < 800; > 800	26	2	variable	N
8 (9/16-9/17)	clear to cloudy	200 < x < 800	18	6-12	W, NW, SW	Y
9 (10/6-10/9)	clear to partly cloudy	200 < x < 800	16	13-19	SE, SW, S	Y
10 (10/29-10/31)	clear to cloudy	200 < x < 800	13	2	NW, SW, variable	Y
11 (11/19-11/20)	clear to cloudy	200 < x < 800	0	6-12	W, SW	Y
12 (12/8-12/9)	clear to cloudy, some drizzle	200 < x < 800	-4	6-12	E , NE	Y
2015						
13 (1/5-1/6)	partly cloudy	200 < x < 800; > 800	-12	30-38	W, NW	Y
14 (1/20-1/21)	clear	> 800	-9	20-29	NW, W	N
15 (2/7-2/10)	partly cloudy to cloudy	> 800	-9	2	W, NW	N
16 (3/9-3/10)	partly cloudy, some snow	> 800	-2	6-12	W, S	N
17 (3/23-3/25)	clear to partly cloudy	> 800	-8	13-19	N, NW, E	Y
18 (4/13-4/16)	clear to partly cloudy	> 800	9	6-12	variable	Y

3.3.2 Location, Behavior, and Exposure Minutes

Stantec documented 18 eagle observations during surveys; 16 observations were bald eagles and 2 could not be identified to species (i.e., it could not be determined whether the eagle was a bald or golden eagle due to the distance of the bird from the observer, lighting, or short duration of the observation). Sixteen observations were of adult eagles, 2 were of sub adult eagles, and age could not be determined for 2 observations. Observations occurred throughout

[2] During round 11, Point 34 was moved 700 m down the dirt road from its original location due to a downed tree and access restriction. The new location provided an adequate viewshed and remained within 1 km of proposed turbines. The new location was used for the remaining rounds.

the day, between 9:00 AM and nearly 16:00 PM. Eagles were observed soaring or in flap and glide flight. No courtship displays, territorial displays, or foraging behaviors were observed. (Table 3-2).

Table 3-2. Location and flight data for eagles observed during eagle point count surveys, Weaver Wind Project, April 2014 – April 2015.

Date	Round	Point Count #	Time	Age	Height Code	Behavior
4/24/2014	1	39	13:23	A	B	SO
4/25/2014	1	32	11:05	A	E	SO
5/12/2014	2	32	11:01	SA	C, D	SO
7/18/2014	5	32	15:45	SA	B	SO
8/6/2014	6	7	14:25	U	B	SO
9/17/2014	8	39	15:07	U	E	SO
9/17/2014	8	32	12:25	A	C, D	FG
10/9/2014	9	7	11:05	A	E	SO
10/30/2014	10	32	11:00	A	B	SO
11/20/2014	11	34	11:28	A	B	SO/FG
11/20/2014	11	34	12:06	A	B	SO
11/19/2014	11	7	12:25	A	B	SO/FG
12/8/2014	12	26	13:39	A	C	SO
1/5/2015	13	34	9:14	A	C	FG
3/23/2015	17	7	8:28	A	B	FG
3/25/2015	17	44	14:07	A	E	FG
3/25/2015	17	44	14:07	A	E	FG
4/16/2015	18	44	15:18	A	E	SO/FG

Age: A=adult; J=juvenile; SA=sub adult; U=unknown

Height Code: A=0–50 m; B=50–100 m; C=100–150 m; D=150–200 m; E= >200 m

Behavior: FG=flap or glide; SO=soaring

Twelve eagle observations occurred within the survey area (i.e., the point survey area up to 2 km^2). Eagles were observed at all 6 point count locations. Stantec recorded 47 total eagle minutes. Of those 47 minutes, 31 eagle minutes occurred inside the survey area and in the approximate rotor-swept zone of the turbines (i.e., 45–80 m; exposure minutes). Point 32 had the greatest number of eagle minutes (17 minutes) and eagle exposure minutes (16 minutes). Point 32 was centrally located. Observations at this location occurred in April, May, July, September and October (Table 3-3).

Table 3-3. Summary of eagle minutes, eagle exposure-minutes, and passage rates by survey plot, Weaver Wind Project, April 2014 – April 2015.

Point count number	# of survey hours	Total eagle minutes observed	Number of eagle exposure-minutes observed inside RSA*	Total passage rate (eagle minutes/hr)	Passage rate within RSA (exposure-minutes/hr)	Dates of eagle observations
7	40	9	5	0.225	0.125	8/6 2014 10/9/2014 11/9/2014 3/23/2015
26	34	2	2	0.059	0.059	12/8/2014
32	34	17	16	0.500	0.471	4/25/2014 5/12/2014 7/18/2014 9/17/2014 10/30/2014
34	34	7	7	0.206	0.206	11/20/2014 1/5/2015
39	34	4	1	0.118	0.029	5/24/ 2014 9/17/2014
44	40	8	0	0.200	0.000	3/25/2015 4/16/2015
Total	**216**	**47**	**31**	**0.218**	**0.144**	**16 days**

3.3.3 Incidental Raptor and Waterbird Observations During Eagle Point Count Surveys

Stantec recorded 95 raptor and waterbird observations during eagle point count surveys. No federally or state-listed raptor species were observed (Table 3-4). Stantec observed 2 observations of 1 Special Concern Species: northern harrier (*Circus cyaneus*). Harrier observations occurred at Point 26 in August and Point 39 in late October. Both individuals soared at relatively low flight heights (< 25 m) One sandhill crane (*Grus canadensis*) was observed on 13 April 2015 outside the turbine area. The crane was soaring and gliding in a northeasterly direction at flight heights of 300 m and higher.

Table 3-4. Raptor and waterbird species observed incidentally during eagle point count surveys, Weaver Wind Project, April 2014 – April 2015.

		Point Count No.					
Species Common Name	**Species Scientific Name**	**7**	**26**	**32**	**34**	**39**	**44**
American kestrel	*Falco sparverius*	1					1
broad-winged hawk	*Buteo platypterus*		4		2	12	3
Cooper's hawk	*Accipiter cooperii*	1					1
merlin	*Falco columbarius*					1	
northern harrier	*Circus cyaneus*		1			1	
osprey	*Pandion haliaetus*		1			1	1
red-shouldered hawk	*Buteo lineatus*				1		1
red-tailed hawk	*Buteo jamaicensis*	2	6	1	2	2	1
sandhill crane	*Grus canadensis*		1				
sharp-shinned hawk	*Accipiter striatus*	2				6	
turkey vulture	*Cathartes aura*	1	10	2	5	3	9
unidentified buteo	NA		1		3	1	1
unidentified raptor	NA					1	2
		7	**24**	**3**	**13**	**28**	**20**

4.0 REFERENCES

Griffith, G.E., J.M. Omernik, S.A. Bryce, J. Royte, W.D. Hoar, J.W. Homer, D. Keirstead, K.J. Metzler, and G. Hellyer, 2009, Ecoregions of New England (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,325,000).

MDIFW (Maine Department of Inland Fisheries and Wildlife). 2014. *Curtailment Policy and Wind Power Preconstruction Study Recommendations*. Maine Department of Inland Fisheries and Wildlife, April 2014.

Stantec (Stantec Consulting Services Inc.). 2014. Work Plan for 2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project. dated 18 June 2014

USFWS (U.S. Fish and Wildlife Service). 2007. National Bald Eagle Management Guidelines. U.S. Fish and Wildlife Service, Washington, DC.

_____. 2013. *Eagle Conservation Plan Guidance* (ECP Guidance), April 2013.

Exhibit 7-6

2012 Wildlife Habitat Report for the Hancock Wind Project

Wildlife Habitat Report

Hancock Wind Project
T22 MD and T16 MD, Hancock County, Maine

Prepared for:

Hancock Wind, LLC

Prepared by:

Stantec Consulting Services, Inc.

30 Park Drive
Topsham, ME 04086

December 2012

Stantec

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 ECOLOGICAL SETTING OF THE PROJECT AREA 2
3.0 EXISTING VEGETATION TYPES AND WILDLIFE HABITAT 2
3.1. Upland Forests 3
3.2. Wetlands 3
4.0 WILDLIFE COMMUNITIES 4
4.1. Birds 4
4.2. Mammals 5
4.3. Amphibians and Reptiles 6
4.4. Significant Wildlife Habitat 6
4.4.1. Critical Habitat for Atlantic salmon 7
4.4.2. Significant Vernal Pools 7
5.0 POTENTIAL PROJECT IMPACTS TO HABITAT AND WILDLIFE 7
5.1. Habitat Conversion 8
5.2. Collision Risk 8
5.2.1. Measurement of Avian Mortality and Comparability 8
5.2.2. Review of Known Collision Risk 9
5.2.3. Summary of Collision Risk at the Hancock Wind Project 11
6.0 LITERATURE CITED 14

LIST OF TABLES

Table 1 Summary of Nation-Wide Bird Mortality Estimates

LIST OF APPENDICES

Appendix A Publicly Available Post-Construction Results

1.0 Introduction

Hancock Wind, LLC, has proposed construction of the Hancock Wind Project (project or Hancock), a utility-scale wind energy facility to be located in T22 MD and T16 MD, Hancock County, Maine. The project will include up to 18 turbines, associated access roads, up to two permanent 105-meter meteorological towers, a 34.5-kilovolt electrical collector system that will connect to an existing electrical substation, and an Operations and Maintenance (O&M) building to be located in Aurora, Maine.

The proposed turbines will be one of two types: Vestas V112 or Siemens 3.0-113 machines, each with a 3.0-megawatt (MW) rated power. The Vestas turbines would be on a 94-meter tower and have 112-meter rotor diameter, for a total height with the blade fully extended of 150 meters (492 feet). The Siemens turbines would be on a 99.5-meter tower and have a 113-meter rotor diameter, for a total height of 156 meters (512 feet).

The project is anticipated to affect wildlife species in various ways. Temporary and permanent changes as a result of the proposed project have the potential to impact wildlife habitat. Impacts to habitats will consist of clearing land for turbines, associated roads and collector lines, as well as the proposed O&M building. The majority of the project area has been actively harvested for timber products and includes several unimproved logging roads.

The potential for avian and bat mortality through direct collisions with the turbines is one of the primary wildlife impacts expected from this project. In addition, direct and indirect impacts to wildlife such as injury, mortality, or displacement are possible during clearing, construction, and operation of wind turbines, access roads, and electric lines and poles. Once constructed, the turbines and associated facilities are anticipated to pose little threat to terrestrial wildlife.

Prior to permitting activities for the project, Stantec Consulting (Stantec) conducted a variety of wildlife surveys in the vicinity of the project area. These pre-construction surveys provided data to help assess the project's potential to impact birds and bats, rare, threatened and endangered (RTE) plants and animals, breeding amphibians, and wetlands.

On September 4, 2012, representatives from Hancock Wind met with representatives from the Maine Department of Inland Fisheries and Wildlife (MDIFW). The purpose of the meeting was to determine if additional field surveys were needed at the project given that pre-construction bird and bat surveys recently had been conducted at the adjacent Bull Hill Wind Project (Bull Hill) in Eastbrook and T16 MD, located within approximately 0.7 miles southwest of the project. During the meeting, MDIFW agreed that pre-construction radar migration and acoustic bat surveys were not necessary at the project, as data collected at Bull Hill were sufficient. Shortly after the September 4 meeting, MDIFW recommended conducting fall raptor migration surveys at the project.

The scope and methodology for surveys conducted at Bull Hill were confirmed through development of a natural resources work plan developed in consultation with MDIFW and USFWS. Stantec met with MDIFW and U.S. Fish and Wildlife Service (USFWS) biologists on July 30, 2009, to discuss the work scope and methods for conducting project surveys, and met again on February 11, 2010, to discuss the results of fall 2009 surveys and appropriate effort for spring 2010 surveys. Additional discussions were conducted with MDIFW and USFWS in February 2012 and September 2012, and a 2012 raptor migration report submitted to MDIFW in December 2012.

Field surveys relevant to the project were conducted between September 2009 and October 2012, and included the following:

- nocturnal radar migration surveys, conducted pre-construction for Bull Hill in fall 2009, spring 2010, and spring 2011;
- acoustic bat surveys, conducted pre-construction for Bull Hill in fall 2009 and spring 2010;
- diurnal raptor surveys, conducted pre-construction for Bull Hill in fall 2009 and spring 2010, as well as surveys conducted within the Hancock project area in fall 2012;
- aerial nest surveys, conducted in spring 2010, spring 2011, and spring 2012; and

- other site-specific surveys included wetland delineations and RTE species surveys conducted in the fall of 2012 (September-December), November 2011, and April and May 2010. Vernal pool surveys within those wetlands delineated in 2010 were completed in April and May 2010. For a complete description of these surveys, refer to Exhibit 7A.

In addition to field surveys, publicly-available information about the existing natural communities in the project area was reviewed. Information used to characterize the existing wildlife communities and their habitats included consultation with state agencies and review of available wildlife habitat databases and published natural resource classification systems. Information gained from this review was confirmed during field surveys between 2010 and 2012.

Available databases of ecological resources and classification systems also were reviewed during this characterization and assessment, including Database of Essential Habitats and Sensitive Natural Areas, as categorized by the MDIFW (http://megisims.state.me.us); Land Use Planning Commission Land Use Maps (http://www.state.me.us/doc/lupc); and Natural Landscapes of Maine – the Maine Natural Areas Program natural community classification system (Gawler and Cutko 2004).

The following sections describe the dominant cover types found in the project area, the wildlife species that are likely to occur within the project area or were documented during field surveys, and the potential for adverse impacts to wildlife and measures to minimize these impacts. Similar discussion for wetland resources and unusual natural areas can be found in application Exhibits 7A and 9A, respectively.

2.0 Ecological Setting of the Project Area

The project area is located in T22 MD and T16 MD, Hancock County. The project is within approximately 0.7 miles north and east of Bull Hill, a currently operational wind project. The project area consists of a series of coastal low-elevation hills, which range in elevation from approximately 250 to 540 feet above sea level. Ridgelines have gently sloping sides with large glacial erratics and boulder-strewn outcrops. There is access to each of the proposed turbine strings, primarily along existing logging roads.

The project is located in the Eastern Lowlands biophysical region.[1] The region is characterized by gently rolling topography with elevations generally below 550 feet. The project area is primarily dominated by a regenerating Beech-Birch-Maple forest. The project area has been managed for timber production and harvesting generally has occurred within the last 10 and 20 years. Wetlands on the ridges are located primarily in low lying areas between the hills and on small terraces along the side slopes. With more moderate topography along the roads, wetlands are generally larger and more complex than on the ridgelines and many of these wetlands contain jurisdictional streams.

3.0 Existing Vegetation Types and Wildlife Habitat

The dominant land cover types dictate the wildlife communities in the project area. Climate conditions, geology, and past land use (i.e., forest harvesting) are the most significant factors affecting the type and structure of the available habitats. Field surveys conducted between 2010 and 2012 indicate that the project area and surrounding landscape is characterized primarily by regenerating upland hardwood forests with pockets of forested, scrub-shrub, and emergent wetlands.

The project layout was designed to utilize existing roadways where possible and to avoid impacts to wetlands and streams. As a result, the proposed turbines are primarily sited in previously disturbed upland forest areas. The following are descriptions of the natural communities that occur in the project area:

[1] McMahon, Janet. 1998 (July). An Ecological Reserves System Inventory. Augusta, ME. ME State Planning Office. 122 pp.

3.1. Upland Forests

Areas of second-growth northern hardwood forests are present on Spectacle Pond Ridge and Schoppe Ridge. Dominant canopy species include American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*) and sugar maple (*Acer saccharum*) trees. Balsam fir (*Abies balsamea*), red spruce (*Picea rubens*), and striped maple (*Acer pensylvanicum*) trees are scattered throughout these forests. Understory vegetation is sparse in some of these communities but includes evergreen wood fern (*Dryopteris intermedia*), hay-scented fern (*Dennstaedtia punctilobula*), bracken fern (*Pteridium aquilinum*), striped maple, wild sarsaparilla (*Aralia nudicaulis*), Blue Ridge sedge (*Carex lucorum*), and Indian cucumber root (*Medeola virginiana*).

Second growth mixed forests occur throughout the upland areas of Schoppe Ridge. These areas are dominated by balsam fir, red spruce, yellow birch, eastern white pine (*Pinus strobus*), and paper birch (*Betula papyrifera*) trees. Selective timber harvests have occurred throughout these forests as evidenced by decaying stumps and residual trees with larger diameters (e.g., 16 to 18 inches in diameter at breast height) that are scattered within the forest. The understory vegetation is typically sparse and very low in diversity. Hay-scented fern is the most common herbaceous understory plant within this community.

Early successional forests located on Schoppe Ridge are dominated by yellow birch, big-toothed aspen (*Populus grandidentata*), red maple (*Acer rubrum*), balsam fir, sugar maple, paper birch, and gray birch (*Betula populifolia*) saplings and small trees. Understory plants are sparse and very low in diversity. Occasional understory plants include hay-scented fern, bracken fern, sheep laurel (*Kalmia angustifolia*), black huckleberry (*Gaylussacia baccata*), withe-rod (*Viburnum nudum*), and dwarf dogwood (*Cornus canadensis*). Timber harvests have occurred approximately 10 to 15 years ago within these early successional areas.

Spruce-fir forests also are scattered on Schoppe Ridge. These forests have very low species diversity, including a very sparse understory. Red spruce and balsam fir trees, saplings, and shrubs dominate these areas. Mosses, including brook moss (*Dicranum scoparium*) and three-lobed bazzania (*Bazzania trilobata*), dominate the herbaceous stratum. Past timber harvests have occurred throughout these areas as evidenced by decaying cut stumps.

Managed plantations are present on Spectacle Pond Ride and Schoppe Ridge. The west end of Spectacle Pond Ridge includes a regenerating red pine (*Pinus resinosa*) plantation that has recently been harvested for timber. Red spruce plantations located along Schoppe Ridge are even-aged stands that have very low species diversity. Saplings of red maple, eastern white pine, big-toothed aspen, and yellow birch are common within these forest stands. Common understory plants include bracken fern, velvet-leaf blueberry (*Vaccinium myrtilloides*), dwarf dogwood, and hay-scented fern.

The forest communities on the ridgeline east of Bull Hill have been recently harvested for timber through selective and strip cutting harvesting methods. Narrow bands of residual trees are interspersed amongst networks of skidder trails throughout the ridgeline. The forests are predominantly mixed forests dominated by residual red spruce, balsam fir, eastern white pine, red maple, and yellow birch trees. Understory species are typically sparse and commonly include regenerating canopy species, bracken fern, sheep laurel, and black huckleberry.

3.2. Wetlands

The majority of wetlands identified within the project area were characterized as forested wetlands. Northern white cedar (*Thuja occidentalis*), balsam fir, red maple, red spruce, and tamarack (*Larix laricina*) dominate the canopy of these wetlands. The shrub layer includes gray birch, white meadowsweet (*Spiraea alba* var. *latifolia*), and winterberry (*Ilex verticillata*). Cinnamon fern (*Osmunda cinamomea*) is common in the herbaceous layer. The soils in these wetlands are generally shallow and commonly consist of organic accumulation over depleted loamy sand and areas of organic material over glacial till or bedrock. The characteristics indicating wetland hydrology in these resources included saturated soil, standing water in pits and wetland drainage patterns.

Scrub-shrub wetlands make up a small portion of the wetlands within the project area. These wetlands include naturally-occurring communities such as those associated with streams and floodplains, and wetlands that have been altered by forest management activities and that are in an early- to mid-stage of succession. The dominant plants observed include speckled alder (*Alnus incana* ssp. *rugosa*), winterberry, white meadowsweet, yellow birch, withe-rod, balsam fir and gray birch in the shrub layer. Crested wood fern (*Dryopteris cristata*), cinnamon fern, leatherleaf (*Chamaedaphne calyculata*), Canada reed grass (*Calamagrostis canadensis*), royal fern (*Osmunda regalis*) are common in the herbaceous layer. The soils in these wetlands are generally shallow and commonly consist of organic accumulation over depleted loamy sand and areas of organic material over glacial till or bedrock. The characteristics indicating wetland hydrology in these resources include saturated soil, standing water in pits and wetland drainage patterns.

Wet meadow communities in the project area consist of early successional wetlands, some of which have recently been altered by timber harvesting. These wetlands are dominated by herbaceous vegetation such as Canada reed grass, cinnamon fern, common wool-grass (*Scirpus cyperinus*), and path rush (*Juncus tennuis*), but they are not typically characterized by long periods of inundations as would be common in marsh habitats. Similar to the other wetland communities within the project area, the soils in these wetlands are generally shallow and consist of organic accumulation over a mineral horizon or over bedrock/till. The indicators of hydrology include water marks, soil saturation to the surface, and standing water in pits.

4.0 Wildlife Communities

Following are brief descriptions of the predominant wildlife species known or suspected to occur in the project area. The information presented here was derived from extensive environmental field surveys conducted in the project area and surrounding area between 2009 and 2012.

4.1. Birds

Birds are among the most abundant and diverse wildlife communities in the region, including the project area. A variety of species are known or suspected to occur in association with the second-growth hardwood and mixed forests. Bird species that frequent these forests include black-capped chickadee (*Poecile atricapillus*), blue jay (*Cyanocitta cristata*), golden-crowned kinglet (*Regulus satrapa*), white-breasted nuthatch (*Sitta carolinensis*), hairy woodpecker (*Picoides villosus*), downy woodpecker (*Picoides pubescens*), least flycatcher (*Empidonax minimus*), ruffed grouse (*Bonasa umbellus*), winter wren (*Troglodytes hiemalis*), hermit thrush (*Catharus guttatus*), red-eyed vireo (*Vireo olivaceus*), ovenbird (*Seiurus aurocapillus*), yellow-rumped warbler (*Setophaga coronata*), black-throated blue warbler (*D. caerulescens*), and black and white warbler (*Mniotilta varia*). Raptors that inhabit upland hardwoods and mixed woods include great-horned owl (*Bubo virginianus*), barred owl (*Strix varia*), northern goshawk (*Accipiter gentilis*), broad-winged hawk (*Buteo platypterus*), and red-tailed hawk (*Buteo jamaicensis*).

Spruce-fir forests provide breeding and year-round habitat for bird species, including red-breasted nuthatch (*Sitta canadensis*), ruby-crowned kinglet (*Regulus calendula*), northern parula (*Parula americana*), magnolia warbler (*Dendroica magnolia*), bay-breasted warbler (*Dendroica castanea*), purple finch (*Carpodacus purpureus*), and evening grosbeak (*Coccothraustes vespertinus*).

Open areas dominated by early successional habitat provide suitable habitat for a number of ground and shrub dwelling birds. Common species include northern flicker (*Colaptes auratus*), eastern wood-pewee (*Contopus virens*), American robin (*Turdus migratorius*), chestnut-sided warbler (*Dendroica pensylvanica*), American redstart (*Setaphaga ruticilla*), common yellowthroat (*Geothlypis trichas*), chipping sparrow (*Spizella passerine*), song sparrow (*Melospiza melodia*), white-throated sparrow (*Zonotrichia albicolis*), dark-eyed junco (*Junco hyemalis*), rose-breasted grosbeak (*Pheucticus ludovicianus*), and common raven (*Corvus corax*). Red-tailed hawks regularly hunt from perches in this habitat.

Wetland habitats may receive use by a subset of species that specialize in these habitats. Included may be American woodcock (*Scolopax minor*), alder flycatcher (*Empidonax alnorum*), gray catbird (*Dumetella carolinensis*), and northern waterthrush (*Parkesia noveboracensis*).

Stantec conducted pre-construction radar nocturnal migration surveys in fall 2009, spring 2010 and fall and spring 2011 at Bull Hill. Passage rates were consistent with the results of other pre-construction surveys conducted at other locations in Maine and in the eastern U.S. For a complete description of these surveys, refer to Exhibit 7C.

Stantec conducted pre-construction raptor migration surveys in summer and fall 2009, and winter and spring 2010 at Bull Hill, as well as raptor migration surveys within the Hancock project area in fall 2012. During all surveys, a total of 12 species of raptor were documented during raptor migration surveys and some of these species could potentially breed in either the Bull Hill or Hancock project area. Species observed during the surveys include American kestrel (*Falco sparverius*), bald eagle, broad-winged hawk, Cooper's hawk (*Accipiter cooperii*), merlin (*Falco columbarius*), northern goshawk, northern harrier (*Circus cyaneus*), osprey, peregrine falcon (*Falco peregrinus*), red-tailed hawk, sharp-shinned hawk (*Accipiter striatus*) and turkey vulture (*Cathartes aura*). One state-listed threatened species, peregrine falcon, was observed during raptor migration surveys, and two species of special concern, bald eagle and northern harrier, were observed. The use of the project area by these species is anticipated to be largely during migration. For a complete description of these surveys, refer to Exhibit 7C.[2]

Stantec also conducted pre-construction aerial surveys for bald eagle nests, heron rookeries, and osprey nests in 2010 and 2011 for Bull Hill and in 2012 for the Hancock Project. In 2010, the survey area included waterbodies in Osborn, Eastbrook, T22 MD, T16 MD, T10 SD, T9 SD, and Franklin. The shorelines of 7 lakes and ponds, as well as numerous bogs, wetlands, and flowages within an approximately 4-mile radius of the proposed Bull Hill turbine locations, were surveyed. No active bald eagle nests were located within four miles of the proposed Hancock turbines. A known bald eagle nest on an island in Molasses Pond was located, but the nest was not active. Two active osprey nests were identified along the Line 55 transmission line to the south of the Project area. A reported great blue heron rookery at the south end of Scammon Pond was not located. In 2011, the survey included waterbodies within 10 miles of the proposed Bull Hill project area. The shorelines of 31 waterbodies were surveyed. Four active bald eagle nests were identified within the 10-mile radius of proposed Hancock turbines. Of these 4 nests, 2 were found to have successfully hatched at least one eaglet at the time of the second flight. The closest active nest was nest #360B on Molasses Pond at approximately 5.8 miles from the nearest proposed Hancock turbine. No incidental observations of great blue heron or osprey were made. In 2012, aerial surveys were conducted within more than 10 miles of the current Hancock Wind Project. This included the shoreline of 36 waterbodies and watercourses. Five active bald eagle nests were observed within 10 miles of the proposed Hancock turbine locations. The closest active nest was located on Spectacle Pond (#221C), approximately 1.7 miles from the nearest proposed Hancock turbine. One great blue heron rookery was observed at Spring Brook (7-8 active nests). One osprey nest was observed near the Spring Brook heron rookery, and one was observed on Bog Brook Flowage. For a complete description of these nest surveys, refer to Exhibit 7C.

4.2. Mammals

Large mammals that are likely to occur within the project area based upon species distribution and available habitat include white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), and black bear (*Ursus americanus*). Predatory and fur-bearer species observed or expected to occur within the project area include American marten (*Martes americana*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), fisher (*Martes pennanti*), and long-tailed weasel (*Mustela frenata*). Common medium-sized mammals expected to occur in the area include raccoon (*Procyon lotor*), porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), and striped skunk (*Mephitis mephitis*).

[2] Following the Spring 2010 Avian and Bat Survey Report (Stantec, August 2010) in Exhibit 7C is a summary table of spring raptor survey results from other projects on forested ridges in the eastern U.S.

The small mammal community likely includes masked shrew (*Sorex cinereus*), pygmy shrew (*Sorex hoyi*), northern short-tailed shrew (*Blarina brevicauda*), eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), deer mouse (*Peromyscus maniculatus*), and southern red-backed vole (*Clethrionomys gapperi*). Other less common species that could occur include smoky shrew (*Sorex fumeus*), northern flying squirrel (*Glaucomys sabrinus*), and woodland jumping mouse (*Napaeozapus insignis*). Some of the more open areas along the ridge could be used by meadow voles (*Microtus pennsylvanicus*), although their overall abundance in this predominantly forested area is likely low relative to other small mammals.

Eight species of bat also could occur in the area based upon their normal geographical range. These include the little brown bat (*Myotis lucifugus*), northern long-eared myotis (*Myotis septentrionalis*), eastern small-footed bat (*Myotis lebeiii*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and tri-colored bat (*Perimyotis subflavus*).[3] Stantec conducted acoustic surveys at Bull Hill in 2009 and 2010 to characterize bat activity in the project area using detectors to record calls of migrating or foraging bats in the vicinity of the project area. Of the calls that were identified to species guild, bats of the Genus *Myotis* were the most abundant during both the fall 2009 acoustic survey and the spring 2010 acoustic survey. Other bat guilds that were documented include big brown/silver haired bat, hoary bat, and eastern red bat/tri-colored bat guilds. Detectors placed in trees and along habitat edges in both seasons recorded more *Myotis* calls than the detectors deployed higher above the ground, within the guy wire arrays of the met towers. For a complete description of these surveys, refer to Exhibit 7C.

4.3. Amphibians and Reptiles

Amphibians and reptiles observed in the project area include wood frog (*Lithobates sylvatica*), bullfrog (*Lithobates catesbeiana*), spotted salamander (*Ambystoma maculatum*), and garter snake (*Thamnophis sirtalis*). Vernal pool surveys were completed for those wetlands that were delineated in the spring of 2010, and a description of these surveys is provided in Exhibit 7A. Potential vernal pools (PVPs) located during the fall of 2011 and 2012 were identified by physical characteristics such as the presence of surface water and topographic position.

4.4. Significant Wildlife Habitat

Under the Natural Resources Protection Act (NRPA), the Maine Department of Environmental Protection (MDEP) regulates activities that would impact Significant Wildlife Habitat such as habitats of state or federally-listed threatened or endangered animal species; Inland Waterfowl and Wading Bird Habitat (IWWH); Deer Wintering Areas (DWAs); shorebird nesting, feeding, and staging areas; seabird nesting islands; or Significant Vernal Pools..

Stantec contacted the Maine Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, and the United States Fish and Wildlife Service (USFWS) during the course of project development and requested information regarding known listed animal species or Significant Wildlife Habitat that have been documented within the vicinity of the proposed project. The responses from those agencies are included in Exhibit 9A.

The only known habitat for state or federally-listed species in the vicinity of the project area is for Atlantic salmon (*Salmo salar*) in perennial streams, described further in 4.4.1. The project area is not within designated Critical Habitat for Canada lynx (*Lynx canadensis*). Based on the results of aerial nest surveys, there is one bald eagle nest location within four miles of the proposed turbines. During three years of surveys, the closest active nest to the proposed turbine locations was nest #221C on Spectacle Pond at approximately 1.7 miles from the nearest proposed turbine location. There are no MNAP-listed critically imperiled or imperiled natural communities in the project area (See Exhibit 9A). The presence of significant vernal pools is discussed in Section 4.4.2.

[3] Formerly known as the eastern pipistrelle (*Pipistrellus subflavus*).

4.4.1.Critical Habitat for Atlantic salmon

The only known threatened or endangered species habitat in the vicinity of the Project area is for Atlantic salmon in perennial streams. The project area is located within the Union River and Narraguagus River watersheds. These rivers and associated perennial streams are within Designated Critical Habitat for the federally-listed Atlantic salmon.

The Critical Habitat for the GOM DPS of Atlantic salmon was designated in June 2009. The area identified as Critical Habitat for Atlantic salmon includes any perennial stream, river, and lake habitats that connect to the marine environment.[4] It includes physical and biological features that are essential to Atlantic salmon life cycle activities (e.g., spawning and juvenile rearing habitat, egg incubation, smolt migration). The project is located within the Graham Lake (010500212) and Narraguagus (010500209) HUC (Hydrologic Unit Code) 10 watersheds, both designated as Critical Habitat. Available U.S. Geological Survey 7.5-minute series topographic maps were reviewed and it was and determined that at least four streams potentially intersect the project area. These are Garden Eden Brook (Unit 2), Smith Brook (Unit 3), a tributary to Garden Eden Brook (Unit 1), and Mud Brook (Unit 3). However, none of these streams, and no other perennial streams within Designated Critical Habitat, are impacted by the project as designed.

The Narraguagus River (West Branch 2.5 miles) and the Union River (East Branch of the Union River runs into Spectacle Pond approximately 2 miles) are the closest designated Essential Fish Habitat (EFH) to the project area. Their tributaries, to the extent they are currently or were historically accessible for salmon migration, are also EFH, and there are many tributaries, including the Bog River and its tributaries which flow in between Unit 2 and 3 close to the project area. The Narraguagus River is also included as a Habitat Area of Particular Concern, which is a discrete subset of an EFH that provides extremely important ecological functions or are especially vulnerable to degradation. Neither of these rivers nor the EFH associated with them is impacted by the project as designed.

A total of 19 streams, 13 of which are perennial, were identified during wetland delineation surveys at the project. No perennial streams are impacted by the project. Additional information on the streams identified in the project area is presented in Exhibit 7A.

4.4.2.Significant Vernal Pools

During surveys conducted in the spring of 2010, six man-made vernal pools were identified within the project area. A total of 35 PVPs were identified during fall 2011 and fall 2012 wetland delineations. Fourteen of those PVPs were determined to be naturally occurring. Based upon the timing of this permit application submission, all of the naturally-occurring PVPs were treated as Significant Vernal Pools under the NRPA. A table detailing observed amphibian breeding activity from the 2010 vernal pool surveys is presented in Exhibit 7A.

No vernal pools are impacted by the project.

5.0 Potential Project Impacts to Habitat and Wildlife

The construction and operation of wind turbines at the project will result in some direct and indirect impacts to local wildlife communities and their habitats. In general, impacts could include habitat conversion as well as collision-related fatalities. The following discusses the potential project impacts based on the findings of on-site field surveys that could affect the natural resources and wildlife groups that are known to occur in vicinity of the project area.

[4] Endangered and Threatened Species; Designation of Critical Habitat for Atlantic Salmon (Salmo salar) Gulf of Maine Distinct Population Segment, Federal Register, vol. 74, No. 117, (Friday 19, 2009).

5.1. Habitat Conversion

The project was designed to avoid impacts to wetlands and streams and therefore, the proposed turbines and associated access roads will largely occur in previously disturbed upland hardwood and mixed forests. The overall result of project construction will be the direct loss of some forested upland areas and the conversion of some forested habitat areas to early-successional habitat.

The development of the project will require the construction of turbine structures, new roads, and an electrical collector system. Each wind turbine will be located in an opening that will be graded relatively flat and, after construction, all but approximately 0.35 acres will be allowed to revegetate to herbaceous and shrub covers. The road system needed to construct the project requires that roads have a travel surface of at least 36 feet wide on the summit for the passage of the crane needed to erect the turbines. All other roads will include a travel surface of up to 24 feet.

For local wildlife, the direct loss of habitat could occur from the conversion of vegetated habitats to permanent roads and turbine clearings. Potential indirect effects could also include disturbance effects during and following construction of the project, which could result in short-term avoidance of the area by some species and targeted use of the project area by others, possible longer-term avoidance of the area by certain species, and the conversion of some forested habitats to early successional habitats. The potential impact to wildlife communities due to habitat conversion is not expected to adversely affect those populations since local wildlife populations have already adapted to the occasional rapid changes in the distribution of habitats along the ridge from harvesting activities.

5.2. Collision Risk

It is known that birds and bats collide with tall structures such as buildings, communications towers, and wind turbines. Because wind turbines are large, have moving parts, and extend above the surrounding landscape, the potential exists for wildlife collisions to occur. However, at existing wind projects in the U.S. where mortality studies have been conducted, collision risk is generally considered low relative to other sources of bird mortality and to other energy sources (i.e., fossil fuels and nuclear power). Table 1 provides a summary of estimates of known sources of bird mortality.

Table 1. Summary of Nation-Wide Bird Mortality Estimates

Structure/Cause	Total Bird Fatalities	Reference
Building and Windows	98 - 980 million	Klem 1991
Power Lines	10,000 - 174 million	Erickson *et al.* 2001
Housecats	100 million	Coleman and Temple 1993
Vehicles	60 - 80 million	Erickson *et al.* 2001
Agricultural Pesticides	67 million	Pimentel and Acquay 1992
Communication Towers	4 - 50 million	Erickson *et al.* 2001
Wind Generation Facilities	10,000 - 40,000	Erickson *et al.* 2001

5.2.1. Measurement of Avian Mortality and Comparability

The original concern that wind farm-induced fatalities could pose biologically significant impacts to bird populations arose from a few facilities, mainly Altamont Pass and Solano County Wind Resource Areas in California [Altamont Pass; Orloff and Flannery 1992, Hunt 2002]). Post-construction monitoring plans are typically developed in consultation with state and federal agencies. Such plans detail field methodology in terms of timing, proportion of turbines to search, size of search areas, and search interval. Plans also specify how fatality estimates are calculated statistically, and how correction factors (i.e., results of searcher efficiency trials in which the observer is tested to help assess what percent of carcasses the observer actually finds, and results of carcass persistence trials, which assess how long carcasses persist on the ground before being scavenged and are available to be discovered), are incorporated. Scavenger removal trials help inform the appropriate search interval (i.e. daily versus weekly). It is important to acknowledge that fatality estimates, which are generally expressed as fatalities per turbine or fatalities per megawatt, are evolving, and fatality estimates between sites must be compared with caution because of differences in methodology or estimators. Also, these studies and statistical analyses have not been designed to recover every bird and bat that may be involved in a collision event at a project over the course of a year; rather they are designed to sample peak periods of collision risk at a representative sample of turbines at a project to estimate the level of take over the course of a study period. In this respect, these estimates are indices of the level of impact that each project is causing. These indices can best be compared with similar field methodology used at sites with similar physical and landscape characteristics (i.e., forested ridgeline, agricultural field).

Bird and bat fatality study protocols at existing wind farms in Maine (Mars Hill, Stetson, Kibby, and Rollins) and New Hampshire (Lempster) have been developed in consultation with the respective state and federal agencies. Other states such as New York and Pennsylvania have developed guidelines for post-construction monitoring methods for which study work plans can be developed in a uniform fashion. While study protocols have been tailored to address individual project study objectives, the afore mentioned studies in Maine and New Hampshire have all included the following key elements for these types of studies: searches under turbines (either a subset or all turbines), searcher efficiency trials, carcass persistence trials, and statistical analysis to estimate total mortality during a study period.

These studies have generally been conducted from mid-April to mid-October (sometimes with a break in June), to cover spring migration, the summer breeding period, the late-summer bat activity period, and the fall migration period. The majority of studies in Maine and New Hampshire have used a weekly search interval where individual turbines are searched every 7 days. The advantage to a weekly search interval versus a daily search interval is the feasibility of including all or half of turbines (depending on the size of the project) in searches. The appropriate search interval (weekly or daily) would be dependent on survey objectives as well as scavenger activity at a project. Weekly searches are adequate if the objective is to determine estimates, or indices, of take for comparison with most other available studies and a reasonable number of carcass persistence trial carcasses remain between search intervals.

Turbine searches at these forested ridgeline projects in Maine and New Hampshire involved searching the areas leveled for turbine lay-down (typical plot diameter of 75 meters) with linear transects established 3 to 5 meters apart. For those wind projects in landscape settings where searching a greater area is feasible, such as agricultural landscapes in New York, search areas are typically as large as 120 meters by 120 meters (the length of the typical height of the maximum rotor-swept height of modern turbines, squared). Some carcasses may land outside of the 75 meters average diameter turbine lay-down area at projects on forested ridgelines; however, studies have indicated that the majority of carcasses are found closer to turbine bases. For example, a study at the Maple Ridge Wind Project in New York, which included search areas of 120 meters by 130 meters, indicated that the mean distance birds and bats were found from tower bases was 39 meters and 26 meters, respectively (Jain et al. 2009). For those projects with exceptionally small search areas (Lempster, NH), search area correction factors – based on the distribution of carcasses found within search areas – may be applied to account for some of the carcasses that may have landed outside of search plots.

Vegetation cover within plots also influences the percent of carcasses that may be found by searchers. Studies may involve vegetation management to increase searcher efficiency rates, or may include visibility class mapping within plots to account for variable searcher efficiency in different vegetation cover types.

5.2.2.Review of Known Collision Risk

Birds

In 2004, raptor mortality estimates at Altamont Pass were 0.24 fatalities per turbine per year (fatalities/turbine/year), or 1,296 raptor fatalities (GAO 2005). Altamont Pass and Solano County Wind Resource Areas are located along migratory ‘bottlenecks’ or sites where birds were seasonally very active. Studies conducted at those California facilities that experienced high fatality rates found significant contributing factors to the high mortality observed: the number, density, and physical characteristics of turbines (there over 5,000 turbines present at Altamont Pass alone); high raptor wintering density; high prey densities within the wind resource areas; and the funneling of migrants through these areas by topographical features. Additionally, the turbines are predominantly older generation turbines that are smaller, lower to the ground, and with blades that spin faster as wind speed increases. Turbines at these sites also are spaced very close together in comparison to more modern facilities with larger turbines. Finally, most turbines are placed on lattice-type towers, which could provide perch locations in close proximity to spinning blades.

Raptor mortality in the U.S., outside of California, has been documented to be very low; mortality rates found at onshore wind developments outside of Altamont Pass have documented 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). Results of roughly 30 studies at over 25 different locations throughout the U.S. (outside California) have documented approximately 50 total raptor fatalities (Appendix B Table 1). This compares with more than 100 raptor mortalities documented per year at Altamont Pass and overall estimates of thousands killed annually at that facility. Documented flight heights of raptors migrating through a project area does not correlate to collision risk, particularly since raptors frequently exhibit avoidance behavior, probably due to their propensity to migrate during clear weather conditions during daylight hours. Studies have documented high raptor collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006, Tetra Tech EC, Inc. 2010). As most raptors are diurnal, raptors are able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, resident young birds that are learning to fly, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

Songbirds (e.g., warblers, vireos, thrushes, sparrows) account for up to 80 percent of known fatalities reported at wind facilities (Johnson *et al.* 2000, Erickson *et al.* 2002). Mortality of these species has included both daytime and nocturnal fatalities (Erickson *et al.* 2001), however collisions are more likely to occur in periods of low visibility during inclement weather mainly at night. Publicly available results of recent studies at 15 wind projects in the northeastern U.S. (Maine, New Hampshire, Vermont, New York) estimate fatality rates between 3.10 to 9.48 birds/turbine/year (Maple Ridge, New York; Jain *et al*. 2007) to 0.44 to 2.5 birds/turbine/year (Mars Hill, Maine; Stantec Consulting 2008) (Appendix B Table 2). Using comparable post-construction monitoring methodologies developed in consultation with USFWS and MDIFW, avian fatality monitoring in 2007 and 2008 at the Mars Hill Wind Project (Mars Hill) estimated 0.44 to 2.5 bird fatalities/turbine/year (36 total birds were found during standard searches; Stantec Consulting 2008) and 2.4 to 2.65 birds/turbine per year (41 total birds were found during standard searches; Stantec Consulting 2009), respectively; fatality monitoring in 2009 and 2010 at Stetson I/II estimated 4.03[5] (Stantec Consulting 2010) to 2.14 bird fatalities/turbine/year (Normandeau Associates 2010), respectively.

Bats

Emerging evidence suggests that migratory bats are at a greater risk of turbine collisions than birds, particularly in certain areas of the country. This concern arose mainly from a study at the 44-turbine Mountaineer Wind Energy Facility in Tucker County, West Virginia where 475 dead bats (47.5 bats/turbine/year) were documented between April 20 and November 9, 2003 (Johnson and Strickland 2004). A 2009 post-construction study at the Blue Sky Green Field project in Wisconsin documented an unprecedented, high mortality rate for the Midwest, with total estimated mortality of 40.5 bat fatalities per turbine (Gruver 2009). At a 56-turbine facility southeast of Lubbock, Texas, observers found 47 Brazilian free-tailed bats, an abundant species, from September 2006 to September 2007 (Miller 2008). At a 68-turbine facility in northwestern Oklahoma, 95 Brazilian free-tailed bats were found (Piorkowski 2006). These and similar subsequent studies have raised concerns that bat mortality associated with wind

[5] Results of the 2009 Stetson study are likely influenced by the proportion of avian carcasses found at turbine number 1 which is situated next to an at-the-time inadvertently lit operations and maintenance building.

turbine collisions could adversely impact bat populations (Williams 2003; GAO 2005; Arnett *et al*. 2008; Kunz *et al*. 2007a).

Mortality of eight bat species has been documented at wind energy facilities in the eastern U.S. (Kunz *et al*. 2007b), with most fatalities occurring during what is generally considered the fall migration period of August to November (Arnett *et al*. 2008, Cryan 2003, Cryan and Brown 2007, Johnson *et al*. 2005). Species documented under turbines in the East include little brown myotis, northern myotis, tri-colored bat, seminole, silver-haired, hoary, red, and big brown bats. Mortality estimates for bats in Maine are far lower than those documented at other projects in the East and in other regions of the U.S. Publicly available results from post-construction monitoring studies conducted between April and November at the 195-turbine Maple Ridge Wind Project in New York in 2007 and the 44-turbine Mountaineer Wind Project in West Virginia in 2003 estimated 15.54 to 18.53 bat fatalities/turbine/year (Jain *et al.* 2008) and 47.53 bat fatalities/turbine/year (Kerns and Kerlinger 2004), respectively. At Maple Ridge, 64 turbines were searched weekly, and at Mountaineer, 44 turbines were searched twice per week. In comparison, post-construction monitoring surveys at Mars Hill in 2007 and 2008 estimated 0.43 to 4.4 bat fatalities/turbine/year and 0.17 to 0.68 bats/turbine/year, respectively (27 total bats were found during standard searches in both years); monitoring at Stetson I in 2009 estimated 2.11 bat fatalities/turbine/year and monitoring at Stetson II in 2010 estimated 2.48 bat fatalities/turbine/year (19 total bats were found during standard searches in both years) (Appendix B Table 2). Note that post-construction mortality studies at these 2 projects were similar in terms of search interval and timing; 28 turbines at Mars Hill and 19/17 turbines at Stetson I/II were searched on a weekly basis between April and October[6]. At the Kibby Wind Project in Franklin County, Maine, 6 total bat carcasses were found during searches in 2011, resulting in estimated fatality rates of 0 bats/turbine/year in spring and 0.37 bats/turbine/year in fall. Searches occurred at half of the turbines (22 out of 44) 3 times every 2 weeks from May to the end of June and July to mid-October (Stantec 2011) (Appendix B Table 2). Mortality estimates at all three projects used estimator adjustment calculations derived from searcher efficiency and scavenger trail data, which has been standard protocol for post-construction monitoring in Maine.

Despite what is currently known about bat collision rates in Maine, it is important to acknowledge that little is known about the migration patterns and numbers of migratory bats in Maine and other States, and the factors contributing to levels of risk. Researchers currently have a limited understanding of the actual mechanism of bat collisions, although evidence from the timing of fatalities documented at existing wind facilities and other structures suggests that migrating bats are most at risk, whereas resident bats during the summer feeding and pup-rearing period are considered low risk (Johnson and Strickland 2004, Johnson *et al*. 2003, Whitaker and Hamilton 1998). Additionally, only certain species of bats appear to be at risk. Of the 45 species of bats that occur in the U.S., only approximately 11 species have been found during mortality searches (Arnett *et al* 2008). In most regions, including the eastern U.S., migratory tree-roosting species such as hoary, eastern red, and silver-haired bats have higher mortality rates at wind projects than cave-dwelling species (Arnett *et al* 2008). At Stetson I in 2009 and Stetson II in 2010, 60 percent (n=3) and 79 percent (n=11), respectively, of bat fatalities found by the observer during standard searches were migratory tree-roosting bats. At Mars Hill in 2007 and 2008, 68 percent (n=15) and 100 percent (n=4), respectively, of bat fatalities found by the observer during standard searches[7] were migratory tree-roosting bats

5.2.3. Summary of Collision Risk at the Hancock Wind Project

Results of post-construction mortality surveys at the project are expected to be comparable to those at Stetson I/II, and Rollins as all three occur on similar landscape features (forested ridgelines) with similar historical land use activity (i.e. harvesting) in a similar geographic region (the Northeast U.S.). The project would include 18 turbines, which is fairly small compared to most wind projects already operating in the eastern U.S., and the smallest project developed by First Wind in Maine. The project will conduct a similar post-construction mortality monitoring study similar to the studies conducted at Rollins and Stetson I/II.

[6] Except for the 2007 study at Mars Hill, which was conducted from April to September.
[7] Standard surveys at Mars Hill included dog searches.

However, unlike at Rollins and Stetson I/II, the project will curtail project turbines, resulting in potentially lower fatality rates at the project than observed at Rollins and Stetson I/II. Curtailment has been shown to be an effective strategy to reduce bat mortality; one recent study documented reductions in nightly fatality from 44 to 93 percent (Arnett *et al* 2010).

Although results of pre-construction surveys alone cannot predict level of risk at a project, when compared to other results of similar projects in the region, results may help relate the project to other projects in the region, or illustrate regional patterns in migration activity, timing, or species composition (in the case of raptors). Understanding regional patterns, particularly when concurrent post-construction mortality results are available from operational wind projects in the same region, may help inform the level of risk at a project. The results of pre-construction surveys are consistent with the results of surveys conducted at other proposed wind developments in the northeastern U.S., as summarized below and further described in the seasonal Avian and Bat Migration Survey Reports (Exhibit 7C).

Raptors

The results of raptor surveys at the project and at Bull Hill are within the range of results documented at other proposed wind projects in the region (Exhibit 7C).

Pre-construction raptor survey results do not correlate to post-construction mortality of raptors. The risk of collision of raptors at facilities aside from those facilities at migration bottlenecks or high use areas is low. Due to most raptors' day-time habits in combination with the slow moving blades of modern industrial turbines, raptors are aware of the spinning blades and rotor structures and avoid them. The turbines at the project will consist of this modern design, lacking the features believed to present a greater risk of collision. Additionally, most raptors migrate during periods of good visibility when conditions are favorable for long-distance flight. Therefore, the risk of migrant raptors colliding with the proposed turbines is anticipated to be low. Some resident raptors engage in flight behaviors that could put them at a greater risk of collision, such as aerial courtship displays. Owls primarily forage during nocturnal and crepuscular periods. Despite these behaviors, as explained above, mortality surveys at existing wind farms, outside of the California facilities that observed high fatalities due to local circumstances, have indicated low raptor mortality. One raptor fatality, a barred owl, occurred in two years of study (2007 and 2008) at Mars Hill, and was thought to have been a natural winter kill during the severe 2007-2008 winter conditions (Stantec 2008). At Stetson I, post-construction raptor surveys occurred in conjunction with the post-construction mortality surveys. A total of 79 raptors (34 in spring; 45 in fall) during 70 hours of survey were observed during both spring and fall survey seasons (Stantec 2010). During post-construction mortality surveys, two red-tailed hawks were found, however they were not turbine-related fatalities (they were electrocuted by a riser pole of the electrical collection system). Incidental observations of raptors during the mortality survey at Stetson I in 2009 included instances of raptor turbine-avoidance behaviors. Out of 47 incidental observations, 7 raptors exhibited turbine-avoidance behaviors. For these 7 observations, raptors made slight changes to their flight paths as they approached spinning turbines. No raptors observed came into contact with the turbines, and no raptor fatalities were documented under turbines despite continued use of the airspace during migration or breeding periods, post-operation (Stantec 2010). Raptor mortality data from other projects in the U.S. and from Stetson I/II indicated that this trend of low raptor mortality can also be expected at the project.

Regardless, to the extent practicable, the project has been designed to reduce potential detrimental effects to local wildlife, including raptors. For example, the electrical collector system has been designed with consideration of the Avian Power Line Interaction Committee's (APLIC) Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. This manual was developed to mitigate and avoid electrocution with overhead electrical lines. The overall goal of the collection system design is to reduce risk of avian electrocution to the extent practicable while ensuring reliability and maintenance safety of the system.

Nocturnal Migrants

Passage rates as measured by radar surveys conducted at the Bull Hill project are consistent with results documented at other proposed wind projects in Maine and in the region (Exhibit 7C). Average flight height in fall 2011 was near the low end of the range of average flight heights at other projects in Maine and in the eastern U.S.; however, it is important to note that flight heights are expected to vary year-to-year based on seasonal weather patterns, and results of pre-construction surveys have not been shown to relate to post-construction fatality results. Emerging data indicates that migration characteristics, such as flight height and passage rates, are known to differ between pre- and post-construction radar datasets at the same study location (Stantec 2010). Average flight height in particular has been shown to differ between pre-and post-construction years, indicating that the presence of the turbines on the landscape may influence the flight behavior of migrants (Stantec 2010). Nocturnal radar surveys were conducted both pre-construction (fall 2006) and post-construction (fall 2009) at Stetson I. Between the two years, the nightly range and seasonal mean of percent of targets observed below maximum turbine height (125 meters [410 feet]) was substantially lower in fall 2009 than in fall 2006. In fall 2006, the range in nightly flight heights was 219 to 506 meters (718 to 1659 feet) with an average flight height of 378 meters (1,239 feet); in fall 2009, the range in nightly flight heights was 328 to 514 meters (1,075 to 1,685 feet), with an average flight height of 420 meters (1,377 feet). In fall 2006, 13 percent of targets were below the proposed maximum turbine height; in 2009, 2 percent of targets were below the maximum turbine height. On a nightly basis during the fall 2009 surveys, flight heights were relatively higher and remained consistently high throughout the night, without a noticeable hourly peak (Stantec 2010).

The results of these and other radar studies conducted in the eastern U.S. suggest that the vast majority of nocturnal migrants fly at altitudes well above the rotor swept zone of proposed turbines. Although some migrating songbirds will be susceptible to collision at the project, there have been no known cases of population-level impacts to individual songbird species as a result of a project (Environmental Bioindicators Foundation, Inc. and Pandion Systems, Inc.), likely because results from operational projects have indicated mortality across a diverse group of songbirds, with no particular songbird species disproportionally affected.

Another example of a strategy to reduce impacts to wildlife and particularly songbirds includes minimizing lighting on the turbines[8] and on buildings within the project area to minimize disruptions in nocturnal migratory behavior, and maximizing use of the existing road network to minimize new roads in the area. Wetland areas will be avoided to the maximum extent possible to reduce impacts to species that use these habitats, including migratory waterbirds and waterfoul.

Bats

The acoustic bat surveys conducted at the Bull Hill project documented results similar to other pre-construction surveys. The results of these surveys, including variability in bat activity and generally low detection rates above canopy height, are consistent with other publicly available acoustic surveys conducted at proposed wind projects in the region (Exhibit 7C). Although bats are likely present in the project area, which is to be expected, the activity levels at Bull Hill within the range documented at other sites with acoustic bat detectors at the forest-edge, including Mars Hill, Lempster, and Stetson (Exhibit 7C).

In addition, Hancock has committed to curtail wind turbines during wind conditions when previous studies have shown that bats are active, and when existing Maine-based post-construction fatality data indicates that the potential for bat mortality is greatest.

---

[8] Turbine lighting on turbines is limited to a single flashing red light based on FAA lighting requirements, placed on a subset of turbine nacelles, which are well below the height at which most migrants fly. See Exhibit 30D for the project Lighting Plan. A recent study found no relationship to avian morality and turbine lighting (Kerlinger, 2010).

6.0 Literature Cited

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Takersley Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61-78.

Arnett, E. B., M. M. P. Huso, J. P. Hayes, and M. Schirmacher. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, D.C. and Sacramento, CA.

Chamberlain, D.E., M.R. Rehfisch, A.D. Fox, M. Desholm, and S.J. Anthony. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis: 148, pp. 198-202.

Coleman, J. and S. Temple. 1993. Rural resident' free-ranging cats: A survey. Wildlife Society Bulletin. 21:381-389.

Cryan, P.M. 2003. Seasonal distribution of migratory tree bats (Lasiurus and Lasionycteris) in North America. Journal of Mammalogy 84:579-593.

Cryan P.M. and A.C. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation, Vol 139, I-II.

Environmental Bioindicators Foundation, Inc. and Pandion Systems, Inc. 2009. Comparison of reported effects and risks to vertebrate wildlife from six electricity generation types in the New York/New England Region. Prepared for the New York State Energy Research and Development Authority.

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, K.J. Sernka and R.E. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the U.S.. National Wind Coordinating Committee Resource document.

Erickson, W.P., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, and K. Bay. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting and mortality information from proposed and existing wind developments. Prepared for Bonneville Power Administration.

GAO. 2005. Wind Power: Impacts on wildlife and government responsibilities for regulating development and protecting wildlife. Report to congressional requesters. September 2005.

Gawler SC and A.R. Cutco. 2004. Natural Landscapes of Maine: A classification of Vegetated Natural Communities and Ecosystems. Maine Natural Areas Program, Maine Department of Conservation. Augusta, Maine.

Gruver, J., M. Sonnenburg, K. Bay and W. Erickson. 2009. Post-construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Frond du Lac County, Wisconsin.

Hunt, G. 2002. Golden Eagle in a perilous landscape: Predicting the effects of mitigation for wind turbine blade-strike mortality. Consultant report, prepared for PEIR-Environmental Area, July 2002.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2006. Annual report prepared for PPM

Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. http://www.wind-watch.org/documents/wp-content/uploads/maple_ridge_report_2006_final.pdf Accessed 1 December 2007.

Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Johnson, G.D., and M.D. Strickland. 2004. An assessment of potential collision mortality of migrating Indiana bats (*Myotis sodalis*) and Virginia big-eared bats (*Corynorhinus townsendii virginianus*) traversing between caves supplement to: biological assessment for the federally endangered Indiana Bat (*Myotis sodalis*) and Virginia big-eared bat (*Corynorhinus townsendii virginianus*). Western EcoSystems Technology, Inc. Cheyenne, WY.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, and D.A. Shepherd. 2000. Avian Monitoring studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a 4-Year Study. Final Report. Western EcoSystems Technology, Inc. Cheyenne, WY.

Johnson, G., W. Erickson, M. Strickland, M. Shepherd, S. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 20: 879-887.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, and D.A. Shepherd. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist 150:332-342.

Johnson, G. D., M. K. Perlik, W. E. Erickson, and M. D. Strickland. 2005. Bat activity, composition, and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32:1278–1288.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003. <http://www.responsiblewind.org/docs/MountaineerFinalAvianRpt3-15-04PKJK.pdf>. (Accessed 30 September 2007).

Klem, D., Jr. 1991. Glass and bird kills: an overview and suggested planning and design methods of prevening a fatal hazard. Pp. 99-103 *in* Wildlife Conservation in Metropolitan Environments. NIUW Symp. Ser. 2. L.W. Adams and D.L. Leedy (eds). Natl. Inst. for Urban Wildlife. Columbia, MD.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5:315-324.

McMahon, J. S. 1998. The biophysical regions of Maine: patterns in the landscape and vegetation. M.S. Thesis, Univ. of Maine, Orono. 120 pp.

Miller, A. 2008. Patterns of Avian and Bat Mortality at a Utility-Scaled Wind Farm on the Southern High Plains. Submitted to Texas Tech University in partial fulfillment of a Masters Degree.

Normadeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.

Orloff, S. and A. Flannery. 1992. Wind turbine effects of avian activity, habitat use, and mortality in Altamont Pass and Solano County wind resource areas, 1989-1991. Final report prepared for Planning departments of Alameda, Contra Costa and Solano Counties, California, March 1992.

Pimentel, D., and Acquay, H. 1992. The Environmental and Economic Costs of Pesticide Use. BioScience 42:750-760.

Piorkowski, M. D. 2006. Breeding Bird Habitat Use and Turbine Collisions of Birds and Bats Located at a Wind Farm in Oklahoma Mixed-Grass Prairie. Submitted to the Faculty of the Graduate College of Oklahoma State University in partial fulfillment of a Masters Degree.

Smallwood, K. S. and C. G. Thelander. 2004. Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final Report by BioResource Consultants to the California Energy Commission, Public Interest Energy Research – Environmental Area, August 2004.

Stantec Consulting. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Prepared for UPC Wind Management, LLC.

Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Prepared for First Wind Management, LLC.

Stantec Consulting. 2010. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report. Prepared for First Wind Management, LLC.

Sterner, D. 2002. A roadmap for PIER research on avian collisions with wind turbines in California. Final report prepared for California Energy Commission, Energy related environmental research, December 2002.

Tetra Tech EC, Inc. Comparison of pre- and post-construction bald eagle use at the Pillar Mountain wind project, Kodiak, Alaska, Spring 2007 and 2010. Powerpoint presentation. http://www.nationalwind.org/assets/research_meetings/Research_Meeting_VIII_Sharp.pdfAccessed 9/19/2012.

Tidhar, David. 2009. Post-construction Wildlife Monitoring Study; Study Plan and Spring 2009 Interim Report. Lempster Wind Project, Sullivan County, New Hampshire. Prepared for Lempster Wind LLC Lempster Wind Technical Advisory Committee, Iberdrola Renewables. Prepared by Western EcoSystems Technology, Inc. Waterbury, VT.

Whitaker, J.O., and W.J. Hamilton. 1998. Mammals of the Eastern U.S.. Cornell University Press.

Whitfield, D.P. and M. Madders. 2006. A review of the impacts of wind farms on hen harriers (Circus cyaneus) and an estimation of collision avoidance rates. Natural Research, LTD, Natural Research Information Note 1 (Revised).

Williams, W. 2003. Alarming evidence of bat kills in eastern U.S. Windpower Monthly 19(10):21-23.

Appendix A
Publicly Available Post-Construction Results

Appendix B Table 1. Comparison of bird and bat mortality at existing wind farms in the eastern U.S.

Site	Habitat type (# turbines)	Dates surveyed	Search interval	# BATS found during surveys (incidental)	Estimated BATS/turbine/ period (total)	# BIRDS found during surveys (incidental)	Estimated BIRDS/turbine /period (total)	Reference
Searsburg, Vermont	forested (11)	June 30 - Oct 18, 1997	11 total (4 per search) 2 to 6 days per month	0	n/a	0	n/a	Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Prepared for the Vermont Department of Public Service Montpelier, Vermont. Subcontractor report for the National Renewable Energy Laboratory NREL/SR-500-28591.
Somerset County, Pennsylvania	agricultural (8)	2000 (12 months)	n/a	0	n/a	0	n/a	Kerlinger, P. 2006. Supplement to the Phase I Avian Risk Assessment and Breeding Bird Study for the Deerfield Wind Project, Bennington County, Vermont. Prepared for Deerfield Wind, LLC.
Mountaineer, West Virginia	forested ridgeline (44)	April 4 - Nov 11, 2003	2x per week	475	47.53 (2092)	69*	4.04 (178 + 33 due to substation lighting)	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003. <http://www.responsiblewind.org/docs/MountaineerFinalAvianRpt3-15-04PKJK.pdf>. (Accessed 30 September 2007).
Mountaineer, West Virginia	forested ridgeline (44)	July 31- Sept 11, 2004	22 daily, 22 weekly	398 (68)	38 (1364-1980)	15 (n/a)	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
Meyersdale, Pennsylvania	forested ridgeline (20)	Aug 2 - Sept 13, 2004	10 daily, 10 weekly	262 (37)	25 (400-660)	13 (4)	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
Buffalo Mtn, Tennessee	reclaimed mine on ridge (18)	April - Dec 10, 2005	18 of 18 every week, every 2 weeks, or every 2-5 days	243 (14)	63.9 (1,149)	9 (2)	1.8 (112)	Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005 June 28, 2007. Prepared for Tennessee Valley Authority.
Maple Ridge, New York	woodland, grassland, agricultural (120)	June 17 - Nov 15, 2006	10 every 3-days, 30 7-days, 10 daily	326 (58)	11.39-20.31 (1367-2437.2)	123 (15)	3.10-9.48 (372-1138)	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2006. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. http://www.wind-watch.org/documents/wp-content/uploads/maple_ridge_report_2006_final.pdf Accessed 1 December 2007.
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 30 - Nov 14, 2007	64 weekly	202 (81)	15.54-18.53 (3030-3614)	64 (32)	5.67-6.31 (1106-1230)	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 15 - Nov 9, 2008	64 weekly	140 (76)	8.18 - 8.92 (1595-1739)	74 (23)	3.42-3.76 (667-733)	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Mars Hill, Maine	forested ridgeline (28)	April 23-June 3, July 15-Sept 23, 2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	22 (2)	0.43-4.4 (12.1-122.5)	19 (3)	0.44-2.5 (27-69)	Stantec Consulting. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC.
Mars Hill, Maine	forested ridgeline (28)	April 19 - June 6, July 15-Oct 8, 2008	28 of 28 weekly, seasonal dog searches	5 (0)	0.17-0.68 (5-19)	17(4)	2.4-2.65 (57-74)	Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.
Munnsville, New York	agricultural forested uplands (23)	April 15-Nov 15, 2008	12 of 23 weekly, seasonal dog searches	9 (1)	0.70-2.90 (16-67)	7 (3)	1.71-2.22 (39-51)	Stantec Consulting. 2009. Post-construction monitoring at the Munnsville Wind Farm, New York, 2008. Prepared for E.ON Climate and Renewables.
Mount Storm, West Virginia	forested ridgeline (82)	July 18 - Oct 17, 2008	18 weekly, 9 daily	182 (27)	daily: 24.21 (1985) weekly: 7.76 (636)	29 (8)	2.41-3.81 (198-312)	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
Mount Storm, West Virginia	forested ridgeline (82)	July-October 2010	25 daily	308 (73)	22.39 (1836)	36 (11)	2.77 (227)	Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2010. Mount Storm Wind Energy Facility Post-construction Avian and Bat Monitoring, July-October 2010. Prepared for NedPower Mount Storm, LLC.
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 27 - October 9, 2008	22 daily	32***	24.2 (557)	N/A	N/A	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 26 - October 8, 2009	22 daily	39***	17.4 (400)	N/A	N/A	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Clinton, New York	agricultural, woodland (67)	April 26 to October 13, 2008	8 daily, 8 every 3-days, 7 weekly	39 (14)	daily: 5.45 (365); 3-day: 4.81 (322); weekly: 3.76 (252)	14 (9)	daily: 1.43 (956); 3-day: 3.26 (218); weekly: 2.48 (166)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009. Annual Report for the Noble Clinton Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Clinton, New York	agricultural, woodland (67)	April 15 to November 15, 2009	8 daily, 15 weekly	36 (6)	daily: 9.72 (651); weekly: 5.16 (3.46)	16 (8)	daily: 1.50 (101); weekly: 1.76 (118)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Clinton Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Ellenburg, New York	agricultural, woodland (54)	April 28 to Oct 13, 2008	6 daily, 6 every 3-days, 6 every 7-days	34 (25)	daily: 8.17 (441); 3-day: 6.94 (375); weekly: 4.19 (226)	12 (10)	daily: 2.09 (113); 3-day: 1.37 (74); weekly: 1.18 (64)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Ellenburg, New York	agricultural, woodland (54)	April 15 to November 15, 2009	6 daily, 12 weekly	28 (4)	daily: 8.01 (433); weekly: 3.70 (200)	19 (2)	daily: 5.69 (307); weekly: 2.29 (124)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Ellenburg Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Bliss, New York	agricultural, woodland (67)	April 21 to Nov 14, 2008	8 daily, 8 every 3-days, 7 weekly	74 (15)	daily: 7.58 (508); 3-day:14.66 (983); weekly: 13.01 (872)	20 (7)	daily: 4.30 (288); 3-day: 0.66 (44); weekly: 0.74 (50)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Bliss, New York	agricultural, woodland (67)	April 15 to November 15, 2009	8 daily, 15 weekly	36 (0)	daily: 8.24 (552); weekly: 4.46 (299)	25 (7)	daily: 4.45 (298); weekly: 2.87 (192)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Bliss Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Altona, New York	primarily woodlots (65)	April 26 to October 15, 2010	22 weekly, 8 daily from July 18 to Sept 18	24 (7)	daily: 6.51 (423); weekly: 3.87 (252)	14 (6)	daily: 1.55 (101); weekly: 2.76 (180)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Altona Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 15 to Nov 15, 2009	5 daily, 12 weekly	62 (7)	daily: 40.4 (2002); weekly: 13.8 (804)	15 (3)	2.9 - 4.7 (147-235)	Stantec Consulting. 2010. Cohocton and Dutch Hill Wind FarmsYear 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 26 to October 22, 2010	17 weekly except when 12 weekly and 5 daily from July 15-Sept 17	63 (5)	daily: 25.62 (1281); weekly 1: 5.04 (252); weekly 2: 10.44 (522)	9 (1)	daily: 2.06 (103); weekly 1: 0.82 (41); weekly 2: 1.16 (58)	Stantec Consulting. 2011. Cohocton and Dutch Hill Wind FarmsYear 2 Post-Construction Monitoring Report, 2010 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Wethersfield, NY	agricultural, woodlots (84)	April 15 to Oct 15, 2010	28 weekly	62 (13)	24.45 (2054)	11 (7)	2.55 (214)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K., Harte, A. 2011. Annual Report for the Noble Wethersfield Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Chateaugay, NY	agricultural, woodlots (71)	April 26 to Oct 15, 2010	24 weekly	22 (7)	3.66 (260)	19 (9)	2.40 (170)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Chateaugay Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31, 2009	4 daily	10 (2)	spring: 0.58 (7); fall: 5.51 (66)	9 (4)	spring: 0.80 (10); fall: 5.95 (71)	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31, 2010	12 weekly	14 (5)	spring (0); fall 7.13 (86)	11 (0)	spring: 1.16 (14); fall: 4.12 (49)	Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Stetson Mountain I, Maine	forested ridgeline (38)	April 20 to Oct 21, 2009	19 weekly	5 (0)	2.11 (80)	30 (9)	4.03 (153)	Stantec Consulting. 2010. Stetson I Mountain Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Stetson Mountain I, Maine	forested ridgeline (38)	April 18 to October 21, 2011	19 weekly	4 (0)	0.43 (16)	7 (0)	1.77 (67)	Normandeau Associates. 2010. Year 3 Post-construction avian and bat casualty monitoring at the Stetson I Wind Farm. Prepared for First Wind, LLC.
Stetson Mountain II, Maine	forested ridgeline (17)	April 19 to Oct 15, 2010	17 weekly	14 (0)	2.48 (42.12)	11 (0)	2.14 (36.41)	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
Kibby Mountain, Maine	forested ridgeline (44)	May 2 to June 20; July 11 to October 14, 2011	22 3 times every 2 wks	6 (3)	spring: (0); fall: 0.37 (16)	17 (4)	spring: 0.72 (32); fall: 0.29 (12)	Stantec Consulting. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.

*33 birds found on May 23, 2003 at turbines near a substation and at substation associated with sodium vapor lights

**Results of spring interim report, study period April 20 to June 1.

***Fresh bats found at curtailment treatment turbines reported only.

Exhibit 7-7-1

Fall 2012 Raptor Survey Results for Hancock Wind Project

Memo

Stantec

To:	Robert Roy First Wind Portland, Maine	From:	Sarah Boucher Stantec Consulting Services Inc. Topsham, Maine
File:	Job # 195600763	Date:	December 10, 2012

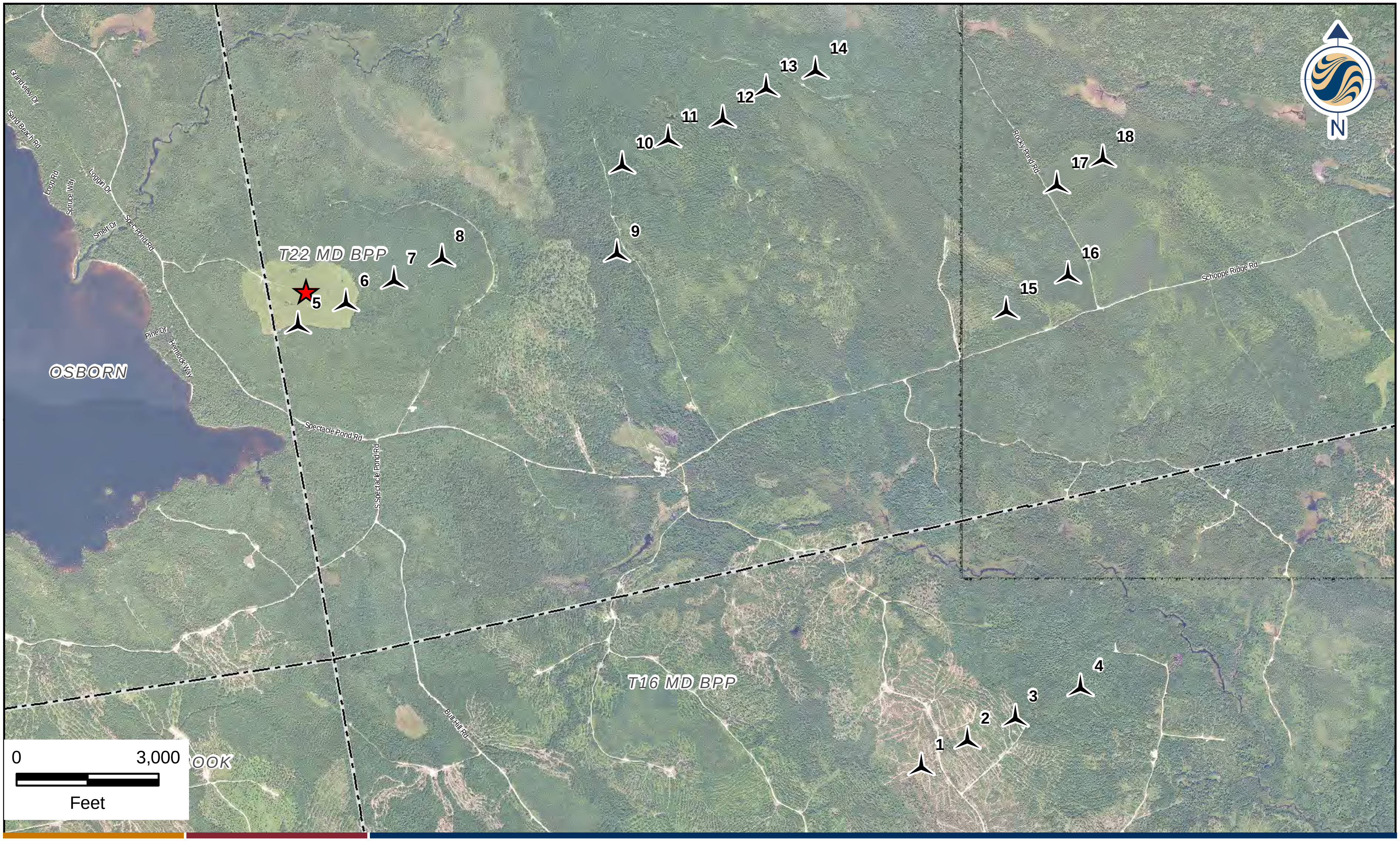
Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

This memo report presents the results of the fall 2012 raptor migration surveys conducted at the proposed Hancock Wind Project (Hancock or Project) in T16 MD and T22 MD in Hancock, Maine (Figure 1). These surveys were conducted based on the outcome of a meeting on September 4, 2012 with First Wind and the Maine Department of Inland Fisheries and Wildlife (MDIFW). The purpose of the meeting was to determine if additional field surveys were needed at the Project given that pre-construction bird and bat surveys recently had been conducted at the adjacent Bull Hill Wind Project in Eastbrook and T16 MD. During the meeting, MDIFW agreed that pre-construction radar migration and acoustic bat surveys were not necessary at the Project, as data collected at the Bull Hill Wind Project was sufficient. However, during follow up correspondence via email, MDIFW indicated that additional raptor migration surveys were recommended for Hancock. Therefore, as suggested by MDIFW, First Wind contracted Stantec to conduct raptor migration surveys at the Hancock Wind Project in fall 2012. The following summarizes the data collected during the fall 2012 raptor migration surveys.

METHODS

Stantec conducted surveys during the fall 2012 migration season on 10 days with fair to exceptional migration weather without rain. Stantec biologists surveyed from scaffolding at a height of approximately 8.2 meters (m) (27 feet [ft]) on Spectacle Pond Ridge (Figure 1). Surveys occurred from 9 am to 4 pm and consisted of one observer scanning the sky with binoculars to locate any passing raptors. Observers recorded data on Stantec raptor datasheets including species, age, and sex as possible, time of observation, flight direction and location (which was drawn on Project area maps), flight behavior, flight height, and time of flight below 156 m (512 ft), the maximum height of the proposed turbines. Each time a raptor was observed, it was recorded, regardless of whether it was suspected to have been observed previously that day. Therefore, daily count totals included all passes of raptors observed throughout a survey day. Incidental observations of raptors and other bird species observed outside the survey period were recorded. Observers recorded weather conditions hourly. Data for passage rate and flight height were calculated by hour, day, and for the season, and flight location and behavior data were summarized.

For the purposes of the report, the ‘study area’ refers to the entire airspace visible from the observation location (Figure 2). The ‘Project area’ refers to only those areas within the study area where turbines are proposed (Spectacle Pond Ridge, areas on Schoppe Ridge, and the unnamed hill northeast of Bull Hill [known as ‘Southeast String’] in this report. Observations also were recorded of raptors over the Bull Hill Wind Project turbines visible from the observation location (Figure 2).



195600763

Stantec

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

00763_01_Raptors.mxd

Legend

- Proposed Turbine Layout
- Raptor Survey Fall 2012

Client/Project
Hancock Wind, LLC
Hancock Wind Project
T16 MD & T22 MD, Maine

Figure No.
1

Title
Fall 2012 Raptor Survey Location
12/6/2012

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

RESULTS

See Table 1 for a results summary.

Table 1. A summary of the fall 2012 survey effort and results at the Hancock Wind Project

Range of survey dates	9/27 - 10/17
No. survey days	10
No. survey hours	69.25
No. raptor species observed	13
Raptor species observed (common name)	**Scientific name**
American kestrel	*Falco sparverius*
bald eagle	*Haliaeetus leucocephalus*
barred owl	*Strix varia*
broad-winged hawk	*Buteo platypterus*
Cooper's hawk	*Accipiter cooperii*
merlin	*Falco columbarius*
northern goshawk	*Accipiter gentilis*
northern harrier	*Circus cyaneus*
osprey	*Pandion haliaetus*
red-shouldered hawk	*Buteo lineatus*
red-tailed hawk	*Buteo jamaicensis*
sharp-shinned hawk	*Accipiter striatus*
turkey vulture	*Cathartes aura*
unidentified accipiter hawk	*Accipiter (sp)*
unidentified buteo hawk	*Buteo (sp)*
unidentified eagle	*Accipitridae (gen, sp)*
unidentified falcon	*Falco (sp)*
unidentified raptor	*Accipitridae (gen, sp)*
Total no. observations of raptors	158
Seasonal passage rate (raptor observations/hour)	2.28
Total no. observations of raptors within Project area (percent of total observations)	42 (27%)
Total no. of observations of raptors seen in the Project area and below turbine height (percent of those in PA; percent of total observations)	41 (98%; 26%)

The observation location had an unobstructed 360-degree view of the surrounding airspace. Spectacle Pond, Spectacle Pond Ridge, Schoppe Ridge, Bull Hill, Little Bull Hill, the Southeast String and the airspace over much of the Union River, Pork Brook, Mahanon Brook, and Hopper Brook all were visible from the observation location (Figures 1 and 2).

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

Figure 2. Observation location view in fall 2012 at the Hancock Wind Project to north (top left), east (top right), southeast (bottom left; note the Bull Hill Wind Project turbines in view), and west (bottom right).

Stantec conducted 10 days of survey between September 27 and October 17 (69.25 survey hours). Weather on survey days was clear to partly cloudy (Table 2). Periods of fog occurred on 2 survey days (October 5 and October 10). Winds were variable, ranging from 0 meters per second (m/s) to 8.5-10.7 m/s (19-24 miles per hour) on 3 survey days (October 2, October 8, and October 11).

Table 2. Wind direction and pressure systems during fall 2012 surveys at the Hancock Wind Project.

Date	Wind direction	Wind speed code (s)	Daytime Pressure System (high or low)
9/27/2012	NW	4	high passing, second high approaching
9/28/2012	SE, SW	2, 3	high passing, precipitation to the south in afternoon
10/2/2012	S	variable	high pressure stalled to the south
10/3/2012	E, SE	1, 2, 3	low approaching from southwest
10/5/2012	SW	1, 2, 3	low passing
10/8/2012	NW	3, 4, 5	high approaching from west
10/9/2012	SE	3, 4	high, second high approaching from south
10/10/2012	SE	1, 2, 3	high passing, low approaching from southwest
10/11/2012	W	4, 5	low giving way to high in evening hours
10/17/2012	NW	1, 2, 3	none

Wind Speed codes **1** = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

Passage Rate

Observers recorded 158 total raptor observations (Appendix A Table 1). The overall passage rate was 2.28 raptor observations per hour (raptors/hr). Daily passage rates ranged from 0.29 raptors/hr on October 11 to 6.00 raptors/hr on September 27 (Figure 3). September 27 was cool and generally clear with moderate to high winds from the northwest and a passing high pressure system.

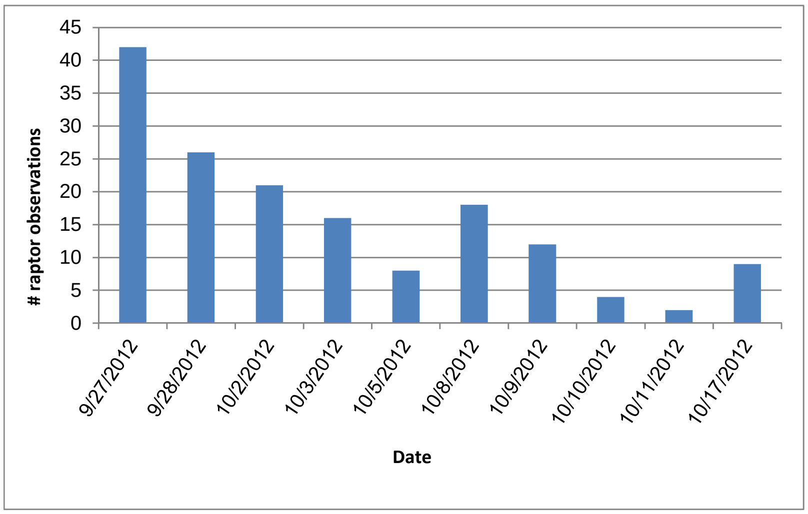


Figure 3. Survey day totals of raptor observations during fall 2012 surveys at the Hancock Wind Project.

Turkey vulture (*Cathartes aura*) was the most commonly observed species (29% of total observations, n=46) (Figure 4). Observations of *Buteo* species (broad-winged hawk (*Buteo platypterus*), red-tailed hawk (*Buteo jamaicensis*), and red-shouldered hawk (*Buteo lineatus*)) accounted for 13% (n=20) of total observations. Similarly, observations of *Accipiter* species (Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*) and northern goshawk (*Accipiter gentilis*)) accounted for 12% (n=19) of total observations. Observations of falcons (*Falco* species; American kestrel (*Falco sparverius*) and merlin (*Falco columbarius*)) accounted for 6% (n=9) of total observations.

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

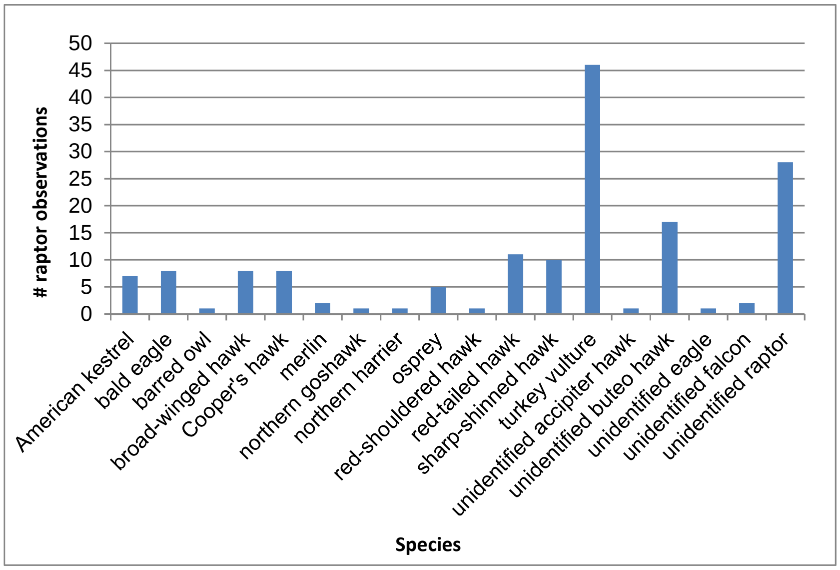


Figure 4. Number of observations of raptor species observed during fall 2012 surveys at the Hancock Wind Project.

Hourly Observations

Throughout the survey season, the majority of observations (20%; n=32) peaked between 1:00 and 2:00 pm (Figure 5, Appendix A Table 2).

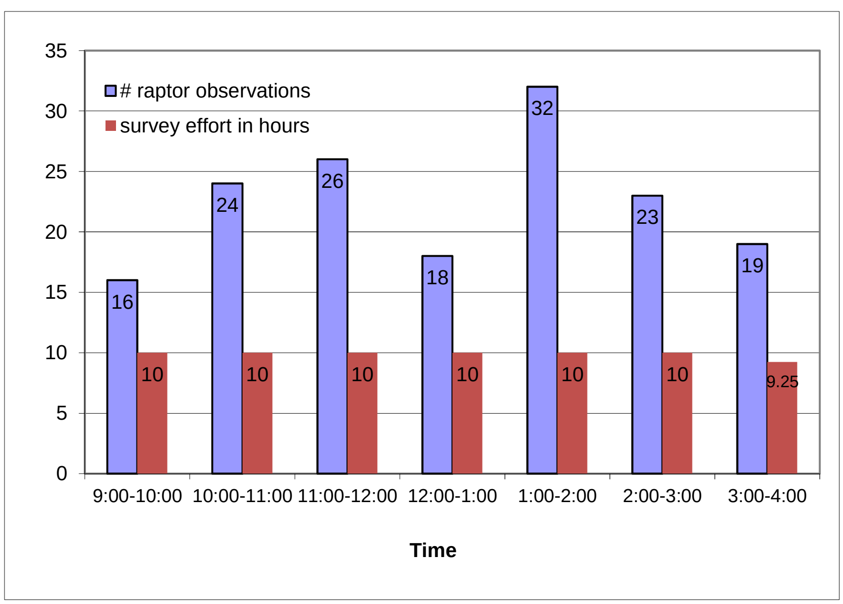


Figure 5. Number of observations of raptors per hour during fall 2012 surveys at the Hancock Wind Project.

Raptor Behaviors

Table 3 provides a summary of raptor behaviors observed relative to topographical features in the study area. Note that there are more behavior observations than there were total raptors

Reference: Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine

observed because some raptors exhibited multiple behaviors while passing through different topographical features in the study area.

Table 3. Raptor behaviors summarized by location in study area and flight position at the Hancock Wind Project, Fall 2012

Behavior		Soaring, Gliding						Powered Flight						Foraging Behaviors						territorial or courtship behavior						Perched					
Flight position where behavior observed		A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D
Location in Study Area	Bull Hill	4	7	1	2	12	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bull Hill, Mahanon Brook, Schoppe Ridge	4	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hopper Brook	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mahanon Brook Valley	0	0	0	1	1	5	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Narragugus River	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Northeast Plain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pork Brook Valley	0	0	0	0	0	20	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Schoppe Ridge	5	4	1	2	9	3	1	2	0	1	1	1	0	1	0	2	2	0	0	0	0	0	0	0	0	1	0	0	1	0
	Schoppe Ridge and Southeast String	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Southeast String	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spectacle Pond	0	2	1	4	6	4	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spectacle Pond Ridge	6	2	0	1	4	2	12	5	0	7	1	1	2	5	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0
	Union River	0	1	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Union River - East Branch	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	unnamed feature outside Project Area	0	4	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total behavior obs = 213		**19**	**21**	**4**	**16**	**39**	**50**	**14**	**8**	**0**	**9**	**3**	**9**	**2**	**7**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**3**	**0**	**1**	**1**	**0**

A1) flight along or parallel to ridge; A2) crossed ridge; A3) flight crossed depression or saddle; B) upper slope; C) lower slope; D) over valley

Soaring or gliding behaviors over the valley (D) or over the lower slopes of hills (C) were most commonly observed (n=89, 42%). An unidentified raptor species exhibited a single territorial behavior over Pork Brook Valley; no other territorial behaviors were documented.

Raptors were considered actively migrating if their flight path was generally southward, which is typical of fall migration. Raptors were characterized as stop-over or seasonally local birds if they were not traveling generally southward, if they were not moving in a direct manner, or if they exhibited foraging or territorial behaviors. Based on these criteria, observers identified 57 actively migrating raptors (36%) (Table 4).

Table 4. Observations of raptors suspected to be actively migrating at the Hancock Wind Project, Fall 2012

Species	not actively migrating	actively migrating	undetermined	TOTAL
American kestrel	2	4	1	**7**
bald eagle	2	5	1	**8**
barred owl	1			**1**
broad-winged hawk	6	2		**8**
Cooper's hawk	6	2		**8**
merlin	2			**2**
northern goshawk		1		**1**
northern harrier		1		**1**
osprey	3	1	1	**5**
red-shouldered hawk			1	**1**
red-tailed hawk	6	5		**11**
sharp-shinned hawk	6	3	1	**10**
turkey vulture	27	12	7	**46**
unidentified accipiter hawk	1			**1**
unidentified buteo hawk	6	6	5	**17**
unidentified eagle		1		**1**
unidentified falcon		2		**2**
unidentified raptor	16	12		**28**
TOTAL	**84**	**57**	**17**	**158**

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

Flight Heights

Observers recorded all estimated flight heights of each bird relative to the different topographical positions of the study area. Table 5 summarizes observations for birds observed both within (positions A1, A2, A3, and B) and outside (positions C and D) the Project area. The average minimum flight height of observations during ridge crossings at high points was 88.1 m (289 ft; for 32 observations). Average minimum flight height over the valley was 179.0 m (587 ft).

Table 5. Number of observations and average flight heights for each position category for birds observed at the Hancock Wind Project, Fall 2012

	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
No. of position observations (will be greater than no. individuals)	32	32	4	29	44	58
Average minimum flight height (m)	52.8	88.1	145.0	119.1	131.7	179.0

Of the 158 total raptor observations made within the study area, 42 observations (27%) occurred within the Project area (Appendix A Table 3). Of those birds within the Project area, 31 (74%) of birds occurred over Spectacle Pond Ridge, 10 (24%) occurred over Schoppe Ridge, and 1 (2%) occurred in the vicinity of Schoppe Ridge and the Southeast String (Table 6).

Table 6. Total observations of raptor species at locations within the Project Area at the Hancock Wind Project, Fall 2012

Species	Schoppe Ridge	Schoppe Ridge and Southeast String	Spectacle Pond Ridge	Grand Total
American kestrel			6	6
bald eagle			3	3
barred owl	1			1
broad-winged hawk				0
Cooper's hawk	2		3	5
merlin			2	2
northern goshawk	1			1
northern harrier			1	1
osprey			4	4
red-shouldered hawk				0
red-tailed hawk	2		1	3
sharp-shinned hawk			8	8
turkey vulture	3			3
unidentified accipiter hawk				0
unidentified buteo hawk	1			1
unidentified eagle		1		1
unidentified falcon			2	2
unidentified raptor			1	1
Totals	10	1	31	**42**

Of birds within the Project area, 41 (98% of birds within the Project area; 26% of total observations) occurred at flight heights below the proposed maximum turbine height of 156 m for at least a portion of their flight (Figure 6, Appendix A Table 3). Of total observations in the Project area, most were of sharp-shinned hawk (n=8, 20%). These observations occurred below turbine height.

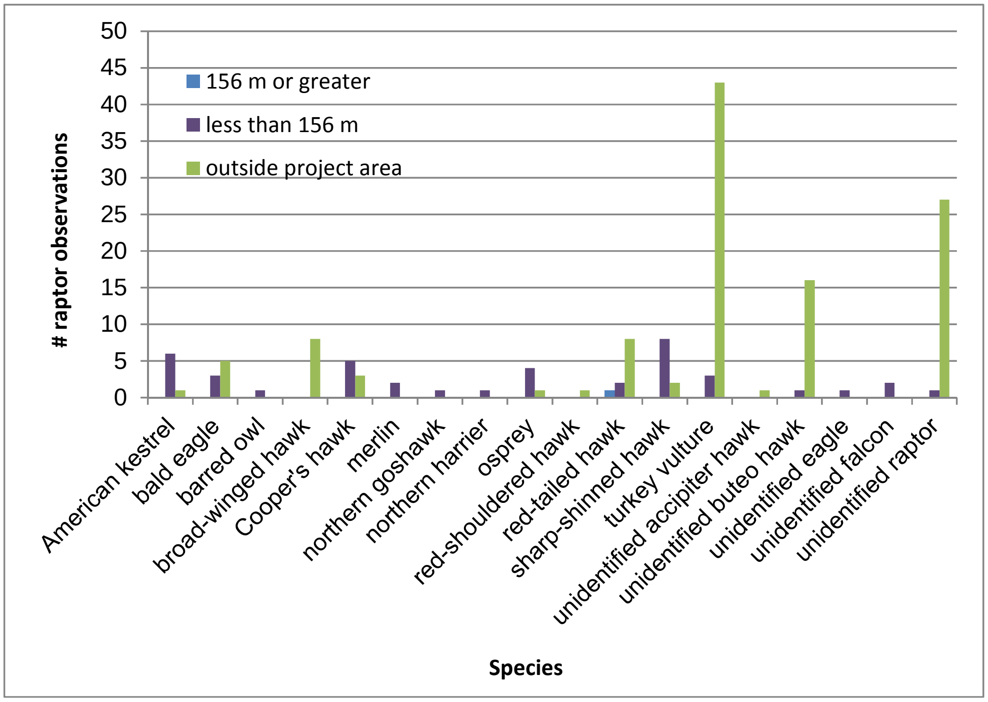


Figure 6. Number of raptors observed within and outside the Project area at heights above and below 156 m during fall 2012 surveys at the Hancock Wind Project.

Rare, Threatened and Endangered Species

No federally or state-listed (MDIFW 2010) species were observed. Two State Species of Special Concern (MDIFW 2011), bald eagle (*Haliaeetus leucocephalus*) (n=8) and northern harrier (*Circus cyaneus*) (n=1), were observed. Three of the 8 bald eagle observations (38%) occurred in the Project area over Spectacle Pond Ridge, and all 3 observations occurred at heights below turbine height for a portion of their flight. Two of these 3 (67%) observations were juvenile bald eagles. These 3 observations spent approximately 2 minutes combined in the Project area and below turbine height (0.05% of total survey minutes), and were observed soaring and gliding along or parallel to the ridge and the lower slope of the ridge. The 5 bald eagle observations outside the Project area occurred over Mahanon Brook Valley, Spectacle Pond, and the lower slopes of Schoppe Ridge. The northern harrier observation occurred over Spectacle Pond Ridge on October 3 at heights below turbine height; this bird was suspected to be actively migrating as it exhibiting powered flight while flying southward.

Incidental Observations

Twenty avian species were incidentally observed (Table 7). None of the species incidentally observed is federally or state-listed endangered or threatened (MDIFW 2011). Only white-throated sparrow (*Zonotrichia albicollis*) is a State Species of Special Concern.

Table 7. Avian species incidentally observed during raptor surveys at the Hancock Wind Project, Fall 2012

Common name	Scientific name
American crow	*Corvus brachyrhynchos*
American goldfinch	*Spinus tristis*
American robin	*Turdus migratorius*
American woodcock	*Scolopax minor*
barred owl	*Strix varia*
black-capped chickadee	*Poecile atricapillus*
blue jay	*Cyanocitta cristata*
Canada goose	*Branta canadensis*
common raven	*Corvus corax*
dark-eyed junco	*Junco hyemalis*
downy woodpecker	*Picoides pubescens*
eastern phoebe	*Sayornis phoebe*
hairy woodpecker	*Picoides villosus*
northern flicker	*Colaptes auratus*
pileated woodpecker	*Dryocopus pileatus*
red-breasted nuthatch	*Sitta canadensis*
song sparrow	*Melospiza melodia*
white-breasted nuthatch	*Sitta carolinensis*
white-throated sparrow	*Zonotrichia albicollis*
yellow-rumped warbler	*Dendroica coronata*

Appendix A Table 4 shows the survey effort and results of comparable fall raptor surveys conducted on forested ridges in the East.

Compared to the results of the fall 2009 raptor surveys at the Bull Hill Wind Project, the total number of observations were comparable but slightly higher at the Project (158 observations compared to 124 observations at Bull Hill), and passage rates at the Project were comparable but slightly higher (2.28 raptors/hr at the Project compared to 1.43 raptors/hr at Bull Hill). In terms of species composition, a greater proportion of observations were of *Accipiter* species in fall 2009 at Bull Hill (27%; n=33) compared to fall 2012 at the Project (12%; n=19), and a greater proportion of observations were of falcons in fall 2009 at Bull Hill (15%; n=19) compared to fall 2012 at the Project (6%; n=9).

The study area's overall passage rate (2.28) is near the upper end of the range of passage rates documented during pre-construction fall studies conducted at other proposed projects on forested ridges in Maine (0.7 to 2.2 raptors/hr), but at the low end of the range of passage rates at other studies in the East (0.7 to 12.7 raptors/hour). The percent below turbine height as calculated for 'the percent of those within the Project area' (98%) is within the range of those recorded at other projects on forested ridges in Maine and the East (43 to 98%). The percent below turbine height as calculated for 'the percent of total observations' (26%) is lower than the minimum percent below turbine height documented at other projects on forested ridges in Maine (58% to 69%) and within the range of percent below turbine height at other projects in the East (21% to 82%).

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING

Sarah Boucher

Sarah Boucher
Project Manager

cc: Josh Bagnato, First Wind
Dave Fowler, First Wind

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

Appendix A

Raptor Survey Results Tables

Reference: Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine

Appendix A Table 1. Daily total observations of raptor species and daily passage rates at the Hancock Wind Project, Fall 2012

Species	9/27/2012	9/28/2012	10/2/2012	10/3/2012	10/5/2012	10/8/2012	10/9/2012	10/10/2012	10/11/2012	10/17/2012	Entire Season
American kestrel		1	3	1		2					7
bald eagle	1		4						1	2	8
barred owl								1			1
broad-winged hawk	6		1	1							8
Cooper's hawk	2	1				3	1			1	8
merlin				1	1						2
northern goshawk								1			1
northern harrier				1							1
osprey			3		1					1	5
red-shouldered hawk					1						1
red-tailed hawk	4		1	3	1		2				11
sharp-shinned hawk			2			5	2			1	10
turkey vulture	18	17	2	6			3				46
unidentified accipiter hawk			1								1
unidentified buteo hawk	5	2	2	2	3	2				1	17
unidentified eagle						1					1
unidentified falcon										2	2
unidentified raptor	6	5	2	1	1	5	4	2	1	1	28
Daily Totals	**42**	**26**	**21**	**16**	**8**	**18**	**12**	**4**	**2**	**9**	**158**

Appendix A Table 2. Hourly summary of raptor observations at the Hancock Wind Project, Fall 2012

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	Grand Total
American kestrel	1	1	2		3			7
bald eagle	1	3		2		2		8
barred owl			1					1
broad-winged hawk		1	5		1	1		8
Cooper's hawk	2		2	1	3			8
merlin			1	1				2
northern goshawk					1			1
northern harrier		1						1
osprey	2	1	1				1	5
red-shouldered hawk						1		1
red-tailed hawk	2		4		1	2	2	11
sharp-shinned hawk	1	4	2	1	2			10
turkey vulture	4	5	4	4	11	10	8	46
unidentified accipiter hawk		1						1
unidentified buteo hawk	1	6	1	2	1	3	3	17
unidentified eagle							1	1
unidentified falcon	1			1				2
unidentified raptor	1	1	3	6	9	4	4	28
Hourly totals	**16**	**24**	**26**	**18**	**32**	**23**	**19**	**158**

Reference: **Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine**

Appendix A Table 3. Number of individuals of species observed within Project boundary in proposed turbine areas above or below 156 m, Hancock Wind Project, Fall 2012

Species	156 m or greater	less than 156 m	outside project area
American kestrel		6	1
bald eagle		3	5
barred owl		1	
broad-winged hawk			8
Cooper's hawk		5	3
merlin		2	
northern goshawk		1	
northern harrier		1	
osprey		4	1
red-shouldered hawk			1
red-tailed hawk	1	2	8
sharp-shinned hawk		8	2
turkey vulture		3	43
unidentified accipiter hawk			1
unidentified buteo hawk		1	16
unidentified eagle		1	
unidentified falcon		2	
unidentified raptor		1	27
TOTAL	**1**	**41**	**116**

Reference: Results of fall 2012 raptor surveys, Hancock Wind Project, Hancock County, Maine

Appendix A Table 4. Summary of available fall raptor survey results at wind sites in the East (1996-present)

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Fall 1996									
Searsburg, Bennington County, VT	Forested ridge	Sept. 11 - Nov. 3	20	80	430	12	5.4	n/a	Kerlinger, Paul. 1996. A Study of Hawk Migration at Green Mountain Power Corporation's Searsburg, Vermont, Wind Powered Site: Autumn 1996. Prepared for the Vermont Public Service Board, Green Mountain Power, National Renewable Ener gy Laboratory, VERA.
Fall 2004									
Deerfield, Bennington Cty, VT (Existing Facility)	Forested ridge	Sept. 2 - Oct. 31	10	60	147	n/a	2.5	n/a	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Deerfield, Bennington Cty, VT (Western Expansion)	Forested ridge	Sept. 2 - Oct. 31	10	57	725	n/a	12.7	n/a	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Sheffield, Caledonia Cty, VT	Forested ridge	Sept. 11 - Oct. 14	10	60	193	10	3.2	(125 m) 31%[1]	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Fall 2005									
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 17 - Oct. 15	6	18	49	5	4.37 [3]	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Moresville, Deleware Cty, NY	Forested ridge	Aug. 31 - Nov. 3	11	72	228	11	3.2	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Mars Hill, Aroostook Cty, ME	Forested ridge	Sept. 9 - Oct. 13	8	42.5	115	13	1.5	(120 m) 58%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan County, NH	Forested ridge	Fall 2005	10	80	264	10	3.3	(165 m) 20.8%[1]	The Louis Berger Group. 2006. Pre and Post-construction Avian Survey, Monitoring, and Mitigation at the Lempster, New Hampshire Wind Power Project. Prepared for Lempster Wind, LLC.
Fall 2006									
Stetson, Penobscot Cty, ME	Forested ridge	Sept. 14 - Oct. 26	7	42	86	11	2.1	(125 m) 63%[1]	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Rollins, Penobscot Cty, ME	Forested ridge	Sept. 13 - Oct. 16	12	89	144	12	1.8	(120 m) 82%[1]	Stantec Consulting. 2008. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Fall 2007									
Roxbury, Oxford Cty, ME	Forested ridge	Sept. 3 - Oct. 15	14	86	96	12	1.1	n/a	Stantec Consulting. 2008. Fall 2007 Migration Survey Report Visual, Acoustic, and Radar Surveys of Bird and Bat Migration conducted at the proposed Record Hill Wind Project In Roxbury, Maine. Prepared for Independence Wind, LLC.
Granite Reliable Power, Coos County, NH	Forested ridge	Sept. 5 - Oct. 16	11	68	44	9	0.7	n/a	Stantec Consulting. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	Sept. 12 - Dec. 1	24	147	769	12	5.2	(125 m) 65%[1]	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Greenland, Grant Cty, WV	Forested ridge	Sept. 12 - Dec. 1	27		858	13	5.9	(125 m) 67%[1]	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 21 - Oct. 28	6	n/a	n/a	n/a	4.4	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Allegany, Cattaraugus Cty, NY	Forested ridge	Sept. 8 - Oct. 11	11	63.78	125	10	2.0	(150 m) 78%[5]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Fall 2008									
Moresville, Deleware Cty, NY	Forested ridge	Oct 14 - Dec 18	19	132	100	12	0.8	(125 m) 74%[5]	Stantec Consulting. 2009. 2008 Late-Fall Raptor Migration Survey Report. Prepared for Moresville Energy LLC.
Highland, Somerset Cty, ME	Forested ridge	Sept 3 to Oct 31	15	135	301	10	2.2	(128 m) 43%[5]	Stantec Consulting Services. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC.
Fall 2009									
Granite Reliable Power, Coos County, NH (Dixville peak)	Forested ridge	Aug 27 to Oct 27	10	68.33	113	11	1.65	(125 m) 76%[5]	Stantec Consulting Services Inc. 2009. Summary of Fall 2009 Raptor Survey Results at the Proposed Granite Reliable Power Project. Prepared for Noble Environmental Power.
Granite Reliable Power, Coos County, NH (Owl head mtn)	Forested ridge	Aug 27 to Oct 27	10	70	129	10	1.84	(125 m) 82%[5]	Stantec Consulting Services Inc. 2009. Summary of Fall 2009 Raptor Survey Results at the Proposed Granite Reliable Power Project. Prepared for Noble Environmental Power.
Groton Wind, Grafton Cty, NH (Tenney ridge)	Forested ridge	Aug 24 to Oct 26	10	79	326	11	4.13	(121 m) 58%[5]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC.
Groton Wind, Grafton Cty, NH (Crosby and Bald Mtns)	Forested ridge	Aug 24 to Oct 26	10	78	370	14	4.74	(121 m) 79%[5]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC.
Stetson, Penobscot Cty, ME	Forested ridge	Sept 2 to Oct 14	8	50	45	11	0.9	n/a	Stantec Consulting. 2009. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC
Bowers, Washington Cty, ME	Forested ridge	Sept 9 to Oct 14	15	105	95	9	0.9	(119 m) 69%[1]	Stantec Consulting. 2009. Fall 2009 Avian and Bat Surveys for the Bowers Wind Project in Washington County, Maine. Prepared for Champlain Wind Energy, LLC.
Bull Hill, Hancock Cty, ME	Forested ridge	Sept 2 to Oct 14	12	87	124	11	1.43	(145 m) 98%[5]	Stantec Consulting. 2009. Summer and Fall 2009 Avian and Bat Survey Report for the Bull Hill Project in T16 MD, Maine. Prepared for Blue Sky East Wind, LLC.
Fall 2010									
Bingham, Somerset Cty, ME (Kingsbury Ridge)	Forested ridge	Sept 2 to Oct 13	12	84	57	11	0.68	(150 m) 85%[5]	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Bingham, Somerset Cty, ME (Johnson Ridge)	Forested ridge	Sept 2 to Oct 13	5	35	61	9	1.74	(150 m) 92%[5]	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Fall 2011									
Antrim, Hillsborough Cty, NH	Forested ridge	Sept 1 to Nov 20	21	147.5	978	10	6.63	(unknown) 37% between 50-500 ft above ground[1]	TRC Engineers and Stantec Consulting Services Inc. 2011. Avian and Bat Protection Plan for the Antrim Wind Energy Project. Prepared for Antrim Wind Energy, LLC.
Passadumkeag, Grand Falls Twp, ME	Forested ridge	Sept 9 to Oct 12	12	84	171	11	2.04	(140m) 58%[5]	Stantec Consulting Services Inc. 2011. Summer and Fall 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Fall 2012									
Hancock, Hancock Cty, ME	Forested ridge	Sept 27 to Oct 17	10	69.25	158	13	2.28	(156 m) 98%[5]	*This Report*

[1] Percent below turbine height calculated for all observations within study area.

[2] Calculated for spring and fall combined.

[3] Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

[4] Calculated for spring and fall 2006 and 2007 combined.

[5] Percent below turbine height calculated for those observations within project area (locations within study area where turbines could possibly be located).

Exhibit 7-7-2

Radar Survey Results for Bull Hill Wind Project
(Spring 2010 & 2011 - Fall 2009 & 2011)

Memo

To: Geoff West
First Wind
Portland, Maine

From: Brooke Barnes
Stantec Consulting Services Inc.
Topsham, Maine

File: Job #195600500

Date: July 12, 2011

Reference: Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine

Stantec conducted nocturnal radar surveys at the proposed Bull Hill Wind Project (Project) in Eastbrook, Maine during Spring 2011 to document the abundance, flight patterns, and flight altitudes of night-migrating birds and bats using X–band marine radar. Stantec previously conducted radar surveys at the Project in Spring 2010; results of these surveys differed slightly from the typical survey results documented at other proposed project sites in Maine. The Maine Department of Inland Fisheries and Wildlife recommended a second season of surveys at the Project. Therefore, Spring 2011 radar surveys were conducted from the same location as Spring 2010 surveys to supplement the 2010 data. This memo report summarizes results of the Spring 2011 radar surveys and attempts to compare those results to the Spring 2010 results, recognizing that year to year variations in bird populations and weather events may affect the timing and magnitude of migration year to year.

METHODS

Spring 2011 radar surveys were conducted on 10 nights between the same survey period as Spring 2010 (April 20 to May 24, 2011) at the same radar location as in Spring 2010[1]. The radar site was located within a clearing near the highest point of Bull Hill surrounded by fairly short, regenerating spruce trees. Consequently, as in Spring 2010, the radar site had good visibility and was capable of detecting targets within nearly all of its theoretical detection range. Data were analyzed and summarized by hour, night and for the season, including passage rate, flight direction and flight height to remain consistent with methods of the Spring 2010 surveys.

RESULTS

Radar surveys were conducted on 10 nights between April 26 and May 22, 2011 on nights with good to fair weather for migration (Appendix A Table 1).

Passage Rates

Nightly passage rates were highly variable, and ranged from 88 ± 23 targets per kilometer per hour (t/km/hr) on April 26 to 1108 ± 145 t/km/h on May 12. The overall passage rate for the entire survey period was 519 ± 57 t/km/hr (Figure 2-1; Appendix A Table 2). Individual hourly passage rates varied from 0 t/km/hr during the 10th hour of May 8 and 9th hour of May 17, to

---

[1] For 2010 and 2011 survey methodology, refer to the Spring 2010 Avian and Bat Survey Report, August 2010.

2118 t/km/hr during the 4th hour of May 22. For the entire season, passage rates typically highest during the third hour past sunset (Figure 2-2).

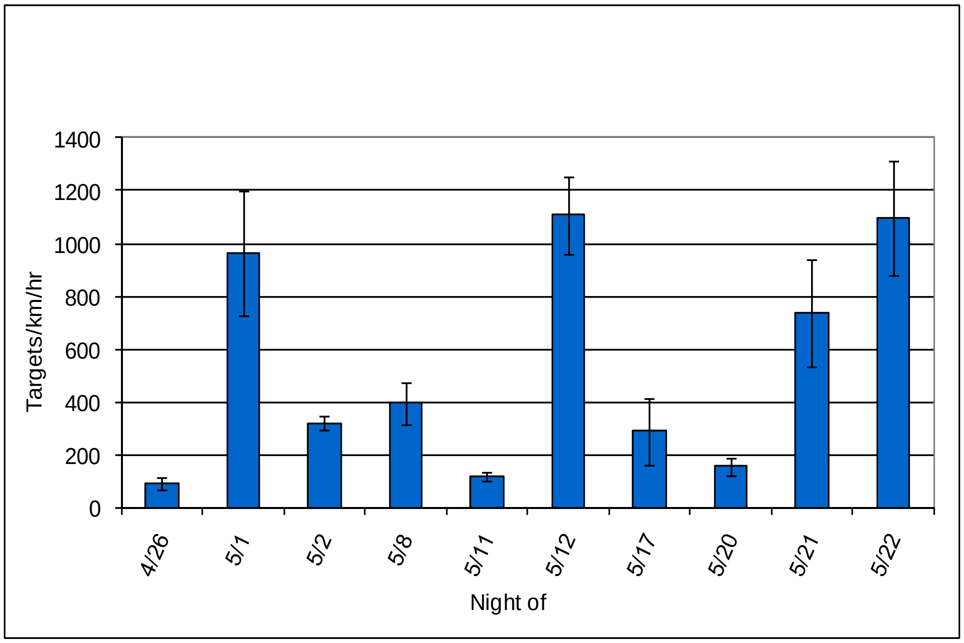


Figure 2-1. Nightly passage rates observed at Bull Hill, Spring 2011 (error bars ± 1 SE)

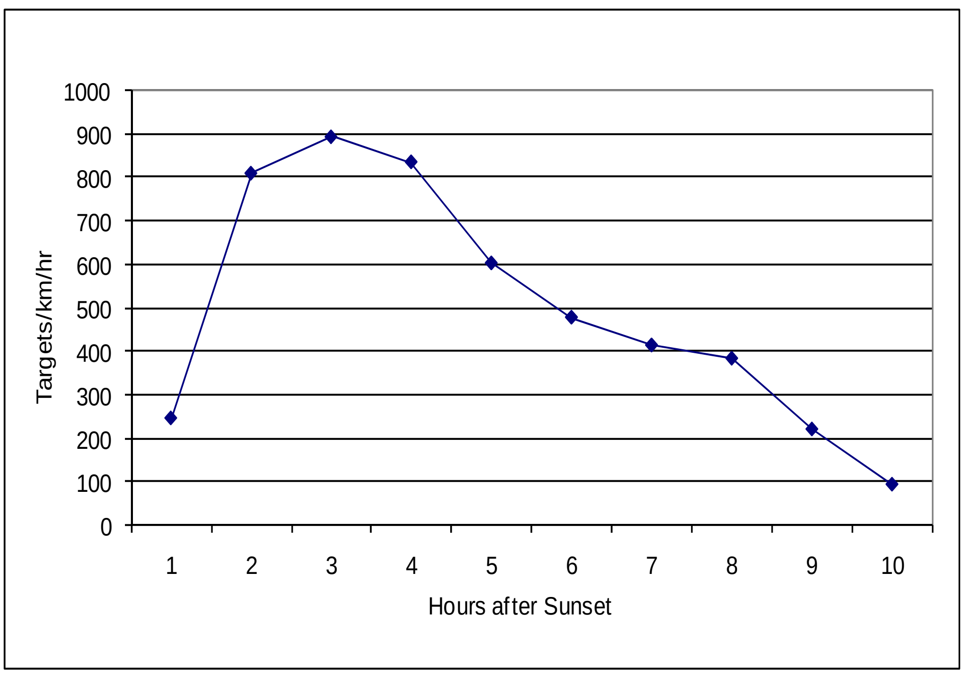


Figure 2-2. Hourly passage rates for entire season at Bull Hill, Spring 2011

Flight Direction

Mean flight direction through the Project area was 98 ± 65 (Figure 2-3; Appendix A Table 3).

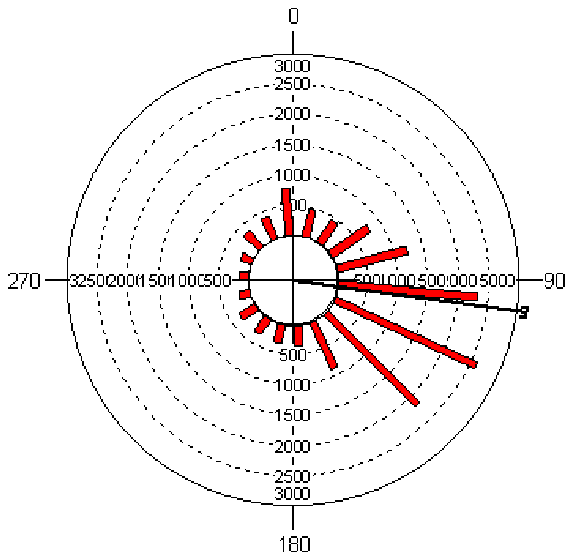


Figure 2-3. Mean flight direction for the entire season at Bull Hill, Spring 2011 (the bracket along the margin of the histogram is the 95% confidence interval)

Flight Altitude

The seasonal average mean flight height of all targets was 371 ± 3 meters (m; 1217 feet [']) above the radar site. The average nightly flight height ranged from 164 ± 59 m on May 21 to 436 ± 76 m on May 2 (Figure 2-4; Appendix A Table 4). The percent of targets observed flying below 145 m, the proposed turbine height, was 21 percent for the season and varied nightly from 7 percent on May 2 to 63 percent on May 21 (Figure 2-5). For the entire season, the mean hourly flight heights were typically highest the 7th hour after sunset (Figure 2-6).

Reference: **Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine**

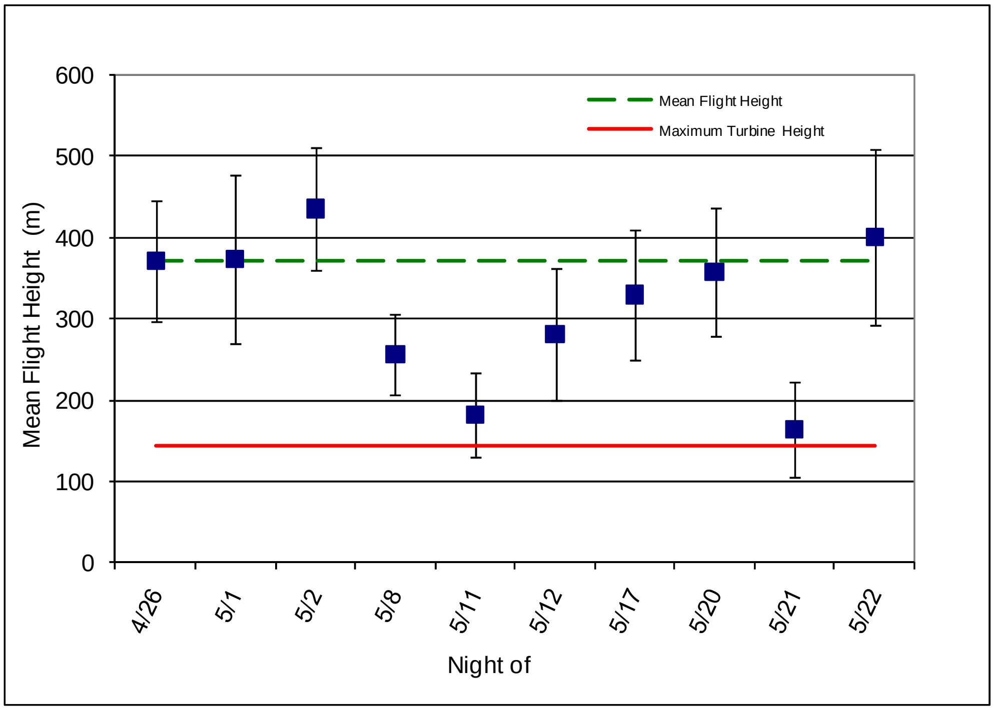


Figure 2-4. Mean nightly flight height of targets at Bull Hill, Spring 2011 (error bars ± 1 SE)

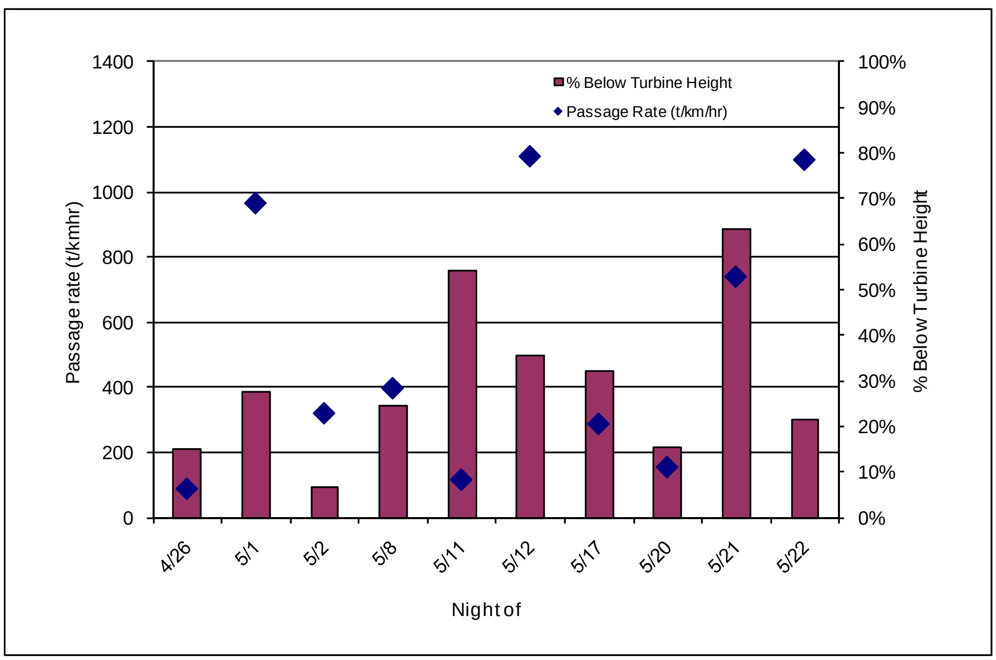


Figure 2-5. Percent of targets observed flying below a height of 145 m (475') at Bull Hill, Spring 2011

Reference: Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine

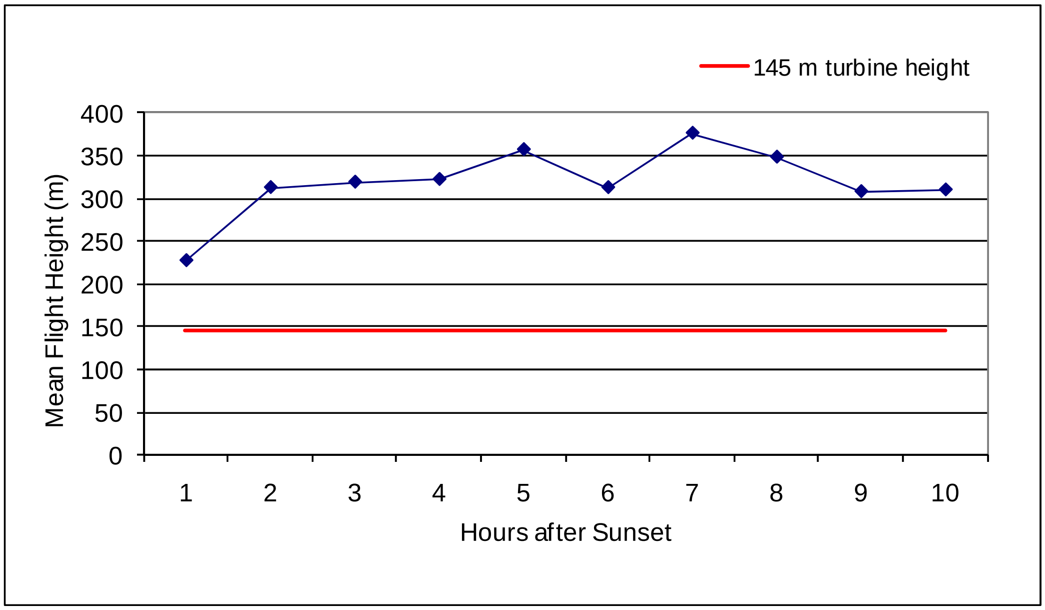
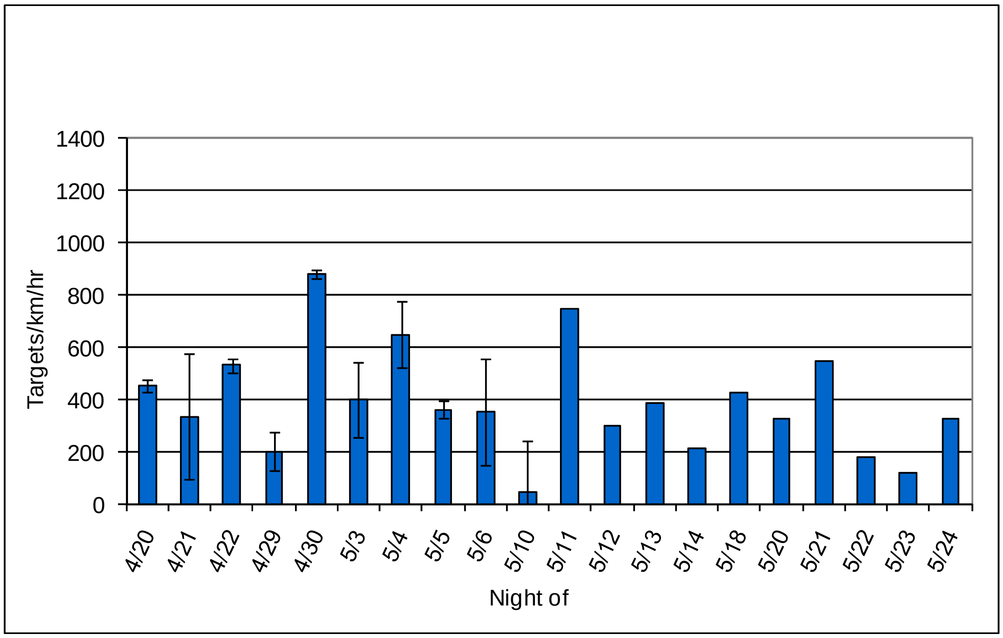


Figure 2-6. Hourly target flight height distribution at Bull Hill, Spring 2011

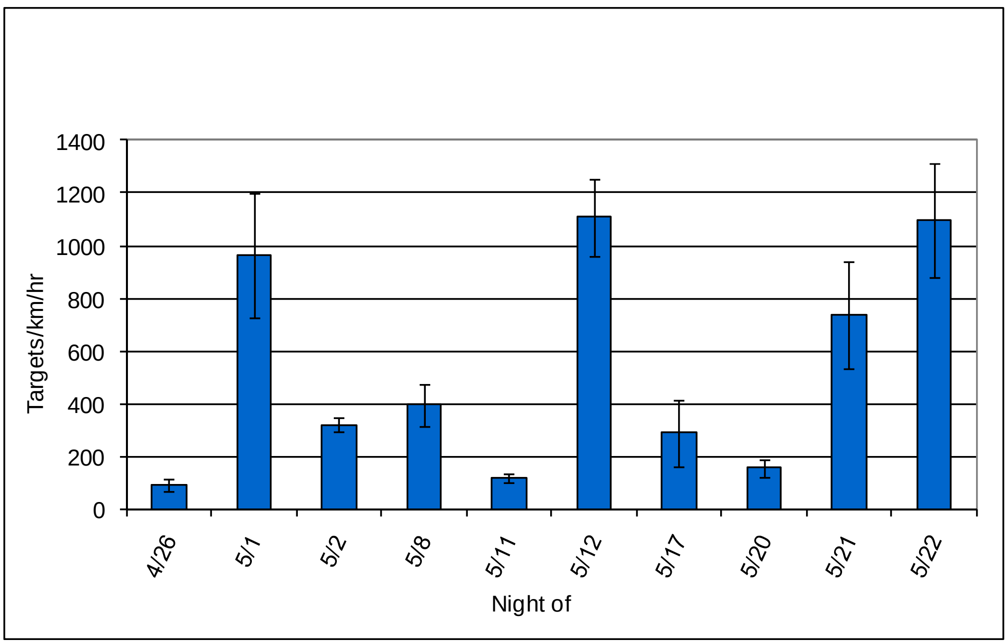
Comparison of 2010 and 2011 Radar Results

The overall passage rate in 2011 (519 ± 57 t/km/hr) was higher than that in 2010 (387 ± 21 t/km/hr). Year-to-year variation in the timing and magnitude of passage rates at the Project is apparent; the highest nightly passage in Spring 2010 (879 ± 76 t/km/hr) occurred on April 30, and in Spring 2011 (1108 ± 145 t/km/hr), on May 12. Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler et al. 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman et al. 1982, Gauthreaux 1991). Regardless, the overall passage rate of 519 t/km/hr is near the high end of the range of results at other projects in the eastern U.S., but within the range of passage rates documented at these other projects (Appendix A Table 5).

Reference: **Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine**

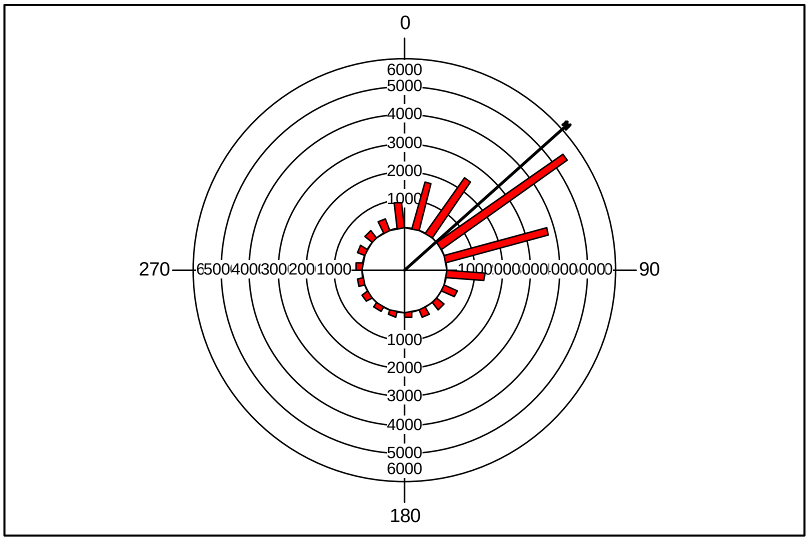


Spring 2010 Passage Rates (20 nights; error bars ± 1 SE)

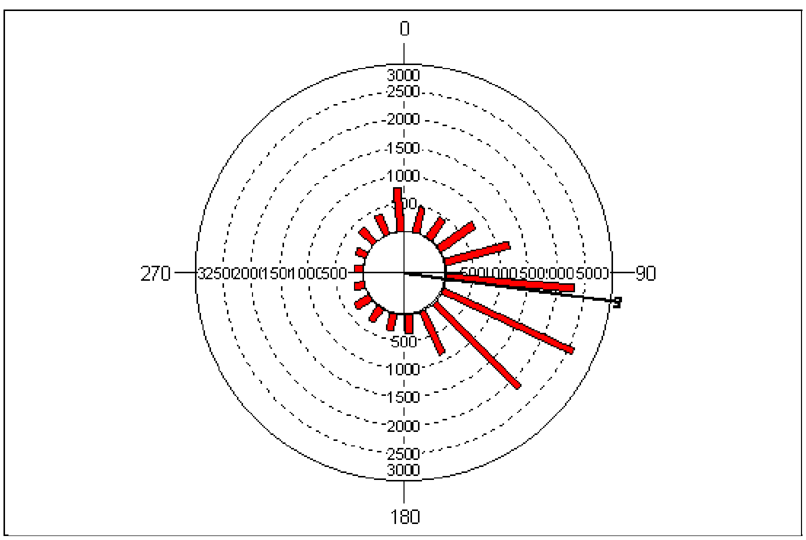


Spring 2011 Passage Rates (10 nights; error bars ± 1 SE)

Flight direction also varied between years. The overall flight direction in Spring 2010 was northeast, and the overall flight direction in Spring 2011 was generally east-southeast. The overall east-southeast flight direction is not typical for average flight direction during spring migration based on radar results at other projects conducted on forested ridgelines in the east. Interestingly, on May 12, the night with the highest passage rate, conditions were clear and wind speed and temperature were average; however average wind direction was 75°, or northeasterly. This wind direction may have "pushed" targets to the southeast during this otherwise suitable migration night[2].



Spring 2010 Flight Direction (the bracket along the margin of the histogram is the 95% confidence interval)



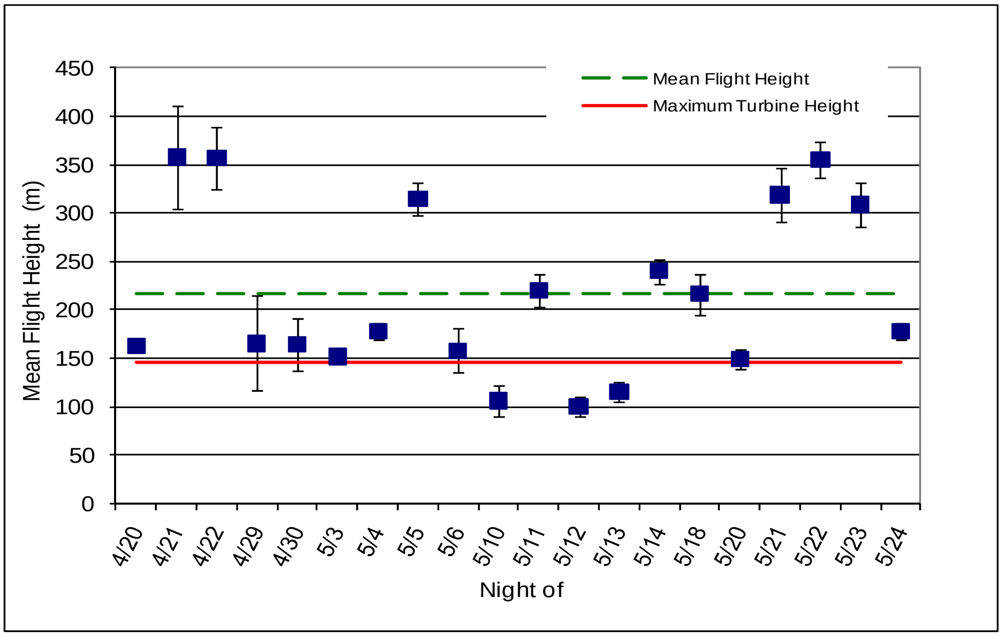
Spring 2011 Flight Direction (the bracket along the margin of the histogram is the 95% confidence interval)

---

[2] All 16 nights between April 26 and May 11 had periods of light to heavy precipitation. This may explain the relatively high passage rate on May 12 despite the northeasterly wind direction generally thought to be unsuitable for migration.

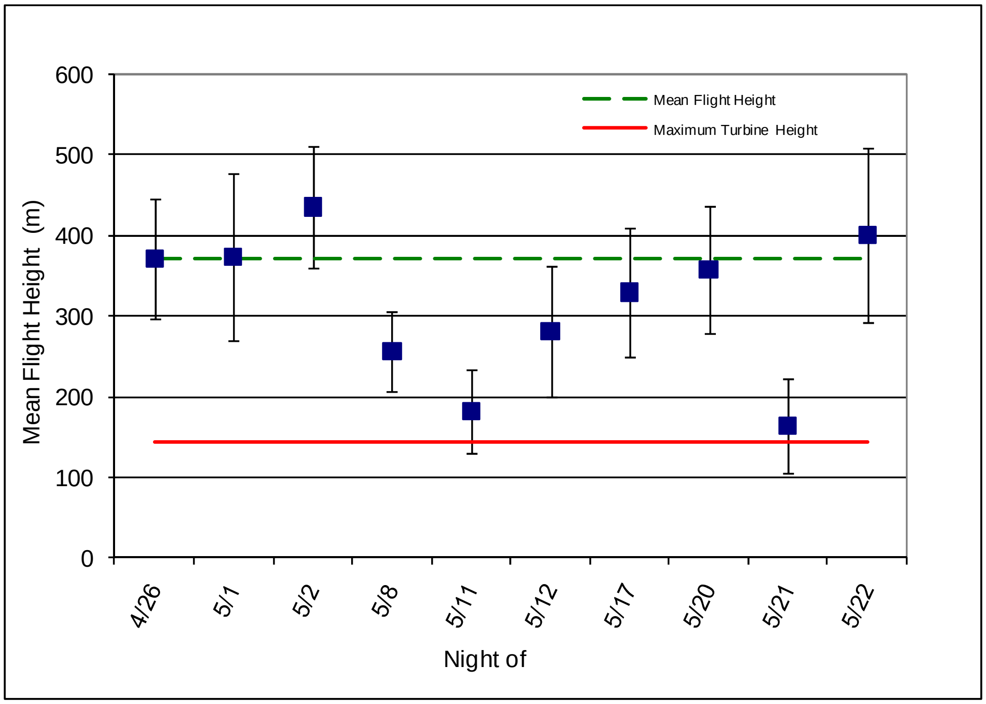
Reference: Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine

The average flight height in Spring 2011 is within the range of results at other projects conducted on forested ridgelines in the east. Flight height varied between 2010 and 2011 at the Project. In 2010, the average flight height was 217 ± 8 m. In 2011, it increased to 371 ± 3 m. In 2011, only 2 nights had flight heights below 200 m: May 11 and May 21; however, no nights had average flight heights below turbine height. The overall percent below turbine height was 21%, which was lower than the percent below turbine height in Spring 2010 (38%). Again, yearly variation in flight characteristics is common, however the difference in flight heights between 2010 and 2011 is likely due to variations in weather patterns between years.



Spring 2010 Flight Heights (error bars ± 1 SE)

Reference: Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine



Spring 2011 Flight Heights (error bars ± 1 SE)

In summary, results at the Project are within the range of results recorded at other radar studies conducted in the east, and provide a sample of baseline migration activity over the Project during Spring 2011. Results of Spring 2011 surveys differed somewhat from Spring 2010 surveys in terms of passage rate, flight direction and flight height, which is to be expected due to year-to-year variation in migration characteristics and weather conditions.

Literature Cited

Able, K.P. 1973. The role of weather variables and flight direction in determining the magnitude of nocturnal migration. Ecology 54(5):1031–1041.

Bingman, V.P., K.P. Able, and P. Kerlinger. 1982. Wind drift, compensation, and the use of landmarks by nocturnal bird migrants. Animal Behavior 30:49–53.

Gauthreaux, S.A., Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187–204.

Gauthreaux, S.A., Jr., and K.P. Able. 1970. Wind and the direction of nocturnal songbird migration. Nature 228:476–477.

Hassler, S.S., R.R. Graber, and F.C. Bellrose. 1963. Fall migration and weather, a radar study. The Wilson Bulletin 75(1):56–77.

Richardson, W.J. 1972. Autumn migration and weather in eastern Canada: a radar study. American Birds 26(1):10–16.

Appendix A – Spring 2011 Radar Summary Tables

Reference: Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine

Appendix A Table 1. Survey dates, results, level of effort, and weather - Spring 2011

Date	Sunset	Sunrise	# of Hours Analyzed	Passage rate	Flight Direction	Flight Height (m)	% below 145 m	Temperature (°C)	Wind Speed (m/s)	Wind Direction (degrees)
4/26	19:31	5:33	10	88	341	372	15%	9	4	115
5/1	19:37	5:25	10	964	103	374	27%	6	5	58
5/2	19:38	5:24	10	320	25	436	7%	8	6	151
5/8	19:46	5:16	10	397	139	257	24%	10	8	85
5/11	19:49	5:12	9	116	140	183	54%	8	9	27
5/12	19:50	5:10	9	1108	109	282	36%	8	5	75
5/17	19:56	5:05	9	287	33	330	32%	10	5	88
5/20	19:09	5:02	9	144	46	358	16%	13	2	187
5/21	20:00	5:01	9	739	107	164	63%	6	4	46
5/22	20:01	5:00	9	1097	96	401	21%	6	6	191
Entire Season			**94**	**519**	**98**	**371**	**21%**	**8**	**5**	**102**

Appendix A Table 2. Summary of passage rates by hour, night, and for entire season.

Night of	Passage Rate (targets/km/hr) by hour after sunset										Entire Night			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**	**Median**	**Stdev**	**SE**
4/26	221	129	154	96	18	21	39	32	18	154	88	68	73	23
5/1	382	1321	2036	1964	1800	825	379	611	293	32	964	718	754	239
5/2	236	450	404	414	396	318	275	236	279	193	320	298	90	28
5/8	134	675	732	700	507	414	282	243	279	0	397	348	252	80
5/11	137	179	164	154	118	100	54	29	114	N/A	116	118	50	17
5/12	275	964	1239	996	1068	1336	1775	1518	800	N/A	1108	1068	434	145
5/17	168	1193	564	293	175	100	61	32	0	N/A	287	168	380	127
5/20	25	329	104	39	150	204	121	246	179	43	144	136	98	31
5/21	243	1339	1664	1575	614	464	361	221	168	N/A	739	464	611	204
5/22	647	1511	1864	2118	1182	1000	796	671	86	N/A	1097	1000	644	215
Entire Season	**247**	**809**	**893**	**835**	**603**	**478**	**414**	**384**	**221**	**84**	**519**	**279**	**557**	**57**

0 indicates no targets counted for that hour   N/A indicates partial or no data for that hour

Reference: **Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine**

Appendix A Table 3. Mean Nightly Flight Direction		
Night of	**Mean Flight Direction**	**Circular Stdev**
4/26	341	63
5/1	103	70
5/2	25	58
5/8	139	81
5/11	140	116
5/12	109	48
5/17	33	95
5/20	46	87
5/21	107	52
5/22	96	32
Entire Season	**98**	**65**

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season.															
Night of	**Mean Flight Height (m) by hour after sunset**										**Entire Night**				**% of targets below 145 meters**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**	**Median**	**STDV**	**SE**	
4/26	239	396	336	268	476	356	477	582	529	242	372	334	238	75	15%
5/1	163	316	307	395	421	478	663	616	406	434	374	266	326	103	27%
5/2	331	436	418	463	477	443	466	435	420	255	436	391	241	76	7%
5/8	183	249	267	270	286	289	256	289	185	--	257	237	150	50	24%
5/11	164	217	270	225	217	125	--	31	87	N/A	183	136	148	52	54%
5/12	242	379	276	253	287	302	201	226	233	N/A	282	219	242	81	36%
5/17	176	294	367	410	387	296	388	497	98	N/A	330	301	241	80	32%
5/20	--	275	399	304	500	363	404	288	320	N/A	356	310	223	79	15%
5/21	203	187	170	165	110	107	125	116	146	N/A	164	102	178	59	63%
5/22	348	377	380	469	410	367	404	402	650	N/A	400	292	324	108	21%
Entire Season	**228**	**313**	**319**	**322**	**357**	**313**	**376**	**348**	**308**	**310**	**371**	**302**	**283**	**3**	**21%**
-- indicates no targets counted for that hour										N/A indicates partial or no data for that hour					

Appendix A Table 5. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
										Spring 2005
2005	Ellenberg, Clinton Cty, NY	40	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(125 m) 20%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	422	(120 m) 6%	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Sheffield, Caledonia Cty, VT	20	180	Forested ridge	166	12-440	40	552	(125 m) 6%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Stamford, Delaware Cty, NY	35	301	Forested ridge	210	10-785	46	431	(110 m) 8%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
2005	Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(100 m) 4%	Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2005	Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Franklin, Pendleton Cty, NY	21	204	Forested ridge	457	34-1240	53	492	(125 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2005	Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	460	71-1769	30	443	(150 m) 14%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Dans Mountain, Allegany Cty, MD	23	189	Forested ridge	493	63-1388	38	541	(125 m) 15%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2005	Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(145 m) 16%1	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
										Spring 2006
2006	Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
2006	Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
2006	Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
2006	Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2006	Kibby, Franklin Cty, ME (Valley)	2	14	Forested ridge	443	45-1242	61	334	(120 m) n/a	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Kibby, Franklin Cty, ME (Mountain)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
										Spring 2007
2007	Stetson, Washington Cty, ME	21	138	Forested ridge	147	3-434	55	210	(120 m) 22%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2007	Cape Vincent, Jefferson Cty, NY	50	300	Great Lakes plain	166	n/a	34	441	(125 m) 14%	Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America.
2007	New Grange, Chautauqua Cty, NY	41	n/a	Great Lakes plain	175	n/a	18	450	(125 m) 13%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2007	Laurel Mountain, Barbour Cty, WV	20	197	Forested ridge	277	13-646	27	533	(130 m) 3%	Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
2007	Errol, Coos County, NH	30	212	Forested ridge	342	2 to 870	76	332	(125 m) 14%	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
2007	Villenova, Chautauqua Cty, NY	40	n/a	Great Lakes plain	419	22-1190	10	493	(120 m) 3%	Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
2007	Roxbury, Oxford Cty, ME	20	n/a	Forested ridge	539	137-1256	52	312	(130) 18%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
2007	Lempster, Sullivan Cty, NH	30	277	Forested ridge	542	49-1094	49	358	(125 m) 18%	Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
										Spring 2008
2008	Allegany, Cattaraugus Cty, NY	30	275	Forested ridge	268	53-755	18	316	(150 m) 19%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2008	Oakfield, Penobscot Cty, ME	20	194	Forested ridge	498	132-899	33	276	(120 m) 21%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
2008	Hounsfield, Jefferson Cty, NY	42	379	Great Lakes island	624	74-1630	51	319	(125 m) 19%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
2008	New Creek, Grant Cty, WV	20	n/a	Forested ridge	1020	289-2610	30	354	(130 m) 13%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
2008	Tenney, Grafton Cty, NH	40	373	Forested ridge	234	35-549	77	321	(125m) 12%	Stantec Consulting Services Inc. 2008. Spring 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
2008	Rollins, Penobscot Cty, ME	20	189	Forested ridge	247	40 - 766	75	316	(120 m) 13%	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
										Spring 2009
2009	Sisk (Kibby Expansion), Franklin Cty, ME	21	193	Forested ridge	207	50-452	28	293	(125m) 18%	Stantec Consulting Services Inc. 2009. Spring 2009 Nocturnal Migration Survey Report for the Kibby Expansion Wind Project. Prepared for TRC Engineers LLC.
2009	Vermont Community Wind Farm, Orleans Cty, VT	15	90	Forested ridge	435	49-771	48	320	(130m) 22%	Stantec Consulting Services Inc. 2009. Spring and Summer 2009 Bird and Bat Survey Report. Prepared for Vermont Community Wind Farm, LLC.
2009	Moresville, Delaware Cty, NY	30	275	Forested ridge	230	30-575	53	314	(125m)12%	Stantec Consulting Services Inc. 2009. 2009 Spring Nocturnal Radar Survey Report for the Moresville Energy Center. Prepared for Moresville Energy LLC.
2009	Highland, Somerset Cty, ME (location 1)	21	192	Forested ridge	496	10-1262	47	287	(130.5m) 26%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC
2009	Highland, Somerset Cty, ME (location 2)	19	161	Forested ridge	511	8-1735	53	314	(130.5m) 23%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC
										Spring 2010
2010	Bowers, Carroll Plantation, ME	20	188	Forested ridge	289	20-589	56	243	(131m) 26%	Stantec Consulting Services Inc. 2010. Draft 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy LLC.
2010	Bull Hill, T16 MD, ME	20	184	Forested ridge	387	43-879	48	217	(145m) 38%	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bull Hill Wind Project. Prepared for Blue Sky East Wind LLC.
										Spring 2011
2011	Bull Hill, T16 MD, ME	10	94	Forested ridge	519	88-1108	98	371	(145m) 21%	*this report*

Note:

[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Memo

Stantec

To:	Dave Fowler Blue Sky East, LLC	From:	Laura Callnan Stantec Consulting Services Inc. Topsham, Maine
File:	Job #195600500	Date:	November 7, 2011

Reference: Fall 2011 Radar Survey Results and Comparison to Fall 2009 Radar Results, Bull Hill Wind Project, Eastbrook, Maine

Stantec conducted nocturnal radar surveys at the proposed Bull Hill Wind Project (Project) in Eastbrook, Maine during fall 2011 to document the abundance, flight patterns, and flight altitudes of night-migrating birds and bats using X–band marine radar. The fall 2011 radar survey is the fourth season of radar conducted at the Project and the second fall season of survey. So that the datasets would be comparable, the fall 2011 radar surveys were conducted from the same location as the 2009 fall surveys. Typically, only one year of radar survey (or two seasons, spring and fall) is required at proposed wind projects in Maine. Because the fall 2011 survey is in addition to the required one year of study, survey effort was decreased to 10 nights and focused on the peak fall migration period and nights with favorable weather conditions for migration.

This memo report summarizes results of the fall 2011 radar surveys and attempts to compare those results to the fall 2009 results, recognizing that year to year variations in bird populations and weather events affect the timing and magnitude of migration over a particular location, as well as how the radar survey samples that migration, from year to year.

METHODS

Fall radar surveys were conducted along an existing road near the highest point of Bull Hill within a small clearing surrounded by regenerating spruce. As in fall 2009, the radar site provided good visibility and the radar was capable of detecting targets within nearly all of its theoretical detection range. Data were analyzed and summarized by hour, night, and for the season, including passage rate, flight direction, and flight height, in an effort to remain consistent with methods of the fall 2009 surveys.

RESULTS

Radar surveys were conducted on 10 nights between September 6 and September 27, 2011 on nights with good to fair weather for migration (Appendix Table 1). Fall 2009 radar surveys were conducted on 20 nights from early-September to mid-October.

Passage Rates

Nightly passage rates were highly variable, and ranged from 111 ± 27 targets per kilometer per hour (t/km/hr) on September 7 to 747 ± 82 t/km/h on September 27. The overall passage rate for the entire survey period was 431 ± 26 t/km/hr (Figure 1; Appendix Table 2). Individual hourly passage rates varied from 5 t/km/hr during the 12th hour of September 19 to 1,211 t/km/hr during the 3rd hour of September 14. For the entire survey, passage rates were typically highest during the fourth hour past sunset and decreased steadily until sunrise (Figure 2).

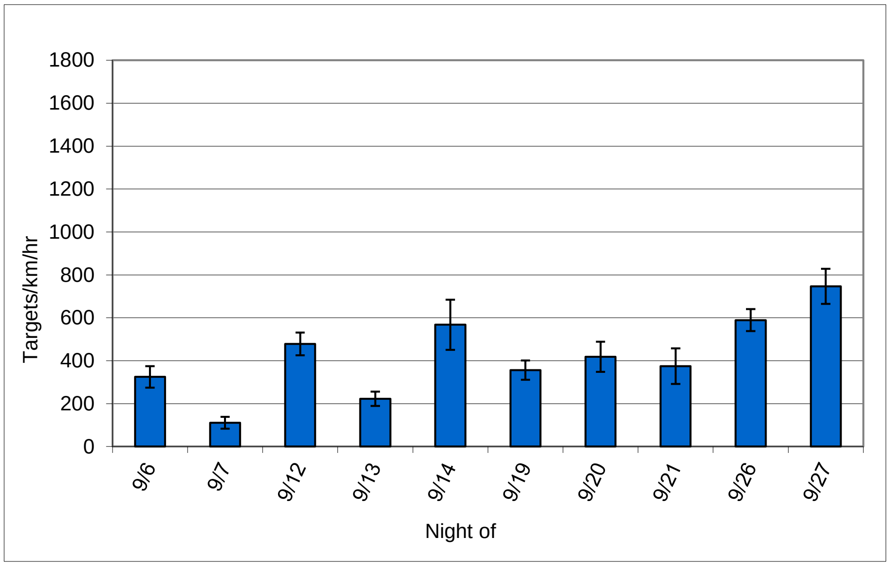


Figure 1. Nightly passage rates observed at the Bull Hill Wind Project, Fall 2011 (error bars ± 1 SE)

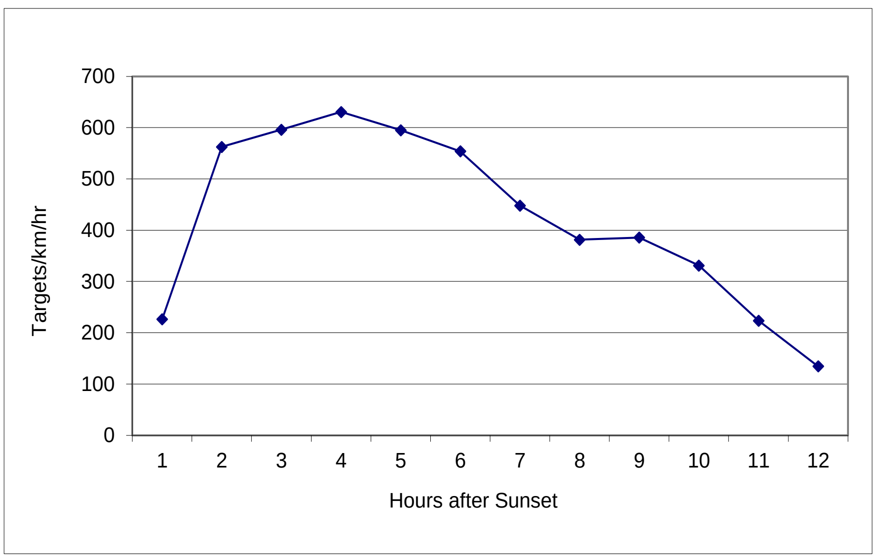


Figure 2. Hourly passage rates for entire season at the Bull Hill Wind Project, Fall 2011

Flight Direction

Mean flight direction through the Project area was 282° ± 67° (Figure 3; Appendix Table 3).

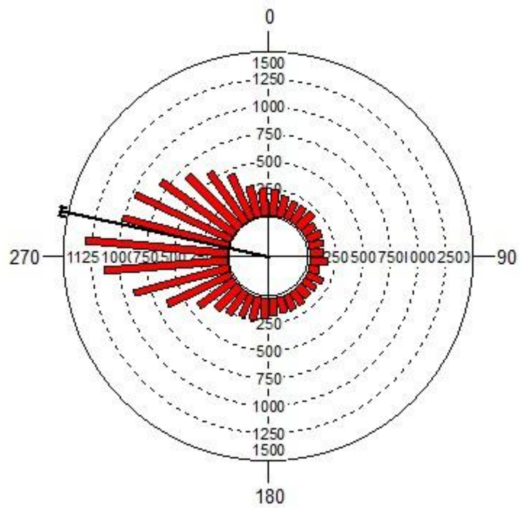


Figure 3. Mean flight direction for the entire season at the Bull Hill Wind Project, Fall 2011 (the bracket along the margin of the histogram is the 95% confidence interval)

Flight Altitude

The seasonal average mean flight height of all targets was 279 ± 2 meters (m; 915 ± 7 feet [']) above the radar site. The average nightly flight height ranged from 181 ± 41 m (593 ± 134') on September 13 to 400 ± 93 m (1,311 ± 305') on September 19 (Figure 4; Appendix Table 4). The percent of targets observed flying below 145 m (475'), the proposed maximum turbine height, was 26 percent for the nights observed and varied nightly from 16 percent on September 6 to 48 percent on September 13 (Figure 5). For the entire survey, the mean hourly flight heights were typically highest during the 4^{th} through 7^{th} hour after sunset (Figure 6).

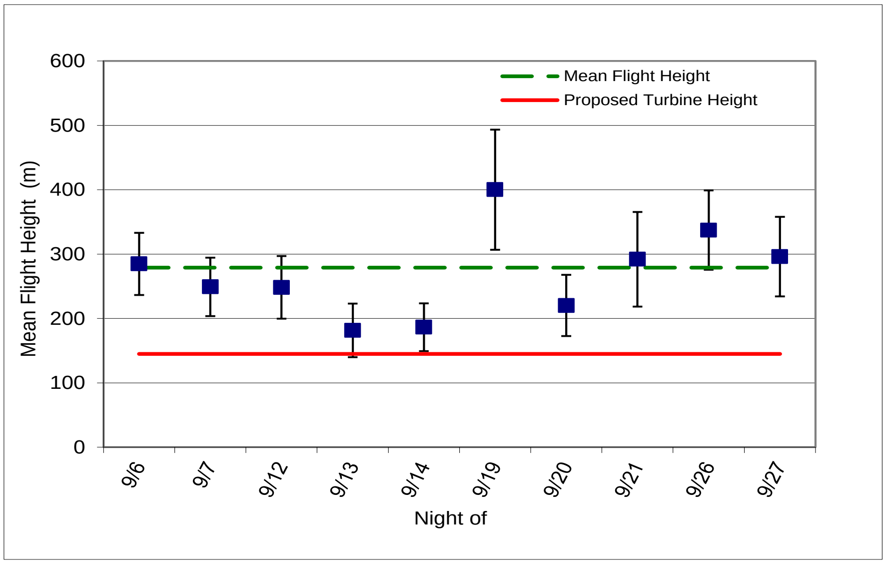


Figure 4. Mean nightly flight height of targets at the Bull Hill Wind Project, Fall 2011 (error bars ± 1 SE)

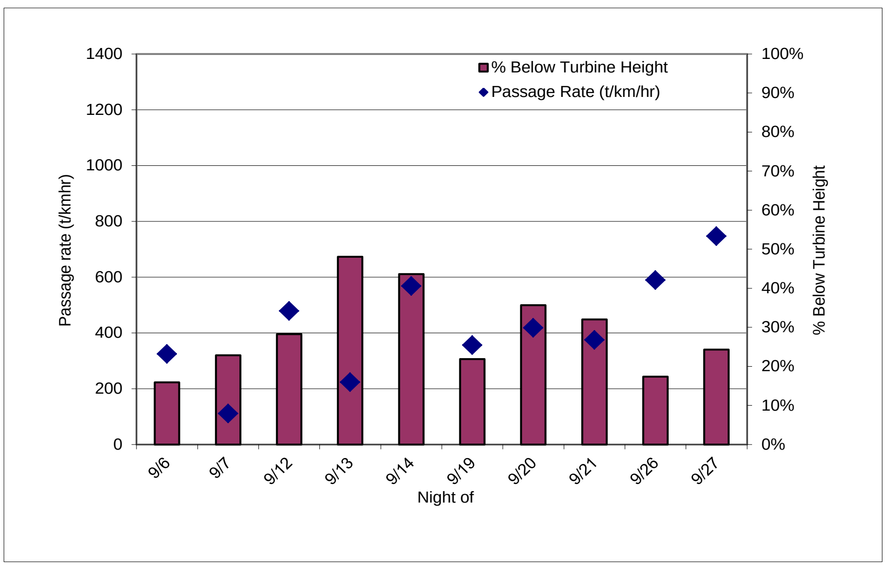


Figure 5. Percent of targets observed flying below a height of 145 m (475') at the Bull Hill Wind Project, Fall 2011

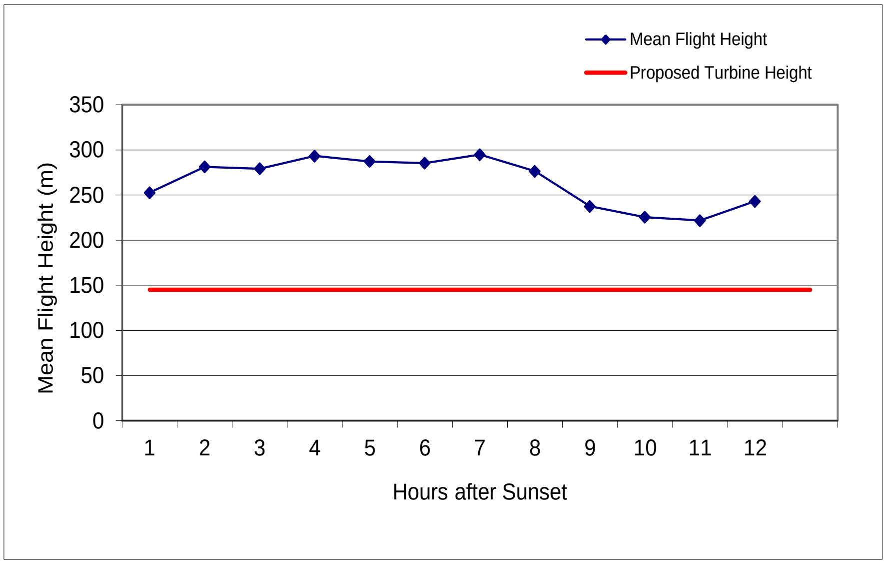
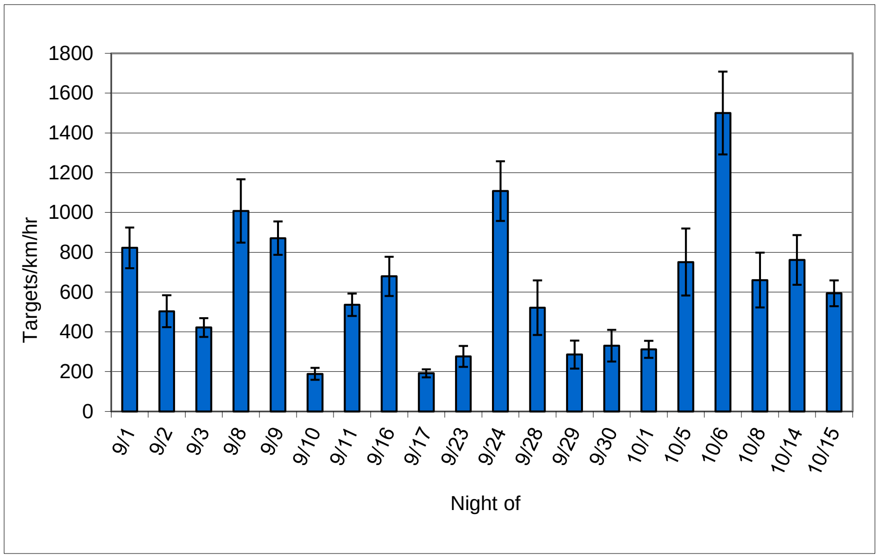


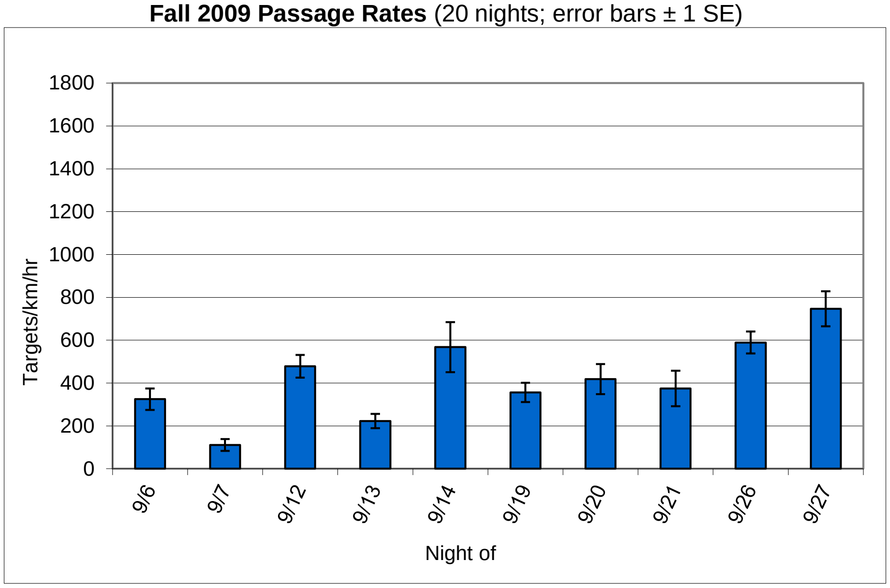
Figure 6. Hourly target flight height distribution at the Bull Hill Wind Project, Fall 2011

Comparison of 2009 and 2011 Radar Results

Year-to-year variation in the timing and magnitude of passage rates at the Project is apparent when comparing the fall radar results from 2009 and 2011. The overall passage rate in fall 2009 (614 ± 32 t/km/hr) was higher than in fall 2011 (431 ± 26 t/km/hr). The highest nightly passage rate in fall 2011 (747 ± 82 t/km/hr) occurred on September 27, and in fall 2009 (1500 ± 209 t/km/hr) on October 6 (Figure 7). Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). The overall passage rate of 431 t/km/hr documented during fall 2011 is 30 percent lower than the 2009 passage rate, and within the range of fall passage rates documented at other projects in the eastern U.S. (Appendix Table 5).



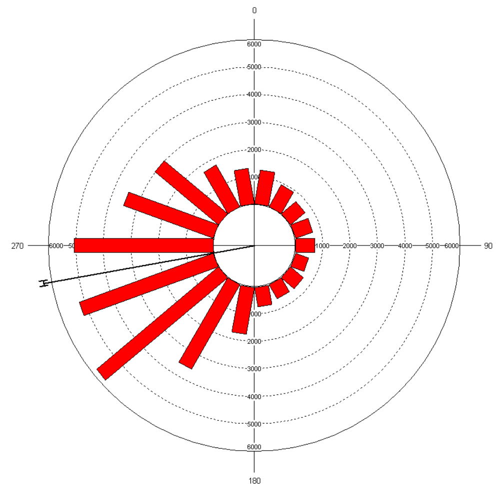
Fall 2009 Passage Rates (20 nights; error bars ± 1 SE)



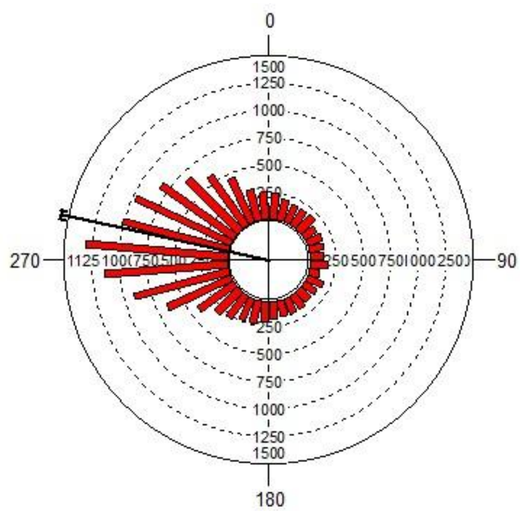
Fall 2011 Passage Rates (10 nights; error bars ± 1 SE)

Figure 7. Comparison of nightly passage rates from fall 2009 and fall 2011 radar surveys

Flight direction also varied between years. The overall flight direction in fall 2009 was 260° ± 66°, a west-southwest direction, and in 2011 was 282° ± 67°, a west-northwest direction (Figure 8). The overall westerly flight direction observed in both years, particularly the west-northwest flight direction, is not typical during fall migration based on radar results at other projects conducted on forested ridgelines in the eastern U.S. (Appendix Table 5). Inclement weather does not appear to have influenced this unique flight direction in fall 2011 as throughout the season, rain occurred only during 3 hours on the night of September 7. Wind direction was not considered a significant factor as during nights with head winds, wind speed was considered too low to impact flight direction. Overall during radar surveys at the Project, conditions were clear and wind speed and temperature were average. Interestingly, the fall 2011 flight direction is within 4 degrees of being the exact opposite direction observed during spring 2011 radar surveys (98°; Stantec 2011). The reasons explaining the atypical seasonal flight directions documented at the Project are likely due to a variety of stochastic factors (i.e., topography and weather) that are outside the scope of this survey.



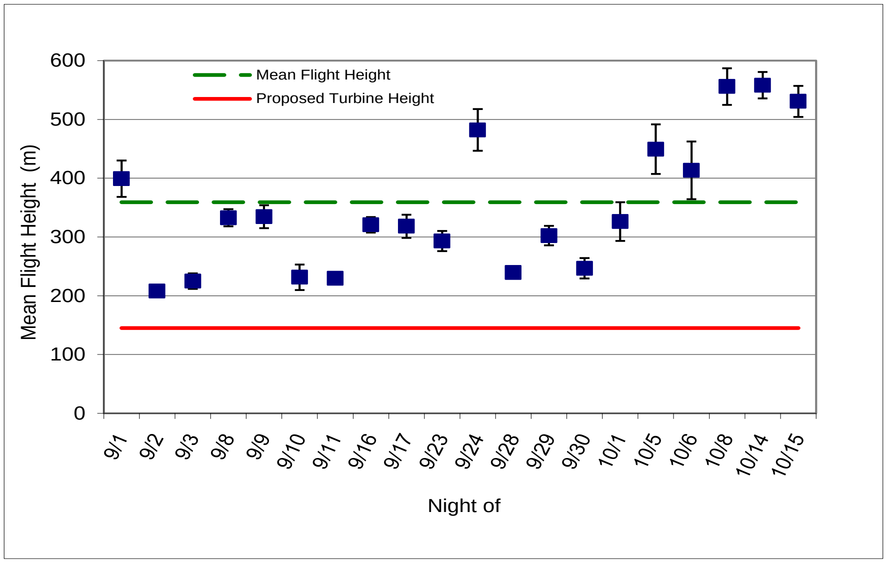
Fall 2009 Flight Direction (the bracket along the margin of the histogram is the 95% confidence interval)



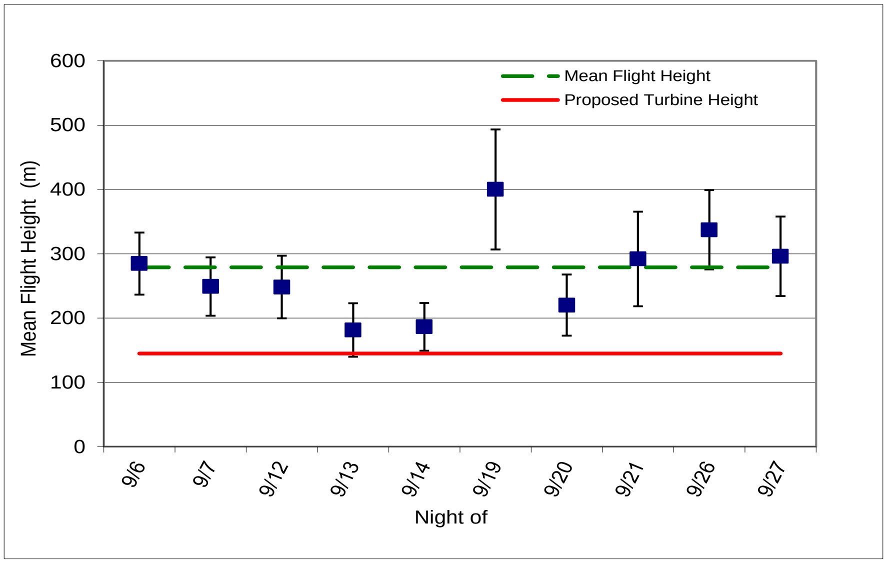
Fall 2011 Flight Direction (the bracket along the margin of the histogram is the 95% confidence interval)

Figure 8. Comparison of seasonal flight directions from fall 2009 and fall 2011 radar surveys

Average flight height varied between 2009 and 2011 at the Project (Figure 9). In 2009, the average flight height was 356 ± 9 m (1,167 ± 30'). In 2011, it decreased to 279 ± 2 m. In 2011, only two nights had hourly flight heights below 145 m: September 13 and September 14; however, no nights had average flight heights below 145 m. On the night with the lowest average flight height (181 ± 41 m on September 13), the average passage rate was the second lowest recorded during the fall 2011 survey (223 ± 33 t/km/hr). The overall percent below turbine height in fall 2011 was 26 percent, which was higher than the percent below turbine height in fall 2009 (14%). Again, yearly variation in flight characteristics is common; however the difference in flight heights between 2009 and 2011 is likely due to variations in weather patterns between years. The average flight height in 2009 is within the range of results at other projects conducted on forested ridgelines in the eastern U.S.; however, the average flight height in 2011 is the lowest recorded at these other projects (Appendix Table 5).



Fall 2009 Flight Heights (error bars ± 1 SE)



Fall 2011 Flight Heights (error bars ± 1 SE)

Figure 9. Comparison of nightly flight heights from fall 2009 and fall 2011 radar surveys

In summary, results of fall 2011 surveys differed somewhat from fall 2009 surveys in terms of passage rate, flight direction, and flight height which is to be expected due to year-to-year variations in migratory populations and weather conditions. Passage rates at the Project in both 2009 and 2011 are within the range of results recorded at other radar studies conducted in the eastern U.S. The average flight height during fall 2011of 279 m is well above the proposed turbine height of 145 m, but is low compared to other projects conducted on forested ridgelines in the eastern U.S. It is important to note that pre-construction radar passage rates and flight heights do not directly relate to the magnitude of avian collisions that occur after the turbines become operational.

Pre-construction radar results at a particular location are known to vary between years due to differences in bird populations and weather events. Emerging data indicates that migration characteristics, such as flight height and passage rates, are known to differ between pre- and post-construction radar datasets at the same study location (Stantec 2010b). Average flight height in particular has been shown to differ between pre-and post-construction years, indicating that the presence of the turbines on the landscape may influence the flight behavior of migrants (Stantec 2010b). Nocturnal radar surveys were conducted both pre- and post-construction at the Stetson Mountain Wind Project (Stetson I) in Penobscot and Washington Counties, Maine. Pre-construction radar studies at Stetson I occurred in fall 2006, and post-construction surveys occurred in fall 2009. Between the two years, the nightly range and seasonal mean of percent of targets observed below maximum turbine height (125 m [410']) was substantially lower in fall 2009 than in fall 2006. In fall 2006, the range in nightly flight heights was 219 to 506 m (718 to 1659') with an average flight height of 378 m (1,239'); in fall 2009, the range in nightly flight heights was 328 to 514 m (1,075 to 1,685'), with an average flight height of 420 m (1,377'). In fall 2006, 13 percent of targets were below the proposed maximum turbine height; in 2009, 2 percent of targets were below the maximum turbine height. On a nightly basis during the fall 2009 surveys, flight heights were relatively higher and remained consistently high throughout the night, without a noticeable hourly peak (Stantec 2010b).

LITERATURE CITED

Able, K.P. 1973. The role of weather variables and flight direction in determining the magnitude of nocturnal migration. Ecology 54(5):1031–1041.

Bingman, V.P., K.P. Able, and P. Kerlinger. 1982. Wind drift, compensation, and the use of landmarks by nocturnal bird migrants. Animal Behavior 30:49–53.

Gauthreaux, S.A., Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187–204.

Gauthreaux, S.A., Jr., and K.P. Able. 1970. Wind and the direction of nocturnal songbird migration. Nature 228:476–477.

Hassler, S.S., R.R. Graber, and F.C. Bellrose. 1963. Fall migration and weather, a radar study. The Wilson Bulletin 75(1):56–77.

Richardson, W.J. 1972. Autumn migration and weather in eastern Canada: a radar study. American Birds 26(1):10–16.

Stantec Consulting. 2010a. Summer and Fall 2009 Avian and Bat Survey Report. Prepared for Blue Sky East Wind, LLC.

Stantec Consulting. 2010b. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009, for the Stetson Mountain Wind Project. Prepared for First Wind Management, LLC.

Stantec Consulting. 2011. Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results, Bull Hill, Eastbrook, Maine. Prepared for Blue Sky East Wind, LLC.

Appendix – Bull Hill Fall 2011 Radar Summary Tables

Appendix Table 1. Survey dates, results, level of effort, and weather[1]										
Date	Sunset	Sunrise	# of Hours Analyzed*	Passage rate	Flight Direction	Flight Height (m)	% below 145 m	Temperature (C)	Wind Speed (m/s)	Wind Direction (degrees)
9/6	19:04	6:03	11	325	254	285	16%	N/A	N/A	N/A
9/7	19:02	6:04	8	111	217	249	23%	N/A	N/A	N/A
9/12	18:53	6:10	11	478	303	248	28%	N/A	N/A	N/A
9/13	18:51	6:11	11	223	346	181	48%	N/A	N/A	N/A
9/14	18:49	6:12	11	568	266	186	44%	N/A	N/A	N/A
9/19	18:39	6:18	12	356	331	400	22%	N/A	N/A	N/A
9/20	18:38	6:19	12	418	282	220	36%	N/A	N/A	N/A
9/21	18:36	6:20	12	375	309	292	32%	N/A	N/A	N/A
9/26	18:26	6:26	12	589	265	337	17%	N/A	N/A	N/A
9/27	18:24	6:27	12	747	286	296	24%	N/A	N/A	N/A
Entire Season			**112**	**431**	**282**	**279**	**26%**	N/A	N/A	N/A

[1] Weather Data is not yet available but can be incorporated into this report upon receipt.

Appendix Table 2. Summary of passage rates by hour, night, and for entire season.															
Night of	Passage Rate (targets/km/hr) by hour after sunset											Entire Night			
	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Median	Stdev	SE
9/6	86	357	414	346	436	521	593	293	268	179	79	N/A	325	346	166	50
9/7	118	246	207	rain	rain	rain	32	57	43	86	100	N/A	111	93	78	27
9/12	193	318	354	489	539	629	571	525	818	511	314	N/A	478	511	174	53
9/13	111	400	329	307	96	196	193	164	304	293	57	N/A	223	196	111	33
9/14	261	657	1211	975	989	811	557	304	246	161	75	N/A	568	557	387	117
9/19	186	507	439	357	275	321	418	529	529	436	271	5	356	388	156	45
9/20	443	754	689	796	564	511	325	268	200	182	211	75	418	384	244	70
9/21	382	832	807	671	557	357	343	250	75	161	54	11	375	350	287	83
9/26	196	654	736	761	771	546	532	639	636	693	607	300	589	638	178	51
9/27	289	900	775	971	1129	1093	918	786	739	611	468	282	747	780	285	82
Entire Season	**226**	**563**	**596**	**631**	**595**	**554**	**448**	**381**	**386**	**331**	**224**	**135**	**431**	**357**	**278**	**26**

0 indicates no targets counted for that hour — N/A indicates no or only partial data for that hour

Appendix Table 3. Mean Nightly Flight Direction		
Night of	**Mean Flight Direction**	**Circular Stdev**
9/6	254	71
9/7	217	65
9/12	303	89
9/13	346	77
9/14	266	64
9/19	331	100
9/20	282	77
9/21	309	57
9/26	265	42
9/27	286	35
Entire Season	**282**	**67**

Appendix Table 4. Summary of mean flight heights by hour, night, and for entire season.

Night of	Mean Flight Height (m) by hour after sunset												Entire Night				# of targets below 145 meters	% of targets below 145 meters
	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Median	STDV	SE		
9/6	331	300	257	285	274	290	305	277	310	281	280	N/A	285	259	160	48	296	16%
9/7	225	265	229	rain	rain	260	372	387	221	195	181	N/A	249	233	136	45	131	23%
9/12	275	277	278	238	263	242	238	224	206	198	277	N/A	248	212	161	49	280	28%
9/13	176	142	164	183	250	200	222	226	187	152	199	N/A	181	152	138	41	239	48%
9/14	189	206	205	192	170	176	176	175	201	204	139	N/A	186	161	123	37	466	44%
9/19	332	362	395	414	443	507	559	477	270	185	206	252	400	291	323	93	142	22%
9/20	196	207	253	245	238	224	176	191	218	233	180	271	220	194	165	48	255	36%
9/21	210	360	362	399	257	295	266	234	251	241	250	213	292	212	255	73	216	32%
9/26	291	307	297	352	365	387	364	340	313	368	301	292	337	296	213	62	302	17%
9/27	302	388	353	333	326	273	271	234	200	198	206	188	296	230	214	62	503	24%
Entire Season	**253**	**281**	**279**	**293**	**287**	**285**	**295**	**276**	**238**	**226**	**222**	**243**	**279**	**230**	**203**	**2**	**2830**	**26%**
-- indicates no targets counted for that hour N/A indicates no or only partial data for that hour																		

Appendix Table 5. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Fall 2004									
Sheffield, Caledonia Cty, VT	18	176	Forested ridge	91	19-320	200	566	(125 m) 1%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Casselman, Somerset Cty, PA	30	n/a	Forested ridge	174	n/a	n/a	436	(125 m) 7%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Dans Mountain, Allegany Cty, MD	34	318	Forested ridge	188	2-633	193	542	(125 m) 11%	Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Franklin, Pendleton Cty, WV	34	349	Forested ridge	229	7-926	175	583	(125 m) 8%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Fall 2005									
Swallow Farm, PA	58	n/a	Forested ridge	166	n/a	n/a	402	(125 m) 5%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Kibby, Franklin Cty, ME (Range 1)	12	101	Forested ridge	201	12-783	196	352	(125 m) 12%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Fayette Cty, PA	26	n/a	Forested ridge	297	n/a	n/a	426	(125 m) 5%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Stamford, Delaware Cty, NY	48	418	Forested ridge	315	22-784	251	494	(110 m) 3%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
Preston Cty, WV	26	n/a	Forested ridge	379	n/a	n/a	420	(125 m) 10%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Highland, VA	58	n/a	Forested ridge	385	n/a	n/a	442	(125 m) 12%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Kibby, Franklin Cty, ME (Valley)	5	13	Forested ridge	452	52-995	193	391	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Mars Hill, Aroostook Cty, ME	18	117	Forested ridge	512	60-1092	228	424	(120 m) 8%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Deerfield, Bennington Cty, VT	32	324	Forested ridge	559	3-1736	221	395	(100 m) 13%	Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Kibby, Franklin Cty, ME (Mountain)	12	115	Forested ridge	565	109-1107	167	370	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Fall 2006									
Somerset Cty, PA	29	n/a	Forested ridge	316	n/a	n/a	374	(125 m) 8%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Bedford Cty, PA	29	n/a	Forested ridge	438	n/a	n/a	379	(125 m) 10%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Stetson, Washington Cty, ME	12	77	Forested ridge	476	131-1192	227	378	(125 m) 13%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Lempster, Sullivan Cty, NH	32	290	Forested ridge	620	133-1609	206	387	(125 m) 8%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Fall 2007									
Laurel Mountain, Barbour Cty, WV	20	212	Forested ridge	321	76-513	209	533	(130 m) 6%	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Errol, Coos County, NH	29	232	Forested ridge	366	54 to 1234	223	343	(125 m) 15%	Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Rollins, Lincoln, Penobscot Cty, ME	22	231	Forested ridge	368	82-953	284	343	(120 m) 13%	Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Roxbury, Oxford Cty, ME	20	220	Forested ridge	420	88-1006	227	365	(130 m) 14%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Allegany, Cattaraugus Cty, NY	46	n/a	Forested ridge	451	n/a	230	382	(150 m) 14%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
New Creek, Grant Cty, WV	20	n/a	Forested ridge	811	263-1683	231	360	(130 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Fall 2008									
Georgia Mountain, VT	21	n/a	Forested ridge	326	56-700	230	371	(120 m) 7%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind.
Oakfield, Penobscot Cty, ME	20	n/a	Forested ridge	501	116-945	200	309	(125 m) 18%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Tenney, Grafton Cty, NH	45	509	Forested ridge	470	94-1174	260	342	(125m) 13%	Stantec Consulting Services Inc. 2008. Fall 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Highland, Somerset Cty, ME	20	216	Forested ridge	549	68-1201	227	348	(130.5m) 17%	Stantec Consulting. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC
Fall 2009									
Sisk (Kibby Expansion) Franklin Cty, ME	20	210	Forested ridge	458	44-1067	206	287	(125m) 23%	Stantec Consulting Services. 2009. Fall 2009 Nocturnal Migration Survey Report. Prepared for TRC Engineers LLC.
Vermont Community Wind Farm, Orleans Cty, VT	20	227	Forested ridge	443	110-1029	215	330	(130m) 15%	Stantec Consulting Services. 2009. Fall 2009 Bird and Bat Survey Report. Nocturnal Radar, Acoustic, and Diurnal Raptor Surveys performed for the Vermont Community Wind Farm Project in Rutland County, Vermont. Prepared for Vermont Community Wind Farm, LLC.
Stetson, Washington Cty, ME	18	201	Forested ridge	457	106-1746	227	420	(119m) 2%	Stantec Consulting Services. 2010. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Bull Hill, Hancock Cty, ME	20	232	Forested ridge	614	188-1500	260	357	(145m) 20%	Stantec Consulting Services. 2010. Summer and Fall 2009 Avian and Bat Survey Report for the Bull Hill Project. Prepared for Blue Sky East Wind, LLC.
Bowers, Washington Cty, ME	22	249	Forested ridge	344	95-844	231	453	(119m) 14%	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Fall 2010									
Bingham, Somerset Cty, ME	20	232	Forested ridge	803	194-2463	234	377	(150m) 20%	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Fall 2011									
Bull Hill, Hancock Cty, ME	10	112	Forested ridge	431	111-747	282	279	(145m) 26%	Stantec Consulting Services. 2011. Fall 2011 Radar Survey Results and Comparison to Fall 2009 Results, Bull Hill, Eastbrook, Maine. Prepared for First Wind, LLC.

Exhibit 7-7-3

2012 Re-analysis Results of Radar Surveys for Bull Hill Wind Project

Memo

Stantec

To:	Robert Roy First Wind Portland, Maine	From:	Laura Callnan Stantec Consulting Services Inc. Topsham, Maine
File:	Job #195600500, 195600763	Date:	December 3, 2012

Reference: **Results of radar and raptor migration surveys at the Bull Hill Wind Project, Hancock County, Maine, when re-analyzed for turbine height at the Hancock Wind Project, Hancock County, Maine**

Between 2009 and 2011, First Wind contracted Stantec Consulting (Stantec) to conduct pre-construction avian and bat surveys including nocturnal radar migration surveys, diurnal raptor migration surveys, and acoustic bat surveys, at the permitted Bull Hill Wind Project in Eastbrook and T16 MD, Maine, located within approximately 0.7 miles of the nearest turbine at the proposed Hancock Wind Project in T22 MD and T16 MD, Maine. At a meeting on September 4, 2012, MDIFW indicated that additional radar migration and acoustic bat surveys were not necessary at the Hancock Wind Project, as data collected at the adjacent Bull Hill Wind Project was sufficient.

Stantec analyzed the radar and raptor migration data collected during pre-construction surveys at the Bull Hill Wind Project for a maximum turbine height of 145 meters (m; 476 feet [ft]), measured to the tip of the blade at its tallest point. However, based on the wind regime, the Hancock Wind Project is investigating the use of 156-m (512 ft) turbines measured to the tip of the blade at its tallest point. This memo presents a reanalysis of the pre-construction radar and raptor survey results collected at the Bull Hill Wind Project for a turbine height of 156 m as is currently planned at the Hancock Wind Project.

For the Bull Hill Wind Project, Stantec reported in 4 separate reports[1] calculations of flight height and percent below turbine height for radar and raptor migration survey data based on a maximum turbine height of 145 m (476 ft). The following radar and raptor results from the Bull Hill Wind Project have been recalculated for the proposed maximum turbine height of 156 m (512 ft) planned at the Hancock Wind Project.

[1] The Summer/Fall 2009 Avian and Bat Survey Report (Stantec, Rev. October 2010), the Spring 2010 Avian and Bat Survey Report (Stantec, August 2010), the Fall 2011 Radar Survey Memo Report (Stantec, November 2011), and the Spring 2011 Radar Memo Report (Stantec, July 2011).

Reference: **Results of radar and raptor migration surveys at the Bull Hill Wind Project, Hancock County, Maine, when re-analyzed for turbine height at the Hancock Wind Project, Hancock County, Maine**

RESULTS

RADAR

Stantec conducted 4 seasons of nocturnal radar surveys at the Bull Hill Wind Project: fall 2009, spring 2010, spring 2011, and fall 2011. When calculated for a maximum turbine height of 156 m (512 ft), the percent of targets flying below maximum turbine height as reported for the Bull Hill Wind Project increased by 3% for all seasons with the exception of spring 2011, for which it increased by 2%.

Season	At 145 m	At 156 m (recalculated)
Fall 2009	14%	17%
Spring 2010	38%	41%
Spring 2011	21%	23%
Fall 2011	26%	29%

RAPTOR

Stantec conducted 3 seasons of raptor migration surveys at the Bull Hill Wind Project: summer 2009, fall 2009, and spring 2010. The percent of raptors observed in the Project area[2] and below turbine height as reported for the Bull Hill Wind Project did not change for any season when calculated for a maximum turbine height of 156 m (512 ft).

Season	At 145 m	At 156 m (recalculated)
Summer 2009	4%	4%
Fall 2009	98%	98%
Spring 2010	100%	100

SUMMARY

Though the percentage of nocturnal migrants documented below maximum turbine height increased by 2 and 3 percent as turbine height increased, the majority of nocturnal migrants occurred well above 156 m in the 4 migration seasons surveyed. Mean flight height of all nocturnal migrants in fall 2009 was 356 ± 9 m (1,167 ± 30 ft); in spring 2010 was 217 ± 8 m (712 ± 26 ft); in spring 2011 was 371 ± 3 m (1,217 ± 10 ft); and in fall 2011 was 279 ± 2 m (915 ± 7 ft). Raptor survey results remained the same despite the increase in turbine height.

Due to the lack of observed relationships between pre-construction radar and raptor survey data and post-construction mortality data, mortality of nocturnal and diurnal migrants at the Hancock Wind Project is expected to be within the range of mortality reported at other operational wind energy facilities with similar landscape features in the region.

[2] As defined as those locations within the study area where turbines were proposed.

Reference: **Results of radar and raptor migration surveys at the Bull Hill Wind Project, Hancock County, Maine, when re-analyzed for turbine height at the Hancock Wind Project, Hancock County, Maine**

Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING

Laura Callnan

Project Scientist

cc: Josh Bagnato, First Wind
Adam Gravel, Stantec

Exhibit 7-7-4

Bald Eagle Aerial Surveys for Bull Hill Wind Project (2010-2011) and Hancock Wind Project (2012)

Memo

To: Geoff West
First Wind

From: Bryan Emerson
Stantec Consulting

File: 195600500

Date: June 11, 2010

Reference: 2010 Bald Eagle Aerial Survey
Blue Sky East / Bull Hill Wind Project, Eastbrook, Maine

As requested, Stantec Consulting (Stantec) conducted aerial surveys for bald eagle (*Haliaeetus leucocephalus*) nests, osprey (*Pandion haliaetus*) nests, and great blue heron (*Ardea herodias*) rookeries in the vicinity of the proposed Blue Sky East Wind Project (Project). The survey area included waterbodies in Osborn, Eastbrook, T22 MD, T16 MD, T10 SD, T9 SD, and Franklin, Maine. Prior to the survey, Stantec reviewed information provided by the Maine Department of Inland Fisheries and Wildlife (MDIFW) regarding known active and historic eagle nest locations and documented great blue heron nesting activity in the vicinity of the Project area. Stantec also consulted with Charlie Todd of MDIFW, who confirmed that the aerial survey was performed at an appropriate time of year and employed the appropriate methods. In compliance with U.S. Fish and Wildlife Service (USFWS) National Bald Eagle Management Guidelines (May 2007), Stantec also notified Mark McCullough of the USFWS Maine Field Office that flights were planned in this area and that Stantec was coordinating with MDIFW on the timing and methods of the flights.

Survey Methods

Stantec conducted the aerial surveys in two phases. The first phase was conducted in two flights on April 13 and 20, 2010, and was performed to identify new nests and to assess eagle nesting activity at known nest locations in the Project area. Danielle D'Auria of MDIFW accompanied Stantec during the April 13, 2010 flight. The survey consisted of low altitude passes, approximately 500 feet above ground level, along the shoreline of 7 lakes and ponds, and around numerous bogs, wetlands, and flowages within an approximately 4-mile radius of the proposed turbine locations for the Project. The lakes and ponds surveyed included Rocky Pond, Spectacle Pond, Molasses Pond, Scammon Pond, Abrams Pond, Webb Pond, and Narraguagus Lake. Webb Pond is located outside of the four-mile radius of the project area; however, it was surveyed because there is an historic eagle nest location on the pond. The shorelines of the waterbodies were surveyed for bald eagle or osprey nest sites, as well as for great blue heron rookeries. Incidental observations of adult and juvenile bald eagles were also recorded.

The second phase was conducted to check the status of active nests in the Project area, and to perform a second search on areas where a nest was suspected but no nest was seen on the first flight. The second flight for this Project area was performed on May 28, 2010.

Survey Results

Stantec did not identify an active bald eagle nest in the Project area during the 2010 surveys. Stantec located a known bald eagle nest on an island in Molasses Pond (MDIFW Nest #360), but the nest was not active. Two adult bald eagles were seen perched together on the western shore of the pond. A second location of potential nesting activity was seen on the island near the intact nest, which may have been an old nest or potentially the beginnings of a new nest. Stantec attempted to find the mapped bald eagle nest locations on Spectacle Pond (MDIFW #221A/B/C), Webb Pond (MDIFW Nest #511), Scammon Pond (MDIFW Nest #170A/B), and Abrams Pond (MDIFW Nest #170C), but no nests were identified. One adult bald eagle was observed on Rocky Pond flying along the western shore of the pond and then leaving the pond to the south. One adult bald eagle was also observed on Spectacle Pond flying along the eastern shore. No other bald eagles or nests were observed. Stantec identified two active osprey nests along the transmission line that bisects the Project area. These two nest locations

Reference: Bald Eagle Nest Survey Results, Blue Sky East Wind Project

are shown on Figure 1. Stantec also attempted to locate a reported great blue heron rookery at the south end of Scammon Pond; however, no rookery was observed.

During the second flight, Stantec surveyed those waterbodies where adult bald eagles were seen during the first phase of flights, but no nests were observed. Stantec surveyed Rocky Pond, Spectacle Pond, and Molasses Pond and found no new, active bald eagle nests. No new osprey nests or heron rookeries were observed during the second flight.

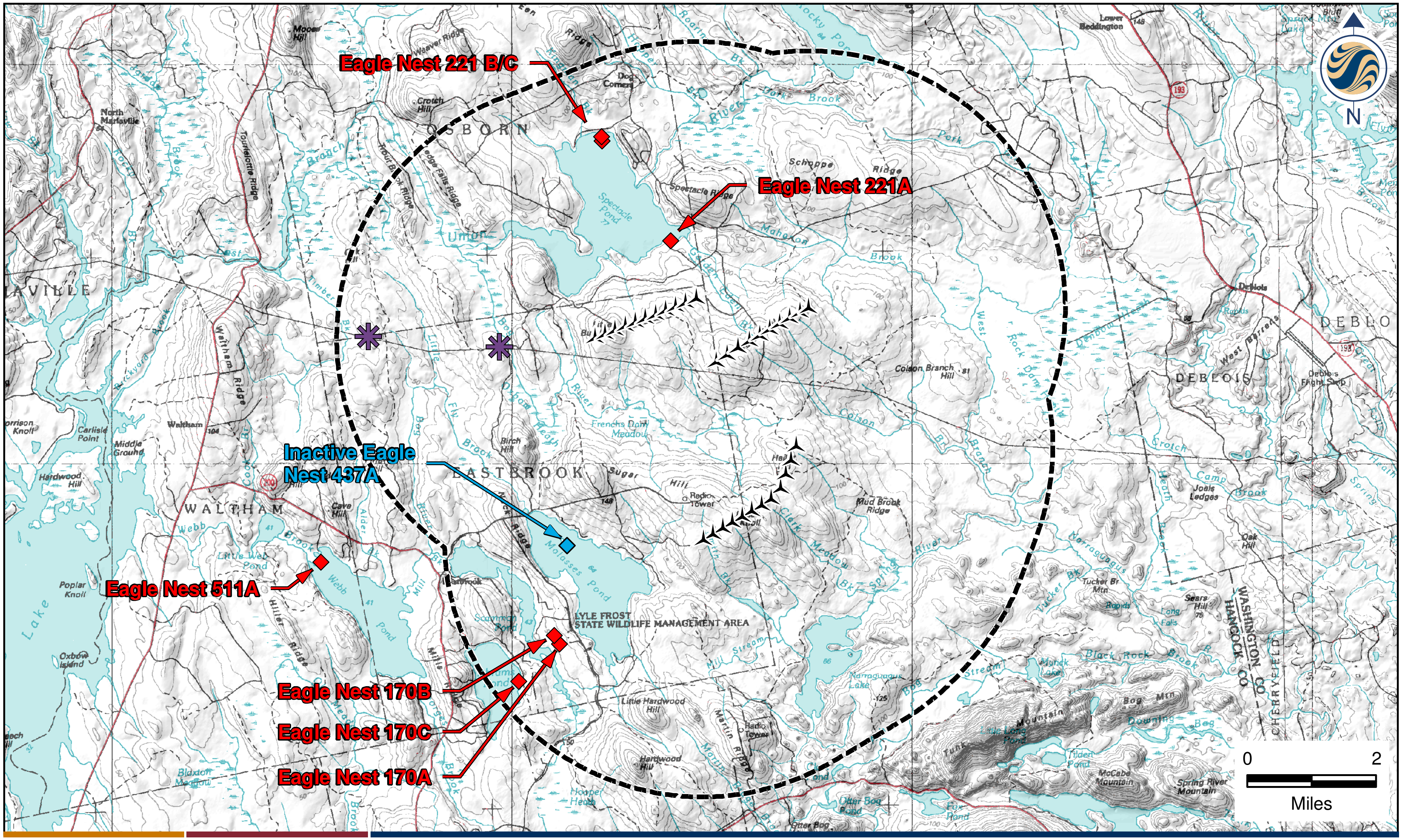
Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING

Bryan Emerson

Bryan Emerson
Project Manager/Wetland Scientist

Cc: David Fowler, First Wind
Robert Roy, First Wind
Brooke Barnes, Stantec
File 195600500



195600500

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

00500-F01-NestSpring2010.mxd

- Proposed Turbine
- Inactive Bald Eagle Nest
- Bald Eagle Nest Not Located in 2010 Survey
- Active Osprey Nest
- 4 Miles from Potential Turbine String

Client/Project

Blue Sky East Wind, LLC
Bull Hill Wind Project
Eastbrook and T16 MD, Maine

Figure No.

1

Title

Spring 2010 Eagle Nest Survey

6/11/2010

Memo

To:	Geoff West First Wind	From:	Bryan Emerson Stantec Consulting
File:	195600500	Date:	August 22, 2011

Reference: **Spring 2011 Aerial Bald Eagle Nest Survey**
Proposed Bull Hill Wind Project, T16 MD, Maine

As requested, Stantec Consulting (Stantec) conducted the second year of aerial surveys for bald eagle (*Haliaeetus leucocephalus*) nests in the vicinity of the proposed Bull Hill Wind Project (Project). The survey included waterbodies greater than 30 acres in size within 10 miles of the proposed Project area (U.S. Fish and Wildlife Service [USFWS] 2011).[1] Prior to the survey, Stantec reviewed information provided by the Maine Department of Inland Fisheries and Wildlife (MDIFW) regarding known active and historic bald eagle nest locations in the vicinity of the Project area. Following protocol previously established by the USFWS (2007),[2] Stantec notified Mark McCullough of the USFWS Maine Field Office that flights were planned in this area and that Stantec was coordinating with MDIFW on the timing and methods of the flights.

Survey Methods

Stantec conducted the aerial surveys in two phases. The first phase was conducted in two flights, on April 14 and 15, 2011. The purpose of the first flights was to search potential nesting habitat to identify new nests and to assess eagle nesting activity at known nest locations within 10 miles of the Project area. The second phase was conducted in one flight on May 25, 2011, to check the status of active nests within 10 miles of the Project area. The timing of the second flight was chosen to correspond with the time period when eaglets have hatched and are visible in the nest (i.e., to determine hatching success).

Each aerial survey consisted of low altitude passes in a Cessna 172 aircraft, approximately 500 feet above ground level, along the shoreline of 31 waterbodies within an approximately 10-mile radius of the proposed Project area. Three mapped nests located outside of 10 miles were also surveyed. A 10-mile survey radius is recommended by the USFWS (2011). The waterbodies surveyed are shown on Figure 1. The shorelines of all waterbodies were surveyed for bald eagle nest sites. Incidental observations of adult and sub-adult bald eagles were also recorded, along with incidental observations of osprey (*Pandion haliaetus*) and great blue heron (*Ardea herodias*). Based on consultation with MDIFW, the aerial surveys were conducted at an appropriate time of year and employed methods consistent with MDIFW and USFWS aerial survey protocols.

Survey Results

During the survey flights, Stantec identified 9 active bald eagle nests within or immediately outside of the 10-mile radius of the Project area. Of these nine nests, six were found to have successfully hatched at least one eaglet at the time of the second flight. Note that no second flight data was collected for nest #528A on Flanders Pond. First flight data for this nest was provided by MDIFW and Stantec did not survey the nest during the second flight because it was outside of 10 miles. It is included in Table 1 below because it is close to the 10-mile survey limit. Nest failures occurred at nest #663A on Lower Middle Branch Pond and nest #142D on Bog Brook Flowage. Stantec also identified 2 empty nests within the survey area: #437A and #034C.

[1] U.S. Fish and Wildlife Service, 2011. *Draft Eagle Conservation Plan Guidance*. U.S. Fish and Wildlife Service, Washington, DC.
[2] U.S. Fish and Wildlife Service, 2007. *National Bald Eagle Management Guidelines*. U.S. Fish and Wildlife Service, Washington, DC.

Based on the timing of the first flight, these 2 nests are assumed to be inactive. Several mapped nests within the survey area were not located during either survey flight. These nest locations represent either historic nest locations or alternate nest locations that have not been active in several years. The closest active nest to the proposed turbine locations was nest #360B on Molasses Pond at approximately 2.93 miles. No other active bald eagle nests are located within 4 miles of the proposed Project area. Four miles is the distance that the Maine Field Office of the USFWS has recommended for bald eagle surveys in Maine.[3] The results of the survey flights are presented in Table 1 below and shown on the attached Figure 1.

Table 1. Results of Aerial Survey Flights – Bull Hill Wind Project

Waterbody	MDIFW Nest #	First Flight Status	Second Flight Status	Approx. Distance to Nearest Turbine (mi)	Notes
Graham Lake	030C	Active – 1 adult in incubating position	Active – 1 eaglet in nest, 1 adult at nest	10.3	Nests 030A/B not found.
Webb Pond	511A	No Nest Found	No Nest Found	--	
Abrams/ Scammon Ponds	170A-C	No Nests Found	No Nests Found	--	
Molasses Pond	360B	Active – 1 adult in incubating position	Active – 2 eaglets in nest	2.93	Nest 360A not found.
Taunton Bay	417B	Active – 1 adult in incubating position	Active – 1 eaglet in nest, 1 adult perched at nest	10.06	Nest 417A not found.
Taunton Bay	631A	Active – 1 adult in incubating position	Active – at least 1 eaglet in nest	8.84	
Hog Bay	034D	Active – 1 adult in incubating position	Active – at least 1 eaglet in nest	8.35	Nests 034A, B, E not found.
Hog Bay	034C	Empty	Empty	8.63	
Flanders Pond	528A	Active – 1 adult in incubating position	No data	10.94	Data received from Charlie Todd of MDIFW
Spectacle Pond	221A-C	No Nests Found	No Nests Found	--	
Lower Lead Mtn Pond	437A	Empty	Empty	8.40	
Lower Middle Branch Pond	663A	Active – 1 adult in incubating position	Empty – nest failure	11.11	New Nest identified in 2010
Spring River Lake	503A	Active – 1 adult in incubating position	Active – at least 1 eaglet in nest, 1 adult at nest	7.53	Nest partially hidden by branches

[3] U.S. Fish and Wildlife Service, 2009. *Guidance for Building and Operating Wind Energy Facilities in Maine Compatible with Federal Fish and Wildlife Regulations*. U.S. Fish and Wildlife Service, Maine Field Office, Orono, ME.

Waterbody	MDIFW Nest #	First Flight Status	Second Flight Status	Approx. Distance to Nearest Turbine (mi)	Notes
Downing Bog	188A	No Nest Found	No Nest Found	--	Sub-adult bald eagle observed near nest location
Bog Brook Flowage	142D	Active – 1 adult in incubating position, 1 adult perched at nest	Empty – nest failure	8.16	Nests 142A-C not found
Beddington Lake	050A/B	No Nests Found	No Nests Found	--	

During the first round of flights in 2011, Stantec observed an adult bald eagle perched on the northern end of Donnell Pond, an adult bald eagle flying over Little Tunk Lake, and an adult bald eagle flying west of Round Pond. No bald eagle nests were observed in the vicinity of any of these incidental sightings. Stantec also observed a sub-adult bald eagle on Downing Bog, near nest #188A. No other bald eagles were seen, and no other incidental observations of great blue heron or osprey were made.

In 2010, Stantec conducted aerial nest surveys for the project using a 4-mile survey radius in accordance with existing protocol at that time (USFWS 2009).[4] During the 2010 survey, nest #360B on Molasses Pond was located but was found to be inactive. No other active nests were documented during these aerial surveys. During the 2010 surveys, nests were not located on Spectacle Pond (MDIFW #221A/B/C), Webb Pond (MDIFW Nest #511), Scammon Pond (MDIFW Nest #170A/B), or Abrams Pond (MDIFW Nest #170C). Similar to 2010, none of these historic nest sites were located in 2011.

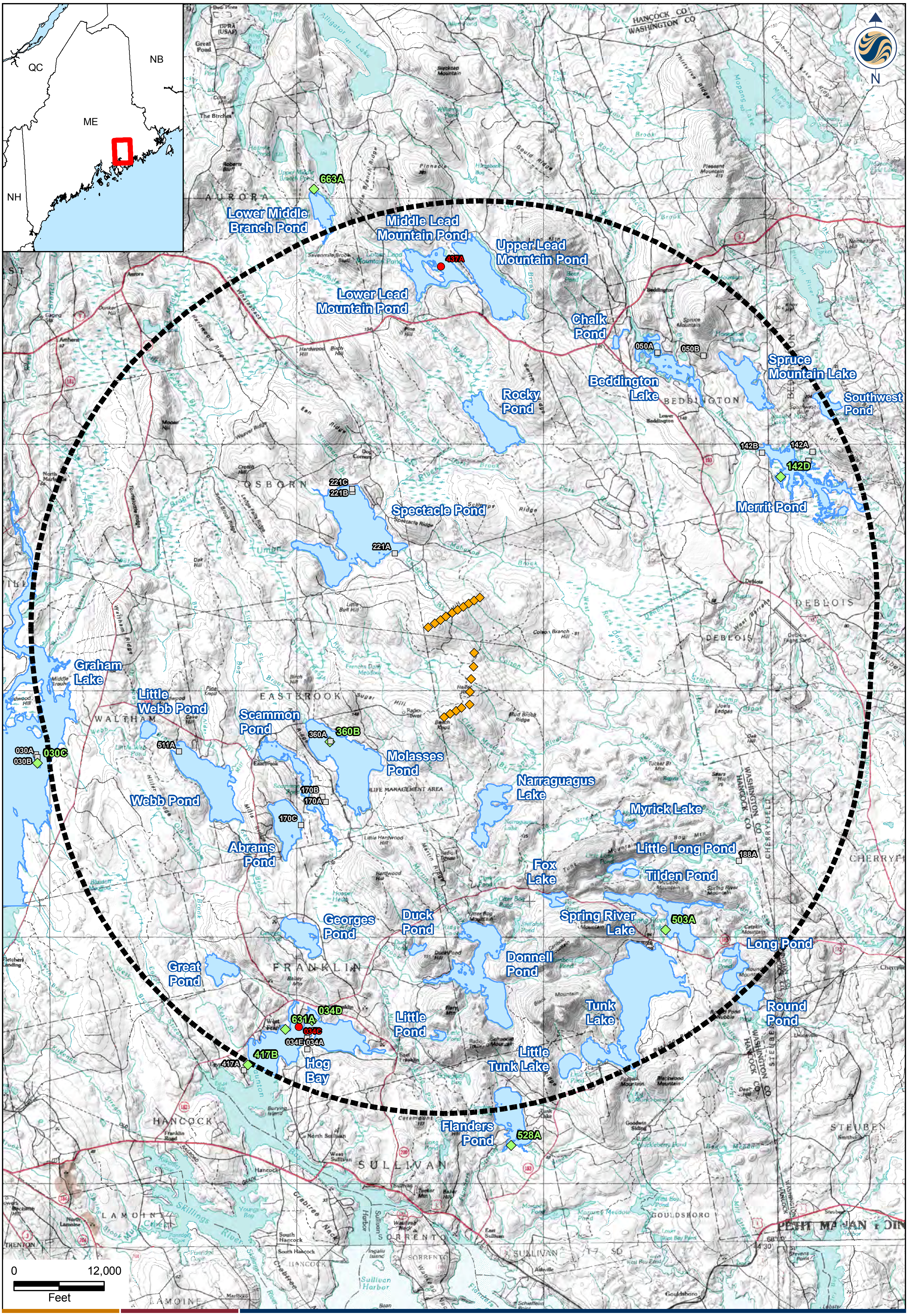
Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING

Bryan Emerson
Project Manager

Cc: Robert Roy, First Wind
Adam Gravel, Stantec
Joy Prescott, Stantec
Brooke Barnes, Stantec

[4] U.S. Fish and Wildlife Service, 2009. *Guidelines for Building and Operating Wind Energy Facilities in Maine Compatible with Federal Fish and Wildlife Regulations*. U.S. Fish and Wildlife Service, Maine Field Office, Orono, ME.



195600500

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

00500-F001-Bull-Hill-Bald-Eagle-Aerial-Survey-Map.mxd

Legend

- Turbine Layout (9/15/10)
- Active Bald Eagle Nest (9 Nests)
- Empty Bald Eagle Nest (2 Nests)
- Bald Eagle Nest Not Found (20 Nests)
- Surveyed Water Body
- Bull Hill Turbine 10 Mile Perimeter

Client/Project
Blue Sky East, LLC
Bull Hill Wind Project
T16 MD, Maine

Figure No.
1

Title
Bull Hill Eagle Survey Map

June 23, 2011

Memo

To:	Josh Bagnato and Bob Roy First Wind	From:	Bryan Emerson Stantec Consulting
File:	195600763	Date:	December 14, 2012

Reference: Spring 2012 Aerial Bald Eagle Nest Survey
Proposed Hancock Wind Project

As requested, Stantec Consulting (Stantec) conducted an aerial survey for bald eagle (*Haliaeetus leucocephalus*) nests in the vicinity of the proposed Hancock Wind Project (project). The survey included waterbodies within 10 miles of the proposed turbine locations (U.S. Fish and Wildlife Service [USFWS] 2011).[1] Prior to the survey, Stantec reviewed information provided by the Maine Department of Inland Fisheries and Wildlife (MDIFW) regarding known active and historic bald eagle nest locations in the vicinity of the project area. Following protocol previously established by the USFWS (2007),[2] Stantec notified Mark McCullough of the USFWS Maine Field Office on April 5, 2012, that flights were planned in this area and that Stantec was coordinating with MDIFW on the timing and methods of the flights.

Survey Methods

Stantec conducted two aerial surveys around the project area. The first flight was conducted on April 13, 2012. The purpose of the first flight was to search potential nesting habitat to identify new nests and to assess eagle nesting activity at known nest locations within 10 miles of the proposed turbine locations. The second flight was conducted on May 20, 2012, to check the status of active nests within close proximity to the project area and included only 2 active nest locations, #221C on Spectacle Pond and #360A on Molasses Pond. These 2 nests were surveyed as part of a greater bald eagle telemetry study project with First Wind, Stantec, and the University of Massachusetts. These 2 new nests were the closest active nests to both the Hancock Project and the recently constructed Bull Hill Wind Project. The second flight was conducted to identify potential nests that could be visited for fledgling transmitter deployment. The timing of the second flight was chosen to correspond with the time period when eaglets have hatched and are visible in the nest (i.e., to determine hatching success). Charlie Todd of MDIFW accompanied Stantec on the second flight.

Each aerial survey consisted of low altitude passes in a Cessna 172 aircraft, approximately 500 feet above ground level, along the shoreline of 30 waterbodies (shown on Figure 1) within an approximately 10-mile radius of the proposed turbine locations. A 10-mile survey radius is recommended by the USFWS (2011). The shorelines of the waterbodies were surveyed for bald eagle nest sites. Incidental observations of adult and sub-adult bald eagles were also recorded, along with incidental observations of osprey (*Pandion haliaetus*) and great blue heron (*Ardea herodias*). Based on consultation with MDIFW, the aerial surveys were conducted at an appropriate time of year and employed methods consistent with MDIFW and USFWS aerial survey protocol.

Survey Results

During the first survey flight, Stantec identified 5 active bald eagle nests within a 10-mile radius of the Project area (Table 1). Of the 2 nests surveyed during the second flight, only nest #221C on Spectacle Pond was found to have successfully hatched at least 1 eaglet. Nest #360 on Molasses Pond was determined to be a nest failure, as no eaglets were observed in the nest during the second flight. The three nests not surveyed during the second flight were assumed to

[1] U.S. Fish and Wildlife Service, 2011. *Draft Eagle Conservation Plan Guidance*. U.S. Fish and Wildlife Service, Washington, DC.
[2] U.S. Fish and Wildlife Service, 2007. *National Bald Eagle Management Guidelines*. U.S. Fish and Wildlife Service, Washington, DC.

be active. Stantec also identified 1 empty bald eagle nest within the survey area, nest #437A on Lower Lead Mountain Pond. One mapped nest within the survey area was not located during the first survey flight, #142C on Bog Brook Flowage. This nest is an alternate location for nest #142D, which was found to be active. Several attempts were made to locate #142C during the first survey flight, but it was not found and is assumed to have fallen down.

The closest active nest to the proposed turbine locations was nest #221C on Spectacle Pond at approximately 1.74 miles. This was the only active or historic bald eagle nest within 4 miles of the proposed turbine locations, the distance that the Maine Field Office of the USFWS has recommended for bald eagle surveys in Maine.[3] The results of the survey flights are presented in Table 1 below and shown on the attached Figure 1.

Table 1. Results of Aerial Survey Flights – Hancock Wind Project

Waterbody	MDIFW Nest #	First Flight Status	Second Flight Status	Approx. Distance to Nearest Turbine (mi)	Notes
Spectacle Pond	221C	Active – 1 adult incubating	Active – at least 1 eaglet in nest	1.74	NEW NEST in 2012
Lower Lead Mountain Pond	437A	Empty	Not surveyed	5.70	2 adults seen near nest
Molasses Pond	360A	Active – 1 adult incubating	Empty – failure	5.75	
Bog Brook Flowage	142D	Active – 1 adult incubating	Not surveyed, Assumed active	6.15	2nd adult flying over nest. Nest 142C not found.
Lower Middle Branch Pond	663A	Active – 1 adult incubating	Not surveyed, Assumed active	8.56	2nd adult perched on pond
Spring River Lake	503A	Active – 1 adult incubating	Not surveyed, Assumed active	9.27	

During the first survey flight, Stantec observed one adult bald eagle flying over Scammon Pond toward Molasses Pond. No other incidental observations of bald eagles were made. Stantec observed one active great blue heron rookery within 10 miles of the turbine locations, #682 on Spring Brook. This rookery consisted of 7 to 8 active nests in dead snags with adults sitting in incubating positions. This rookery is located approximately 6.5 miles from the nearest proposed turbine location. Stantec also attempted to locate two additional great blue heron rookeries within the 10-mile survey area, #123 on Bog Brook Flowage and #125 on Horseshoe Pond. Stantec was unable to locate either rookery. Stantec also identified 2 active osprey nests within the 10-mile survey area. One was located along the existing transmission line near the great blue heron rookery #682 on Spring Brook and was approximately 6.5 miles from the project. The second nest was located in a low snag in Bog Brook Flowage approximately seven miles from the project. Both nests were active with an adult osprey sitting on the nest in an incubating position. No other great blue heron rookeries or osprey nests were observed during the surveys.

Year 2012 was the third year that Stantec has performed aerial eagle nest surveys in the vicinity of the project. In 2010 and 2011, Stantec performed aerial surveys for the Bull Hill Wind

[3] U.S. Fish and Wildlife Service, March, 2012. *Guidelines for Building and Operating Wind Energy Facilities in Maine Compatible with Federal Fish and Wildlife Regulations*. U.S. Fish and Wildlife Service, Maine Field Office, Orono, ME.

Project,[4,5] which is located less than 1 mile southwest of the project. Stantec reviewed the results of the Bull Hill surveys as they relate to the project, and the results are summarized below and shown on Table 2.

In 2010, Stantec conducted aerial nest surveys using a 4-mile radius surrounding the proposed Bull Hill turbine locations in accordance with existing protocol at the time. During these surveys, Stantec did not identify any active bald eagle nests with the 4-mile survey area. Nest #360A on Molasses Pond was located in 2010, but it was found to be empty and inactive. Nests #221A-C on Spectacle Pond were not located during the 2010 surveys. In 2011, Stantec conducted aerial surveys using a 10-mile radius surrounding the proposed Bull Hill turbine locations. Based on the results of these surveys, Stantec identified 4 active nests located within 10 miles of the current project turbine locations: #663A on Lower Middle Branch Pond, #142D on Bog Brook Flowage, #360B on Molasses Pond, and #503A on Spring River Lake. In 2011, the closest active nest to the proposed project turbines was #360B on Molasses Pond at approximately 5.75 miles.

Table 2. Historic Activity at Bald Eagle Nests within 10 miles of Hancock Wind Project

Waterbody	MDIFW Nest #	2012 Status	2011 Status	2010 Status
Spectacle Pond	221C	Active - eaglets hatched	No Nest Located	No Nest Located
Lower Lead Mountain Pond	437A	Empty	Empty	Not Surveyed
Molasses Pond	360A	Active - failure	Active - eaglets hatched	Empty
Bog Brook Flowage	142D	Active	Active - failure	Not Surveyed
Lower Middle Branch Pond	663A	Active	Active - failure	Not Surveyed
Spring River Lake	503A	Active	Active - eaglets hatched	Not Surveyed

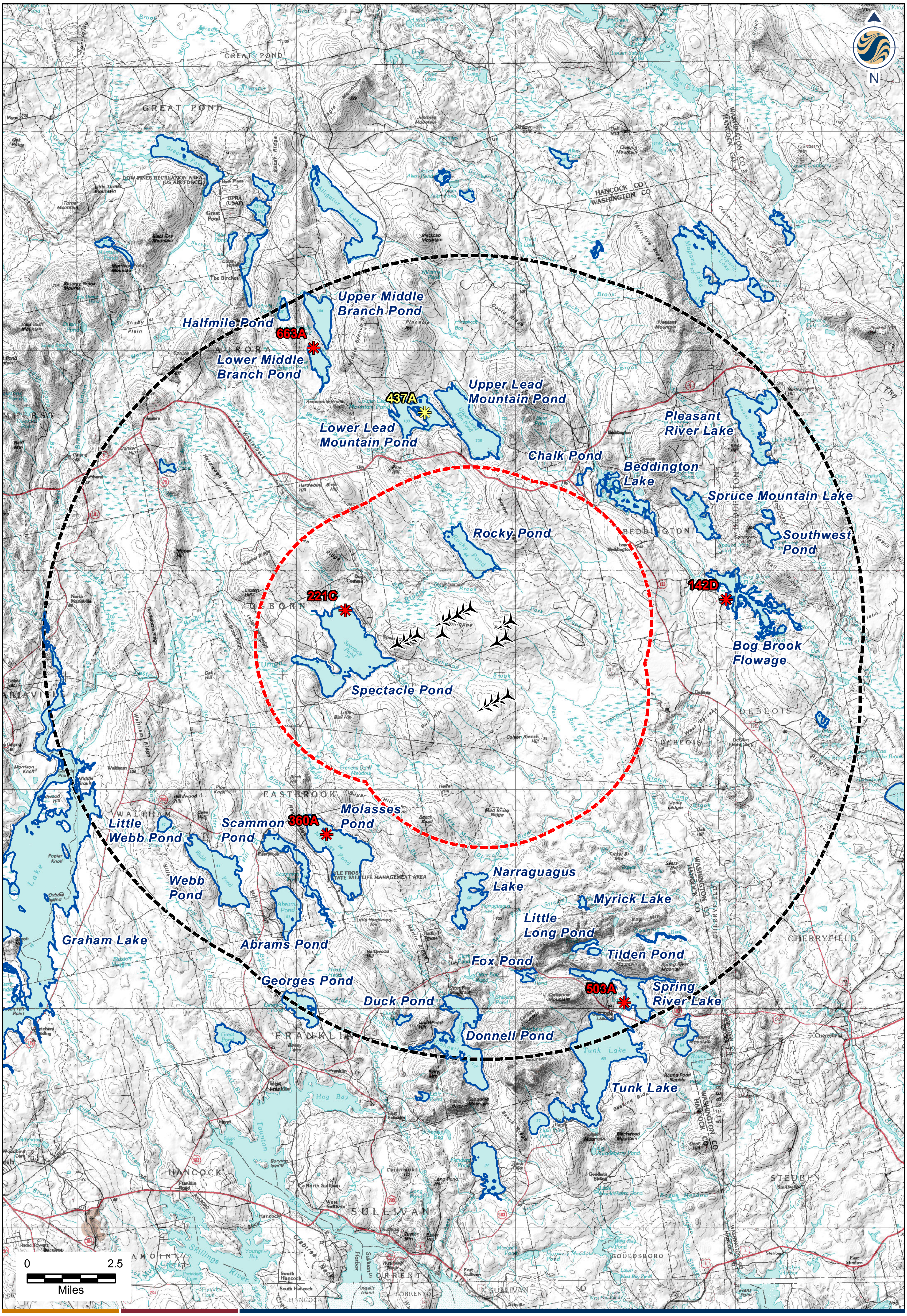
Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING

Bryan Emerson
Project Manager

Cc: Adam Gravel, Stantec
Brooke Barnes, Stantec

[4] Stantec Consulting. 2010. *2010 Bald Eagle Aerial Survey, Blue Sky East/Bull Hill Wind Project, Eastbrook, Maine*. Prepared for First Wind, June 11, 2010.
[5] Stantec Consulting. 2011. *Spring 2011 Aerial Bald Eagle Nest Survey, Proposed Bull Hill Wind Project, T16 MD, Maine*. Prepared for First Wind, August 22, 2011.



195600763

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

Stantec

Bald Eagle Nest
- Active
- Empty

Proposed Turbines
2012 Hancock Study Area 10 miles
2012 Hancock Study Area 4 miles

Client/Project
Hancock Wind, LLC
Hancock Wind Project
T16 MD & T22 MD, Maine

Figure No.
1

Title
2012 Bald Eagle Nest Survey

12/13/2012

00763_01_Eagles2012.mxd

Exhibit 7-7-5

Summer and Fall 2009 and Spring 2010 Avian and Bat Survey Reports for Bull Hill Wind Project

Summer and Fall 2009 Avian and Bat Survey Report

Summer and Fall 2009
Avian and Bat Survey Report

for the Bull Hill Project
In T16 MD, Maine

Prepared for

Blue Sky East Wind, LLC
179 Lincoln Street, Suite 500
Boston, MA 02111

Prepared by

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Revised October 2010

Executive Summary

In advance of permitting activities for the proposed Bull Hill Wind Project (Project) in T16 MD, Maine, Blue Sky East Wind, LLC contracted Stantec Consulting Services Inc. (Stantec) to perform bird and bat scientific surveys for the purpose of evaluating 2009 summer and fall activity within the Project area. Survey methods and work plans, including nocturnal marine radar surveys, bat detector surveys, and raptor migration field surveys, were developed in consultation with state and federal wildlife agencies.

Nocturnal Marine Radar Survey

Radar surveys were conducted during 20 nights in fall 2009 (between September 1 and October 15) to characterize nocturnal migration activity in the Project area. Surveys were conducted using X-band radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar was located on the summit of Bull Hill and provided adequate visibility of the surrounding airspace to characterize migration.

The overall mean passage rate for the entire fall survey period was 614 ± 32 targets per kilometer per hour (t/km/hr), and nightly passage rates varied from 188 ± 30 to 1500 ± 209 t/km/hr. Mean flight direction through the Project area for the season was 260± 66°. The seasonal mean flight height of targets was 356 ± 9 meters (m; 1168 ft [']) above the radar site, and nightly flight heights ranged from 208 ± 9 m to 558 ± 22 m. The percent of targets observed flying below 145 m (476') (the height of the proposed turbines) was 14 percent for the entire season.

The mean passage rate of 614 t/km/hr at Bull Hill is on the higher end of the range of results reported at other sites in forested landscapes in the northeast. Mean flight height of targets at the Project is similar to flight heights reported from other studies.

Bat Detector Survey

The goal of the acoustic surveys was to characterize seasonal patterns in bat activity levels and examine how weather conditions influence bat activity at the Project. Six Anabat® acoustic bat detectors were deployed in the Project area between mid July and early November to document bat activity. Two detectors were deployed on the Little Bull Hill meteorological tower (met tower), and four were deployed in trees throughout the Project area. Detectors were deployed at relatively low heights where increased bat activity levels are generally documented, particularly during the non-migratory periods. Data were summarized by guild and species and tallied per detector on an hourly and nightly basis.

Detectors operated properly for most of the season, resulting in 634 detector nights of data. During this survey period, 4657 call sequences were recorded, resulting in a detection rate of 0.2 bat call sequences per detector night for the met tower detectors combined, and 10.8 bat call sequences per detector night for the tree detectors combined. The NE Tree Detector had the highest monthly detection rate (37.4 call sequences per detector night) in July. Detection rates recorded during the fall 2009 season at the Project are at the low end of the range found at other forest edge detector sites in the northeast.

Raptor Migration Field Survey

Raptor migration surveys were conducted during two seasons: on 6 survey days from August 1 to August 27 for summer surveys, and on 12 survey days from September 2 to October 14 for fall raptor migration surveys. The primary goal of summer surveys was to characterize bald eagle activity in the Project area during the late-fledging period. The primary goal of the fall surveys was to characterize raptor movement in the Project area during the fall migration season. Total survey hours for each season were 46 and 87, respectively. Visual observation surveys were conducted from 9 am to 4 pm and were based on Hawk Migration Association of North America methods.

No bald eagles were observed during summer surveys. A total of 24 raptors representing 6 species were observed during summer surveys. Red-tailed hawk (*Buteo jamaicensis*) and turkey vulture (*Cathartes aura*) were the most commonly observed species. Daily counts ranged from 2 to 6 raptors and the overall passage rate was 0.52 birds/hour. Of total raptors observed, four percent were observed in the Project area during summer surveys, and 100 percent of those were documented flying at heights less than 145 m for at least a portion of their flight during summer surveys.

During fall raptor migration surveys, a total of 124 raptors representing 11 species were observed. Sharp-shinned hawk (*Accipiter striatus*) and turkey vulture were the most commonly observed species. Daily counts ranged from 5 to 19 raptors and the overall passage rate was 1.43 birds/hour. Of total raptors observed during fall migration surveys, 48 percent were observed in the Project area, and 98 percent of those were documented at heights less than 145 m for at least a portion of their flight.

No state or federal endangered, threatened or special concern raptor species were observed during the 2009 summer surveys. During fall 2009 surveys, one state endangered raptor species, peregrine falcon (*Falco peregrinus*), was observed in the Project area, as well as two state special concern species, bald eagle (*Haliaeetus leucocephalus*) and northern harrier (*Circus cyaneus)*.

Patterns in flight characteristics at the Project are similar to the results of other surveys in forested ridges in the northeast.

Table of Contents

EXECUTIVE SUMMARY E.1

1.0 INTRODUCTION 1
1.1 PROJECT BACKGROUND 1
1.2 PROJECT AREA DESCRIPTION 1

2.0 NOCTURNAL RADAR SURVEY 4
2.1 INTRODUCTION 4
2.2 DATA COLLECTION METHODS 4
2.2.1 Radar Data 4
2.2.2 Weather Data 8
2.3 DATA ANALYSIS METHODS 8
2.3.1 Radar Data 8
2.3.2 Weather Data 9
2.4 RESULTS 9
2.4.1 Passage Rates 9
2.4.2 Flight Direction 10
2.4.3 Flight Altitude 11
2.4.4 Weather Data 12
2.5 DISCUSSION 13

3.0 ACOUSTIC BAT SURVEY 15
3.1 INTRODUCTION 15
3.2 DATA COLLECTION METHODS 15
3.2.1 Acoustic Detector Site Selection 15
3.3 DATA ANALYSIS METHODS 19
3.3.1 Weather Data 21
3.4 RESULTS 21
3.4.1 Timing of Activity 21
3.4.2 Species Composition 23
3.4.3 Activity and Weather 24
3.5 DISCUSSION 25

4.0 DIURNAL RAPTOR SURVEYS 28
4.1 INTRODUCTION 28
4.2 METHODS 28
4.2.1 Field Surveys 28
4.2.2 Data Analysis 30
4.3 RESULTS 31
4.3.1 Rare, Threatened or Endangered Species 37
4.3.2 Incidental Bird Observations 37
4.4 DISCUSSION 38

Summer Bald Eagle Surveys 38
Fall Migration Surveys 39

5.0 LITERATURE CITED 41

Tables

Table 3-1 Summary of bat detector field survey effort and results at Bull Hill, Fall 2009
Table 3-2 Distribution of detections by guild for detectors at Bull Hill, Summer-Fall, 2009
Table 4-1 Summary of raptor surveys conducted at the Bull Hill Wind Project in T16 MD, Maine, 2009
Table 4-2 Number of observations and average flight heights for each position category for birds observed at Bull Hill, 2009
Table 4-3 Number of individuals of species observed within Project area in proposed turbine areas (flight positions A1, A2, A3, and B) above or below 145 m at Bull Hill, 2009
Table 4-4 Incidental birds seen at Bull Hill, 2009

Figures

Figure 1-1 Avian and Bat Location Map
Figure 2-1 An example of ground clutter causing objects in horizontal mode and vertical mode
Figure 2-2 Proper site selection can reduce ground clutter to the center of the radar screen so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area
Figure 2-3 Detection Range of the radar in vertical mode
Figure 2-4 Nightly passage rates observed (error bars ± 1 SE) at Bull Hill, 2009
Figure 2-5 Hourly passage rates for entire season at Bull Hill, 2009
Figure 2-6 Mean flight direction for the entire season at Bull Hill, 2009
Figure 2-7 Mean nightly flight height of targets (error bars ± 1 SE) at Bull Hill, 2009
Figure 2-8 Percent of targets observed flying below a height of 145 m (476’) at Bull Hill, 2009
Figure 2-9 Hourly target flight height distribution at Bull Hill, 2009
Figure 2-10 Nightly mean wind speed (m/s) at Bull Hill, 2009
Figure 2-11 Nightly mean temperature (°Celsius) at Bull Hill, 2009
Figure 3-1 Monthly detection rates per detector at the tree detectors at Bull Hill, 2009
Figure 3-2 Monthly detection rates per detector at met tower detectors at Bull Hill, 2009
Figure 3-3. Hourly bat call sequence detections at Bull Hill, 2009
Figure 3-4 Total nightly bat call sequence detections at Bull Hill, 2009
Figure 3-5 Nightly mean wind speed and bat call detections at Bull Hill, 2009
Figure 3-6 Nightly mean temperature and bat detections at Bull Hill, 2009
Figure 4-1 Raptor flight position categories in relation to the topography of the Project area at Bull Hill, 2009
Figure 4-2 Total number of birds observed per survey day at Bull Hill, 2009
Figure 4-3 Number of individuals of species observed at Bull Hill, 2009
Figure 4-4 Number of individuals observed per survey hour at Bull Hill, 2009
Figure 4-5 Number of observations of flight behaviors at Bull Hill, 2009

Appendices

Appendix A Radar Survey Data Tables
Appendix B Bat Survey Data Tables
Appendix C Raptor Survey Data Tables

PN19560500*

* *This report was prepared by Stantec Consulting Services Inc. for Blue Sky East Wind, LLC. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.*

1.0 Introduction

Blue Sky East, LLC. (Blue Sky East), an affiliate of First Wind, is considering construction of a commercial-scale wind energy project located in T16 MD, Hancock County, Maine (Figure 1-1). The Bull Hill Wind Farm (the Project) includes two separate turbine arrays[1] on lower elevation hillsides: one on Bull Hill and one on Heifer Hill and Beech Knoll. The Project will consist of 19 turbines, access roads, and a transmission line. Turbines will be mounted on tubular steel towers with an approximate hub height of up to 95 meters (m) and a rotor diameter of 100 m. The proposed turbines would have a height of up to 145 m (476 feet [']) to the tip of a fully extended blade.

Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of results; and the conclusions reached based on those results.

1.1 PROJECT BACKGROUND

In advance of permitting activities for the Project, Blue Sky East contracted Stantec to perform bird and bat scientific surveys for the purpose of evaluating 2009 summer and fall activity near and within the Project area. This report describes the work conducted by Stantec during summer and fall 2009, including summer eagle surveys and fall radar surveys, raptor surveys and acoustic bat surveys.

On July 30, 2009, prior to initiation of field surveys, Blue Sky East and Stantec presented a draft work plan for comprehensive natural resource surveys during an initial agency consultation with biologists from the Maine Department of Inland Fisheries and Wildlife (MDIFW).

Stantec conducted a site visit with regional and state MDIFW biologists on October 6, 2009, to allow agency staff to observe existing ecological conditions within the Project area, to be informed of remaining field survey efforts and field survey results to date, and to assess future Project planning considerations. Three meteorological towers (met towers) were erected in the summer of 2009 in the Project area.

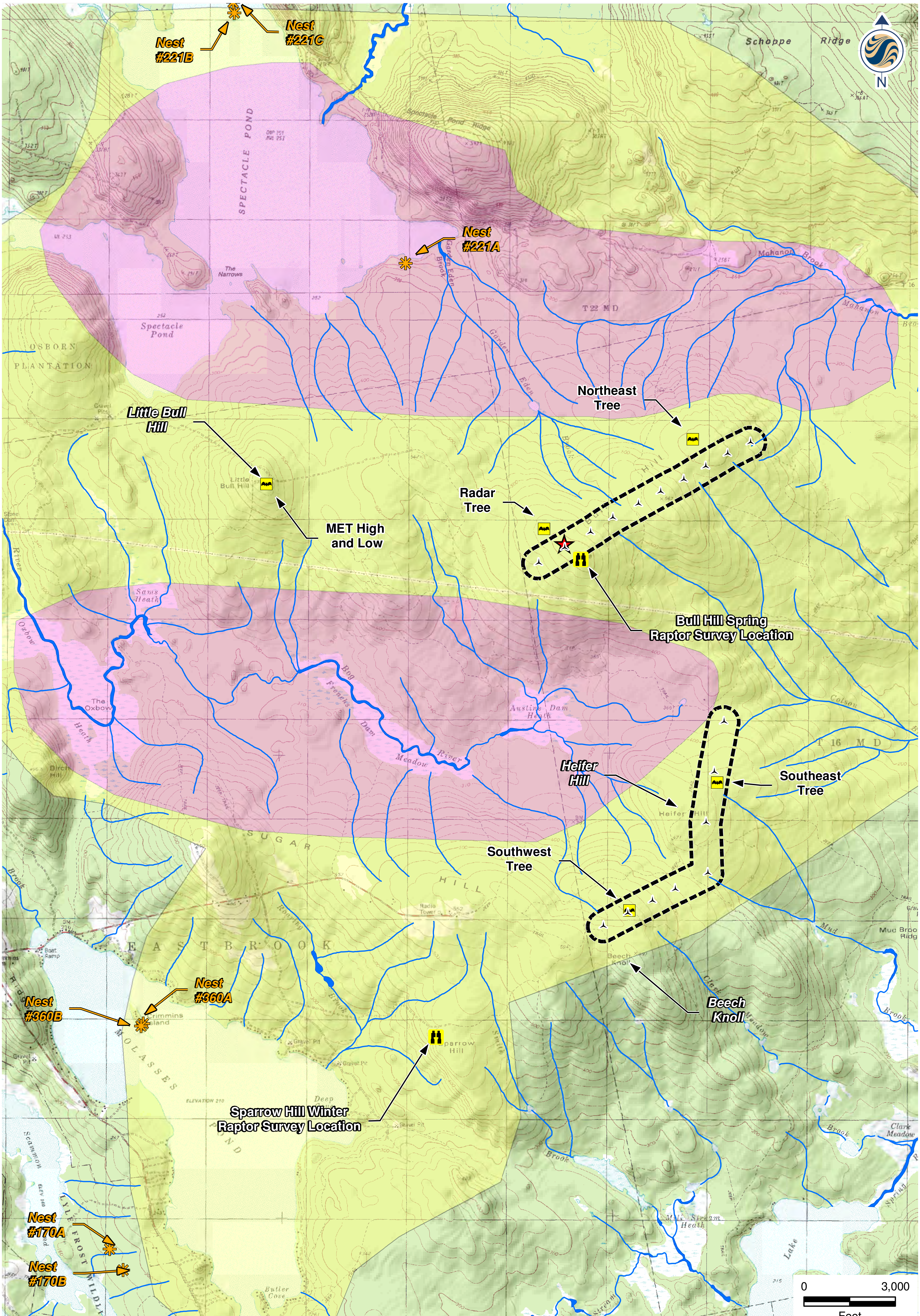
1.2 PROJECT AREA DESCRIPTION

The Project area consists of a series of coastal low elevation hills: Bull Hill, Beech Knoll and Heifer Hill (Figure 1-1). At 255 meters ([m], 837 feet [']) above sea level, Bull Hill has the highest elevation in the Project area and like the other peaks, consists of gently sloping to moderately steep topography. An existing network of well-maintained logging roads is present throughout the Project area and the effects of past and current timber harvesting are evident across the entire Project area, from large clear-cuts to small selective harvesting areas. Aside from the roads and skidder trails, the Project area is almost entirely undeveloped.

[1] This report was revised in October 2010 to reflect the height of the recently chosen turbines and the revised 19-turbine, two turbine array, Project area layout.

The Project is located in the Eastern Lowlands biophysical region. This region is characterized by extensive lowlands with elevations generally below 600'. The region also contains the largest concentration of peatlands, marshes, and swamps in the state. The representative vegetation communities present within the Project area include: forested uplands and wetlands, scrub-shrub wetlands, emergent wetlands, and stream systems. Examples of these wetland communities present near the Project area include: Oxbow Heath, Frenchs Dam Meadow, and Austins Dam Heath. These communities are large, open wetland systems with dense ericaceous shrubs amidst areas of open water; stands and even individual dead standings trees appear to be infrequent based on initial visits to these areas. Forested communities are representative throughout and dominate higher elevations within the Project area, while wetland systems are most common at lower elevations. The proposed Project area includes a variety of natural community types including, but not limited to, Beech-Birch-Maple Forest, Spruce-Northern Hardwoods Forest, and Red Oak-Northern Hardwoods-White Pine Forest. Dominant canopy species present in the Project area include white pine (*Pinus strobus*), red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), red oak (*Quercus rubra*), white ash (*Fraxinus americana*), paper birch (*Betula papyrifera*), and gray birch (*Betula populifolia*). Common shrub species include hobblebush (*Viburnum lantanoides*), witch-hazel *(Hamamelis virginiana*), American beech (*Fagus grandifolia*), and the aforementioned tree species. Herbaceous species present in the Project area include Canada mayflower (*Maianthemum canadense*), partridgeberry (*Mitchella repens*), wintergreen (*Gaultheria procumbens*), bunchberry (*Cornus canadensis*), bracken fern (*Pteridium aquilinum*), wild sarsaparilla (*Aralia nudicaulis*), starflower (*Trientalis borealis*), and evergreen wood fern (*Dryopteris intermedia*). The majority of wetlands in the area are forested, with occasional scrub-shrub and emergent wetlands associated with disturbance from timber harvesting. Streams are primarily high-gradient, fast-moving perennial and intermittent streams that exhibit heavy flow in spring and during rain events, and little to no flow during the summer and dry periods.

The Project area is located between the Union River and Narraguagus River watersheds. These rivers and associated perennial streams are Designated Critical Habitat for the federally-listed Atlantic salmon (*Salmo salar*). The Project area is not within designated critical habitat for Canada lynx (*Lynx canadensis*). Three bald eagle nests were identified within four miles of the Project area located on Spectacle Pond, Molasses Pond, and Scammon Pond (Figure 1-1). The proposed turbine portion of the Project area does not intersect any state protected wildlife areas, such as Inland Waterfowl and Wading Bird Habitat or Deer Wintering Areas.



195600500

Stantec

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

00500-F001-1-EagleRaptor-Survey-Viewshed.mxd

Legend

- Proposed Turbine Layout (7-16-10)
- Radar Location
- Bat Detector
- Bald Eagle Nests
- Areas Visible During Raptor Survey
- Areas Not Visible During Raptor Survey
- Bull Hill Turbine Delineation Limit (7-16-10)
- USGS River and Streams

Client/Project
Blue Sky East Wind, LLC
Bull Hill
Eastbrook and T16 MD, Maine

Figure No.
1-1

Title
2010 Radar, Raptor, & Acoustic Survey Location Map
August 5, 2010

2.0 Nocturnal Radar Survey

2.1 INTRODUCTION

Radar surveys were conducted in the Project area to characterize fall 2009 nocturnal migration patterns. The majority of North American passerines (songbirds) migrate at night; the strategy of migrating at night may have evolved to take advantage of more stable atmospheric conditions for their flapping flight (Kerlinger 1995). Additionally, cooler nighttime temperatures may provide a more efficient medium to regulate body temperature during more active, flapping flight and reduce predation risk while in flight (Alerstam 1990, Kerlinger 1995). Documenting the patterns of nocturnal migrants requires the use of radar or other non-visual technologies. The goal of the surveys was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude.

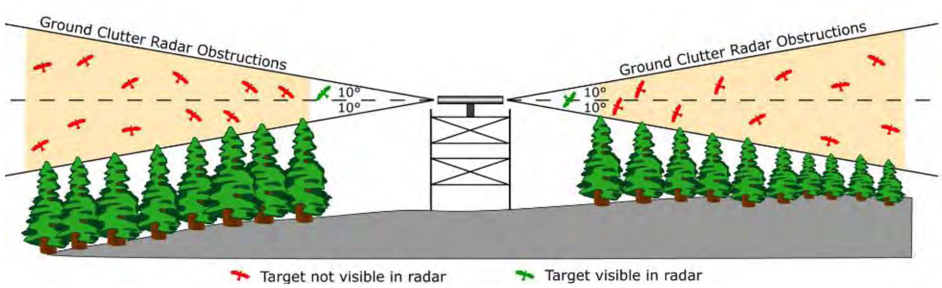
Radar surveys were conducted from sunset to sunrise over the course of 20 nights between September 1 and October 15. The radar was deployed on Bull Hill (Figure 1-1), at an elevation of 188 m (616’).

2.2 DATA COLLECTION METHODS

2.2.1 Radar Data

Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen were identified as “targets.” The radar has an “echo trail” function which captures past echoes of flight trails, enabling determination of flight direction. During all operations, the radar’s echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5’) waveguide antenna, deployed 7 m (25’) above ground. The antenna has a vertical beam height of 20° (10° above and below horizontal), and the front end of the antenna was inclined approximately 5° to increase the proportion of the beam directed into the sky.

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas (Figure 2-1).


Ground Clutter Radar Obstructions
10°
10°
Ground Clutter Radar Obstructions
10°
10°
Target not visible in radar
Target visible in radar

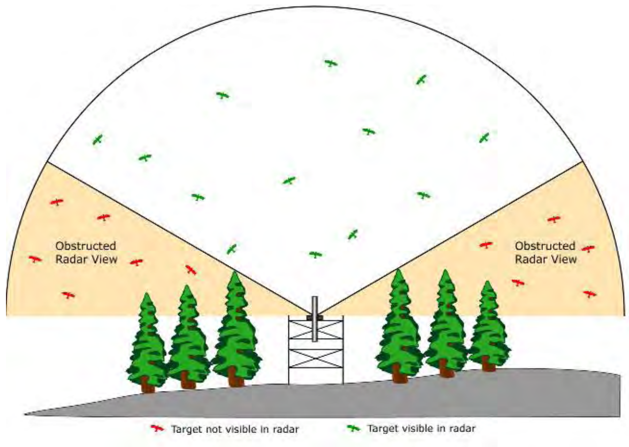


Figure 2-1. An example of ground clutter causing objects in horizontal mode (top) and vertical mode (bottom). Although the radar records three-dimensional space, it is translated by the radar screen into a two dimensional representation, which can cause targets to be obscured from view.

However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar. These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen – targets are indistinguishable from the "clutter" as represented on the radar screen (Figure 2-2). However, targets traveling into and out of the ground clutter areas can be tracked. The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers, mist, or fog were sampled.

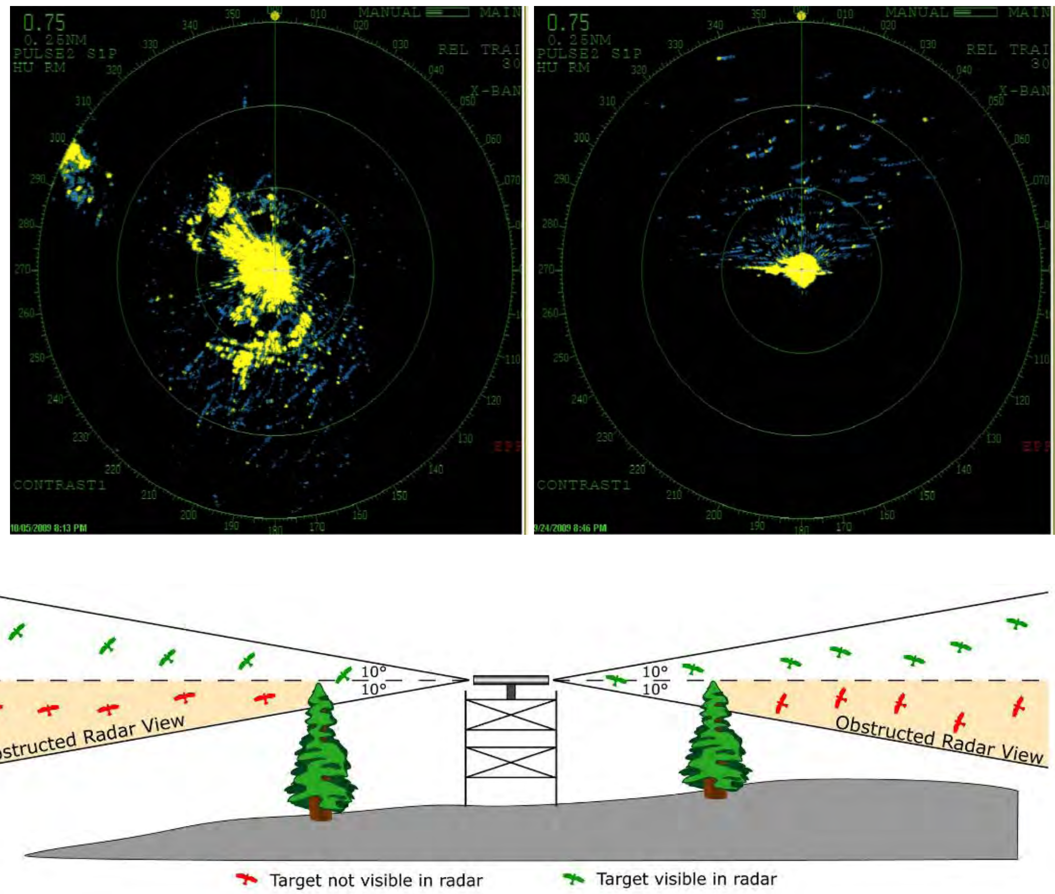


Figure 2-2. Proper site selection can reduce ground clutter to the center of the radar screen (bottom), so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area (top; horizontal screenshot is on the left and vertical is on the right).

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the Project Site (Figure 2-3). By analyzing the echo trail, the flight direction and flight speed of targets can be determined.

In vertical mode, the radar unit is tilted 90° to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20° radar beam (Figure 2-3). Both modes of operation were used during each hour of sampling.

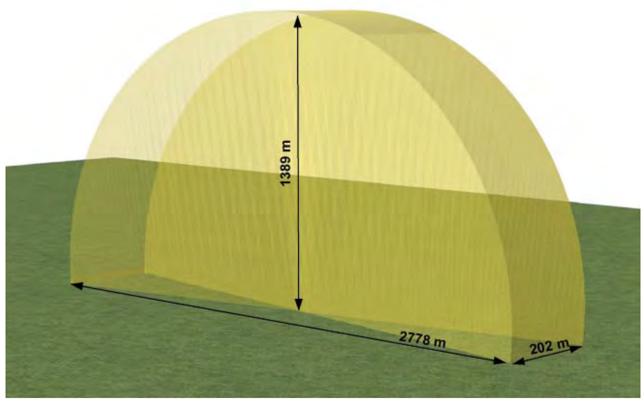


Figure 2-3. Detection Range of the radar in vertical mode

The radar was operated at a range of 1.4 km (0.75 nautical miles) to ensure detection of small targets. When radar is operated at ranges greater than 1.4 km, larger birds can be detected but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets; consequently, 1.4 km is the appropriate detection range for this type of study.

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. A stratified random sample set was developed by randomly selecting 6 horizontal samples and 6 vertical samples per hour of survey. This sampling schedule allowed for randomization of sample selection and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

2.2.2 Weather Data

Temperature, wind speed and wind direction were recorded on an hourly basis from the top of a 197' on-site met tower located on Little Bull Hill for the duration of the survey period. This information was used during data analysis to help characterize any patterns in migration activity for particular nights and for the season overall.

2.3 DATA ANALYSIS METHODS

2.3.1 Radar Data

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 145 m (476'), the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

2.3.2 Weather Data

The mean nightly temperature, wind speed and wind direction were calculated for each night of the survey period.

2.4 RESULTS

Radar surveys were conducted during 20 nights from September 1 to October 15 (Appendix A, Table 1). Although the radar's view was partially obscured in some areas of the radar detection range, targets could be tracked as they moved in and out of those areas; the radar view was adequate to characterize migration. The radar was elevated off the ground thus reducing the amount of the radar beam reflected back by surrounding vegetation (Figure 2-4).

2.4.1 Passage Rates

Nightly passage rates varied from 188 ± 30 targets per kilometer per hour (t/km/hr) on September 10 to 1500 ± 209 t/km/h on October 6, and the overall passage rate for the entire survey period was 614 ± 32 t/km/hr (Figure 2-4; also Appendix A, Table 1). Individual hourly passage rates ranged from 0 to 2507 t/km/hr (Appendix A, Table 2). Hourly passage rates were variable within and between nights. For the entire season, passage rates were typically highest during the third hour after sunset and gradually decreased until sunrise (Figure 2-5).

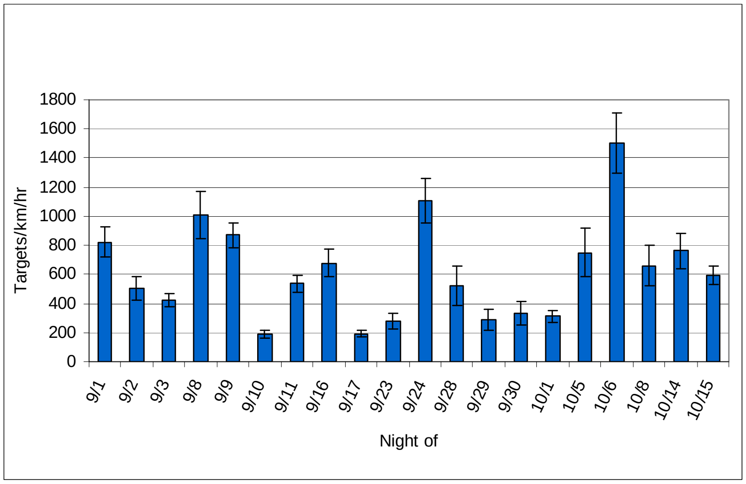


Figure 2-4. Nightly passage rates observed (error bars ± 1 SE) at Bull Hill, 2009

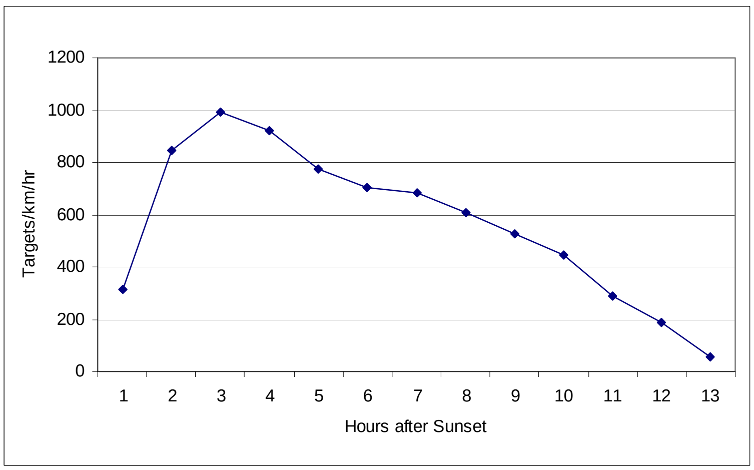


Figure 2-5. Hourly passage rates for entire season at Bull Hill, 2009

2.4.2 Flight Direction

Mean flight direction through the Project area was 260° ± 66° (Figure 2-6). Flight directions were generally to the southwest, but varied between nights (Appendix A, Table 3).

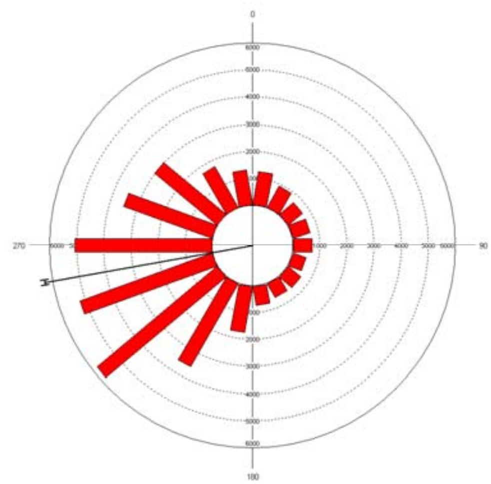


Figure 2-6. Mean flight direction for the entire season at Bull Hill, 2009 (the bracket along the margin of the histogram is the 95% confidence interval)

2.4.3 Flight Altitude

The seasonal average mean flight height of all targets was 356 ± 9 m (1168') above the radar site. The average nightly flight height ranged from 208 ± 9 m on September 2 to 558 ± 22 m on October 14 (Figure 2-7; Appendix A, Table 4). The percent of targets observed flying below 145 m was 14 percent for the season and varied nightly from 4 percent on September 24 and October 8 to 45 percent on September 2 (Figure 2-8). For the entire season, the mean hourly flight heights were typically highest from the fifth to the sixth hour after sunset (Figure 2-9).

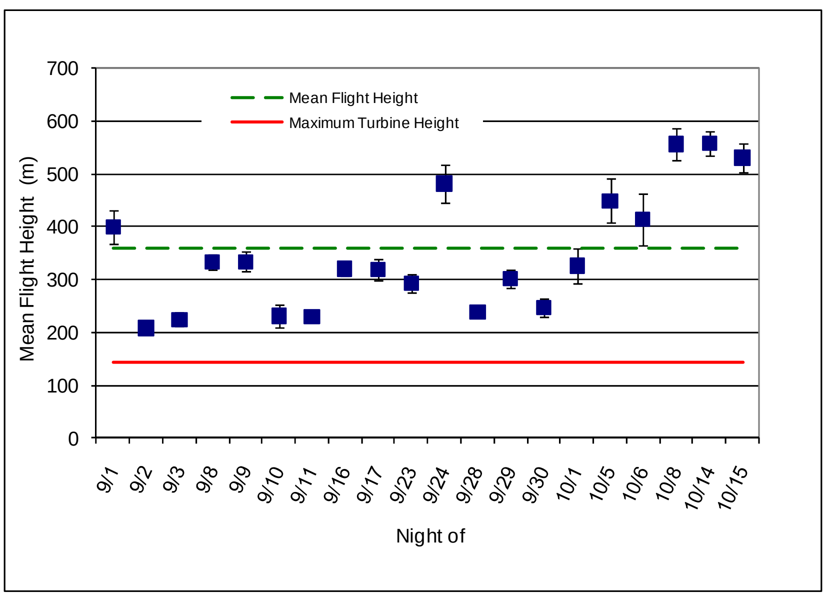


Figure 2-7. Mean nightly flight height of targets at Bull Hill, 2009 (error bars ± 1 SE)

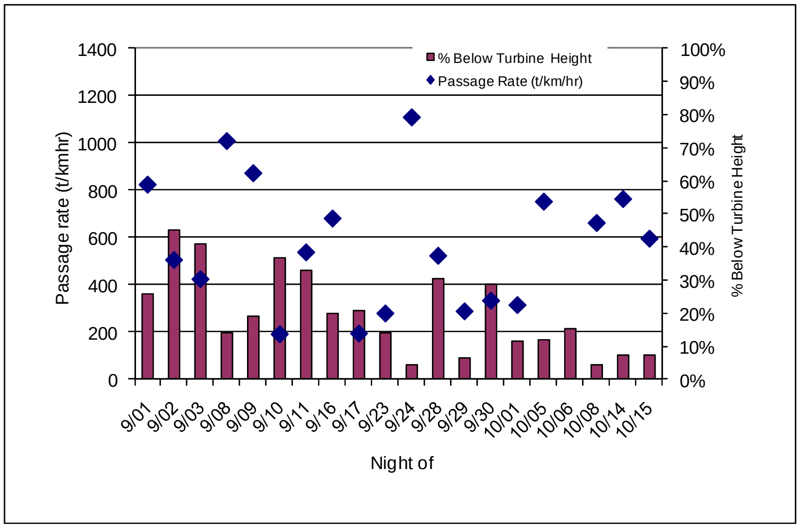


Figure 2-8. Percent of targets observed flying below a height of 145 m (476') at Bull Hill, 2009

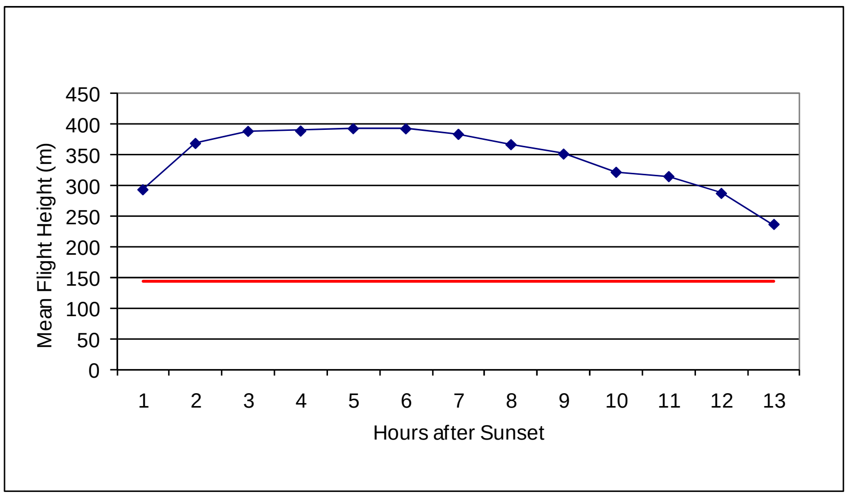


Figure 2-9. Hourly target flight height distribution at Bull Hill, 2009

2.4.4 Weather Data

Weather data was available from September 1 to October 15. Mean nightly wind speeds in the Project area varied between 2.7 and 7.5 meters per second (m/s), with an overall mean of 6.0 m/s (Figure 2-10). Mean nightly temperatures varied between -1.3°C and 16.6°C, with an overall mean of 8.0°C (Figure 2-11).

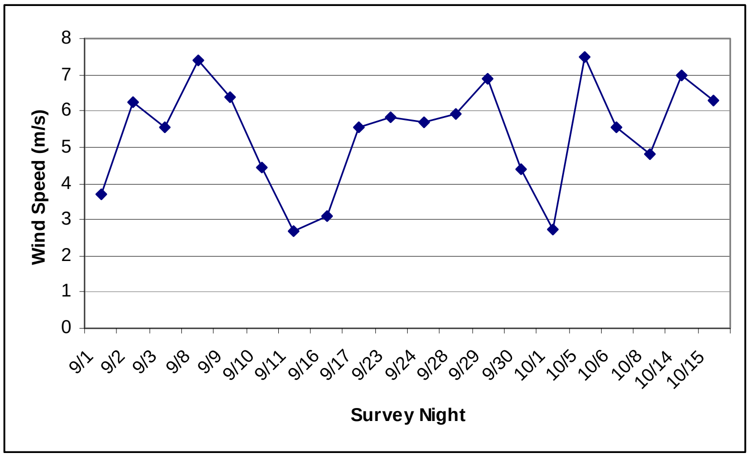


Figure 2-10. Nightly mean wind speed (m/s) at Bull Hill, 2009

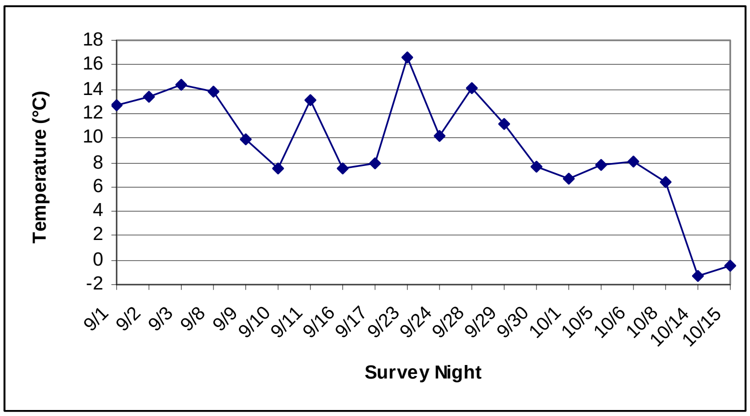


Figure 2-11. Nightly mean temperature at Bull Hill, 2009 (°Celsius)
(nightly maximum and minimum temperatures not available)

2.5 DISCUSSION

Radar surveys are designed and carried out to sample migration activity over a given point in order to provide baseline site data prior to the construction and operation of proposed commercial wind projects. The results of this nocturnal radar survey provide a snapshot of avian migration in space and time; in this case, over Bull Hill during dates typical for fall migration in northern Maine. Results of the survey are within the range of results for publicly available fall studies in the northeast conducted on forested ridges. These include highly variable passage rates between nights and flight heights primarily occurring between 200 and 600 m above the ridgeline. Within nights, migration activity was generally greatest three hours after sunset; flight height appeared to peak during the fifth to sixth hour after sunset within nights. Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler et al. 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman et al. 1982, Gauthreaux 1991). Large migration events are generally thought to occur on mild nights with a following wind. This appeared to be true in regard to wind direction at Bull Hill, as nights with the highest passage rates (1500 t/km/hr on October 6 and 1108 t/km/hr on September 24) had northerly winds on average (from 312˚ and 357˚, respectively; Appendix A, Table 1). Within the fall radar survey at Bull Hill, nightly average mean passage rates were highly variable, ranging from 188 to 1500 t/km/hr; this indicates that nocturnal migration was pulsed, presumably related to seasonal timing and regional weather conditions. Variability in the range of nightly fall passage rates is common at other proposed commercial wind energy projects (Appendix A, Table 5).

Flight direction varied slightly from directions recorded at other radar sites in the northeast (Appendix A, Table 5). A more westerly flight direction at Bull Hill may be due to the fact that Bull Hill is much closer geographically to the coast (roughly 15 miles inland) than other northeast radar sites. Birds migrating along large-scale coastal features (Alerstam 1978, Bruderer 1997, Fortin *et al*. 1999 and Hagstrum 2000) have been documented altering their flight direction as the night progresses, from a direction following the coastline, to a more landward direction (Fortin *et al*. 1999). Thus, birds flying over the Project area may be flying westward before sunrise, given the northeast-southwest orientation of the coastline nearest to the Project area.

The mean passage rate of 614 t/km/hr at Bull Hill is on the higher end of the range of results from these other studies (91 to 620 t/km/hr; Appendix A Table 5). Comparison of mean passage rates between radar surveys at the Project and similar surveys conducted at other sites must be done with caution, as differences in passage rates may be due to a variety of factors including level of survey effort, differences in radar view between sites, topography, local landscape conditions, and vegetation surrounding a radar survey location. The radar location at Bull Hill provided adequate visibility of the surrounding airspace in all directions to characterize migration. Merging of migration flyways may lead to increased densities of birds in certain areas (Bruderer 1997). Birds may concentrate at points along the coast in the northeastern United States for several reasons, including to avoid predation, and to reach suitable habitats for resting and feeding (Alerstam 1978). Possible concentrations of birds along the coast in the northeast may explain relatively high passage rates at the Project.

The emerging body of studies characterizing nocturnal bird movements shows a relatively consistent pattern in flight altitude, with most birds appearing to fly at altitudes of several hundred meters or more above the ground (Appendix A, Table 5). Mean flight height at Bull Hill (356 t/km/hr) is similar to mean flight heights reported from other fall radar studies conducted in the northeast. Comparison of flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The radar survey location on Bull Hill resulted in most of the surrounding tree canopy being level with, or slightly below, the antenna of the radar; thus the location provided good visibility of the surrounding airspace.

No nights at the Project exhibited a total mean flight height below 145 m (Appendix A, Table 1). Where radar surveys have been conducted at any Project, it is expected that some target activity will be observed within the turbine elevation zone. Post construction mortality studies have demonstrated that identifying pre-construction targets flying within turbine elevations does not directly correlate to collision risk. In addition, the majority of hourly and nightly mean flight heights of targets documented at the Project were found to be well above the height of the proposed turbines.

3.0 Acoustic Bat Survey

3.1 INTRODUCTION

Acoustic sampling of bat activity has become a standard aspect of pre-construction surveys for proposed wind-energy development (Kunz *et al.* 2007). Acoustic surveys were associated with several major assumptions (Hayes 2000) and results cannot be used to determine the number of bats inhabiting an area or determine the number of bats which may be killed post-construction. However, acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. While this data may be useful in predicting trends in post-construction mortality rates, the current lack of data on this topic precludes quantitative prediction of risk. The object of acoustic surveys at Bull Hill were (1) to document bat activity patterns from July to late fall in airspace near the rotor zone of the proposed turbines, at an intermediate height, and near the ground; and (2) to document bat activity patterns in relation to weather factors, including wind speed and temperature.

Eight species of bats occur in Maine, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (BCI 2001). All eight bat species found in Maine are listed as species of Special Concern in Maine's Wildlife Action Plan due to the lack of information about the species in Maine and their apparent decline in recent years. Additionally, the eastern small-footed bat is listed as a Species of Greatest Conservation Need because only one hibernacula record and few summer records exist for the state of Maine. No known bat hibernacula exists in the vicinity of the Project area.

3.2 DATA COLLECTION METHODS

3.2.1 Acoustic Detector Site Selection

Anabat II and Anabat SDI detectors (Titley Electronics Pty Ltd.) were used for the duration of the fall 2009 acoustic bat survey. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of the species of bats that could occur in the Project area. Anabat II detectors were coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards; newer SD1 model detectors do not require use of a ZCAIM. Anabat detectors are frequency division detectors, dividing the frequency of echolocation sounds made by bats by a factor of 16, then recording these sounds for subsequent analysis. The audio sensitivity setting of each Anabat system was set between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33').

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unmodified Anabat unit.

Six detectors were deployed for the duration of the fall survey period (Figure 1-1). Two detectors were suspended in a met tower on Little Bull Hill and four detectors were deployed in trees on either end of the northern and southern Project area ridgelines. Detectors were mobilized on July 14 and operated until November 4 when they were demobilized. Each detector was programmed to record nightly from 7:00pm to 7:00am. Maintenance visits were conducted approximately every two weeks to check the condition of the detectors and to download data to a computer for analysis.

Detector Descriptions:

In order to record bats flying above and below the turbine rotor zone, "met detectors" were deployed at a height of 50 and 35 m. Both were attached to a fixed pulley system suspended in the guy wires of the Little Bull Hill Met Tower. Two guy lines were used to secure the detector in place and ensure the solar panel faced south. The tower clearing was approximately 50 m in diameter and the surrounding landscape was a relatively open forest canopy and understory with predominantly birch with a small component of spruce. No source of water or available snags was observed near the turbine clearing.

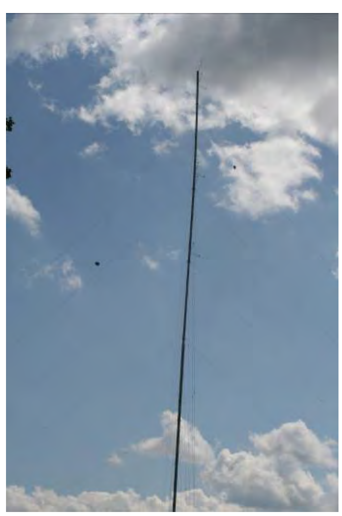


Photo 1 – Bull Hill Met Tower

The “NE Tree” detector was deployed at a height of 5 m high in a tree along the edge of a gravel logging road. The surrounding forest was a mix of hardwood and soft wood; birch was the dominant tree species. Undergrowth was a mix of raspberry and grasses. Logging trails perpendicular to the road were filled with slash left behind from recent a harvest. At least one snag was visible from the detector location. The surrounding forest canopy was predominantly young regenerating birch species and appeared to have been cut within the previous five year.

Photo 2 – NE Tree Detector

The “Radar Tree” detector was deployed in a tree at the end of a logging road that bisected a patch of young even-aged spruce. The detector was suspended over an old log landing filled with slash from a recent harvest. The logging road was heavily ditched on either side and standing water was frequently observed along the roadway. Several large snags were apparent from the detector location. The surrounding forest canopy was relatively open with very little ground clutter.

Photo 3 – Radar Tree Detector

The “SE Tree” detector was deployed at a height of approximately 3 m high in a tree along a logging road, at an intersection. The surrounding forest showed signs of recent harvest and was predominately red spruce, a small component of hardwood, and a few mature white pine throughout. The gravel logging roads were heavily ditched with signs of standing water along the roadway. A few large snags were visible from the detector location and an abandoned log landing filled with slash and planted in a mix of grasses was located a few hundred feet from the detector.

Photo 4 – SE Tree Detector

The “SW Tree” detector was suspended at a height of approximately 5 m high in a mature spruce along a gravel logging road at the edge of a log landing filled with slash. The surrounding forest was predominately red spruce with a small component of hardwood species and a relatively open forest canopy. The understory was a mix of raspberry and grasses. A few large snags were observed in the vicinity of the detector.

Photo 5 – SW Tree Detector

3.3 DATA ANALYSIS METHODS

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings with only one call were eliminated from analysis as has been done in similar studies (Arnett *et al*. 2006). Call sequences typically include a series of calls characteristic of normal flight or prey location ("search phase") and capture periods (feeding "buzzes").

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of bats that occur in the northeast. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al*. 2006), detection rates are summarized on both of these temporal scales. Nightly detection rates were summarized by month as well as for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al*. (2007). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would required much larger sample sizes (Arnett *et al*. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al*. 1999, O'Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[2] reflecting the bat community in the region of the Project area, as follows:

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz.

- **Myotis (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.

- **Eastern red bat/tri-colored bat[3] (RBTB)** – Eastern red bats and tri-colored 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.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

---

[2] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.
[3] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

3.3.1 Weather Data

Weather data was collected from the Little Bull Hill met tower for direct comparison with acoustic bat data. The mean, maximum, and minimum temperature, and wind speed were calculated for each night.

3.4 RESULTS

3.4.1 Timing of Activity

Detectors were deployed July 14 and continued to record data through November 4, for a total survey period of 634 detector nights. The range of dates that each detector was deployed is summarized in Table 3-1. Two incidents occurred during the fall survey to cause a lapse in data collection at two of the bat detectors. During demobilization, the met tower high detector became lodged in the guy wire system of the met tower and data was not retrieved. The missing acoustic data will be added to the fall data set when the met tower is dropped for regular maintenance. The second lapse in data was caused by theft of the SW Tree detector. The final download of the SW Tree detector was on October 15; missing data occurred from then until November 4. Few bat calls were recorded at other detectors from October 15 through November 4, indicating that few bat calls were likely missed by the malfunctioned or stolen detectors.

Activity levels at tree detectors peaked from late July to early August (Figure 3-1). Activity levels at the two met tower detectors peaked in early September (Figure 3-2). The four tree detectors recorded an overall detection rate of 10.8 bat call sequences per detector night during the fall season (Table 3-1). The overall detection rate for the two met tower detectors combined was 0.2 bat call sequences per detector night during the fall season (Table 3-1). Individual detector rates ranged from 0.1 to 15.0 bat call sequences per detector night. The highest monthly detection rate recorded at a tree detector was 37.4 bat call sequences per detector night during the month of July at the NE Tree detector. The highest monthly detection rate recorded at a met tower detector was recorded during September at the Met Tower Low detector, and was 0.6 bat call sequences per detector night. For all detectors combined, hourly bat activity was generally highest during the fifth hour after sunset, then declined until sunrise (Figure 3-3).

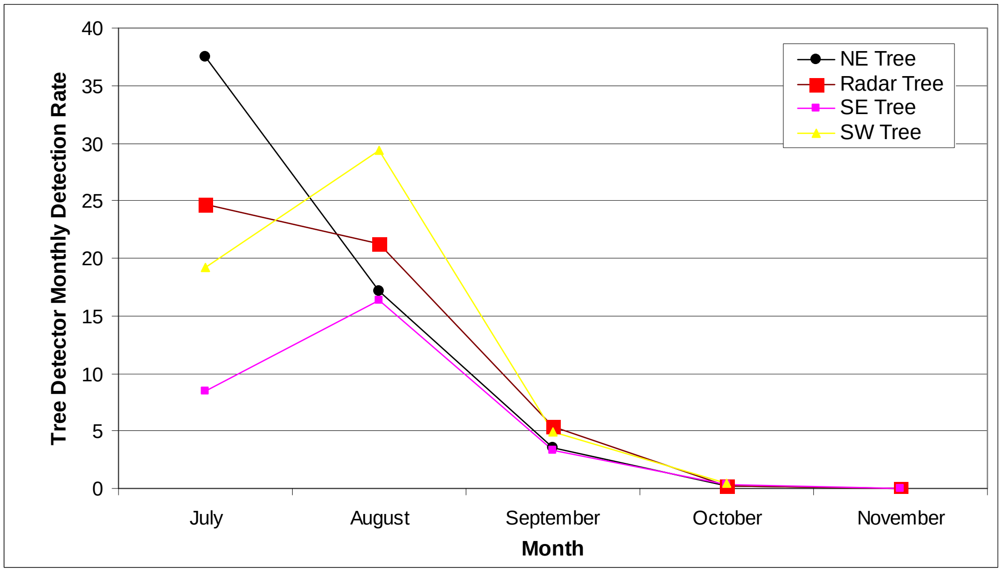


Figure 3-1. Monthly detection rates per detector at the tree detectors at Bull Hill, 2009

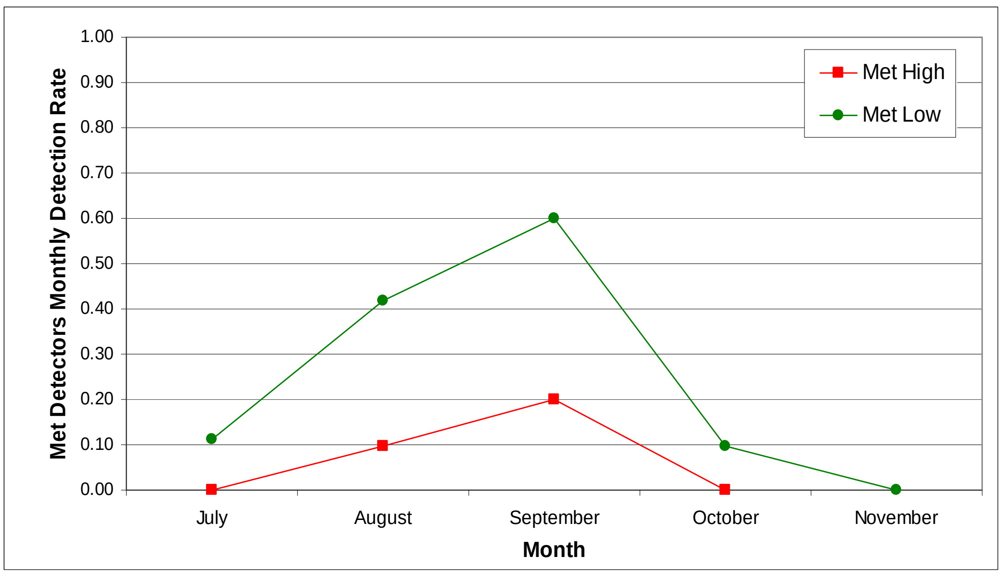


Figure 3-2. Monthly detection rates per detector at met tower detectors at Bull Hill, 2009

Table 3-1 Summary of bat detector field survey effort and results at Bull Hill, Summer-Fall, 2009						
Location	**Dates Deployed**	**Calendar Nights**	**Detector-Nights***	**Recorded Sequences**	**Detection Rate ****	**Maximum Sequences recorded *****
Met High	July 14 to Oct 15	94	94	9	0.1	3
Met Low	July 14 to Nov 4	114	114	36	0.3	6
NE Tree	July 14 to Nov 3	114	104	1164	11.2	223
Radar Tree	July 14 to Nov 4	114	114	1272	11.2	160
SE Tree	July 14 to Nov 4	114	114	767	6.7	47
SW Tree	July 14 to Oct 15	94	94	1409	15.0	73
Overall Met Results	--	***208***	***208***	***45***	***0.2***	--
Overall Tree Results	--	***436***	***426***	***4612***	***10.8***	--
* One detector-night is equal to a one detector successfully operating throughout the night.						
** Number of bat echolocation sequences recorded per detector-night.						
*** Maximum number of bat passes recorded from any single detector for a detector-night.						

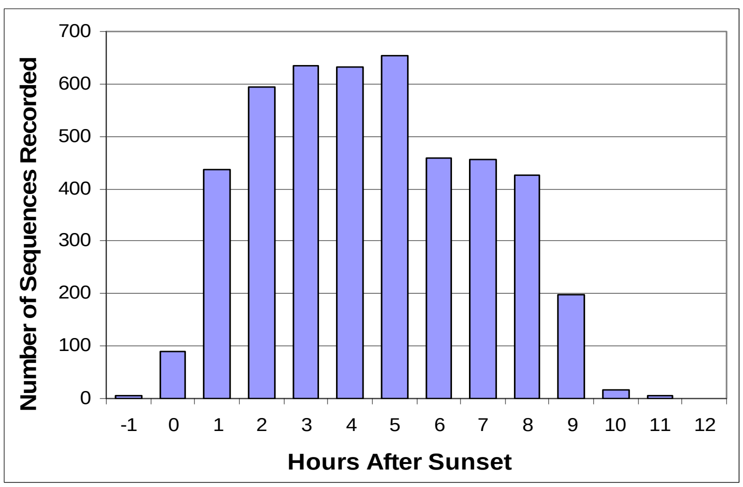


Figure 3-3. Hourly bat call sequence detections at the Bull Hill Wind Project.

3.4.2 Species Composition

The met tower detectors recorded similar ratios of the Big Brown-Silver Haired (n=10), Hoary Bat (n=9) and Myotis species (n=8) guilds (Table 3-2). However, the tree detectors recorded a higher divergence of species ratios. Myotis species (n=2,323) were the most frequently recorded bat call at the tree detectors followed by unknown species (n=1,614). The unknown species guild can be broken down into low-frequency and high-frequency calls (Figure 3-4).

Table 3-2 Distribution of detections by guild for detectors at Bull Hill, Summer-Fall, 2009						
Detector	**Guild**					**Total**
	BBSH	**HB**	**MYSP**	**RBTB**	**UNKN**	
Met High	1	4	1	1	2	9
Met Low	9	5	7	2	13	36
NE Tree	98	0	358	26	682	1,164
Radar Tree	354	0	547	35	336	1,272
SE Tree	69	5	483	33	177	767
SW Tree	25	6	935	24	419	1,409
Total Met Detectors	**10**	**9**	**8**	**3**	**15**	**45**
Total Tree Detectors	**546**	**11**	**2,323**	**118**	**1,614**	**4,612**
Met Detector Guild Composition %	**22.2%**	**20.0%**	**17.8%**	**6.7%**	**33.3%**	**--**
Tree Detector Guild Composition %	**11.8%**	**0.2%**	**50.4%**	**2.6%**	**35.0%**	**--**

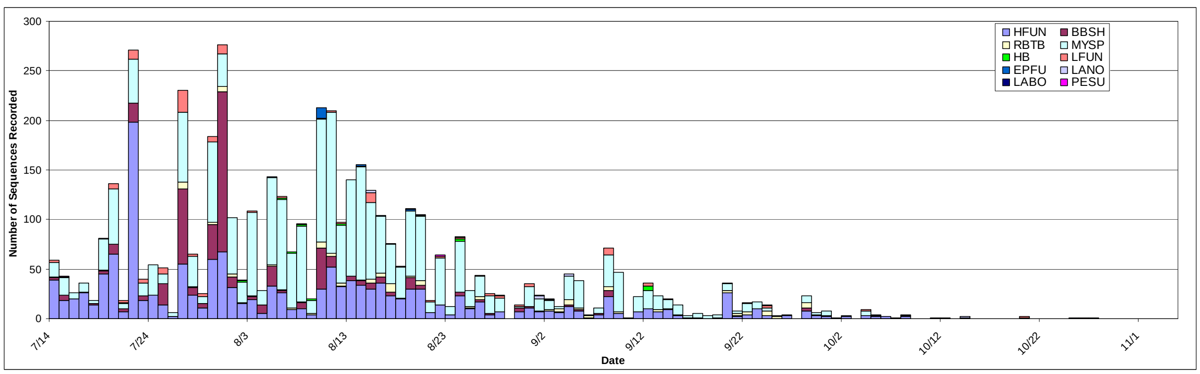


Figure 3-4. Total nightly bat call sequence detections at Bull Hill, 2009

Appendix B provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix B Tables 1 through 6 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Analook files for all 4,657 recorded call sequences can be made available upon request.

3.4.3 Activity and Weather

Mean nightly wind speeds in the Project area from July 14 to November 4 varied between 2.3 and 9.9 m/s, with an overall mean of 5.6 m/s (Figure 3-5). Mean nightly temperatures varied between -1.2 °C and 21.1 °C, with an overall mean of 11.9 °C (Figure 3-6). In general nightly activity levels were highest on nights when temperatures were warm and winds were relatively calm.

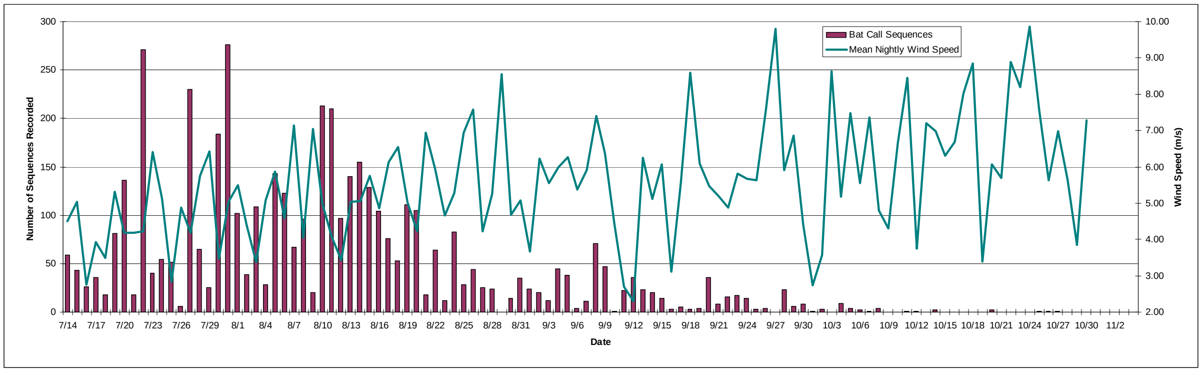


Figure 3-5. Nightly mean wind speed (m/s) (green line) and bat call detections at Bull Hill, 2009

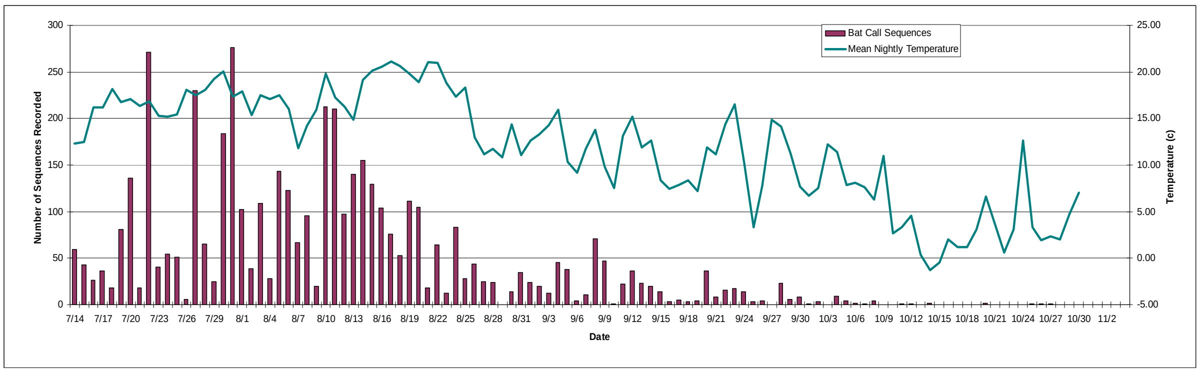


Figure 3-6. Nightly mean temperature (°Celsius) (green line) and bat detections at Bull Hill, 2009 (nightly maximum and minimum temperatures not available)

3.5 DISCUSSION

Bat activity was variable among detector heights and locations during the summer-fall 2009 migration season. However, some trends were observed. Call volumes varied month to month, although peaked early in the season (53% of call sequences were detected in August). Call volumes then declined through the month of September; during October, all detectors declined to a monthly average of less than 0.5 calls per detector night. The overall detection rate for the two met tower detectors was 0.2 call sequences per detector night, while the four tree detectors recorded and overall detection rate of 10.8 call sequences per detector night in October. Detection rates recorded at the Bull Hill Project area are consistent with pre-construction acoustic data from other proposed wind projects in similar landscapes in the northeast (Appendix B, Table 7). Furthermore detection rates recorded during the fall 2009 season at the Bull Hill Project are at the low end of the range found at other forested sites in the northeast (Appendix B, Table 7). The NE Tree detector recorded the highest average monthly detection rate of all six detectors during the month of July, 2009 (37.4 bat call sequences per night), the majority of which were from the HFUN guild. When considering the level of activity documented by acoustic surveys, the numbers of recorded bat call sequences cannot be directly correlated with the number of bats in an area because acoustic detectors do not allow for differentiation between individuals.

It is important to use caution when comparing detection rates across detectors and sites. Detector location and height can significantly affect detection rates. It is important to consider individual detector heights and habitats when making detection rate comparisons.

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat, have easily identifiable calls. Other species, such as the big brown bat and silver-haired bat, are difficult to distinguish acoustically. Similarly, certain members of the Myotis genus, such as the little brown bat, are far more common and have slightly more distinguishable calls than other species. A total of 2,331 Myotis call sequences (50.1% of total call sequences recorded) were detected at the Project in fall 2009. Both Myotis and RBTB calls fall within the range of the HFUN category and are often identified as such when less than five calls are recorded. During the fall 2009 season, Myotis calls were labeled to guild nineteen times more often than RBTB calls, which likely indicates that more of the HFUN calls were from the Myotis guild than the RBTB guild.

The RBTB guild includes the tri-colored bat and eastern red bat. 121 call sequences, 2.6 percent of total call sequences recorded by detectors during the fall survey, belonged to the RBTB guild. Of these calls, three were identified as eastern red bats and two as tri-colored bats. Eastern red bats have relatively unique calls which span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Tri-colored bats tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. Although both species do have distinct call characteristics their calls most often appear similar making differentiation difficult resulting in a RBTB classification.

The BBSH guild includes the big brown bat and silver-haired bat, both of which produce search-phase calls with minimum frequencies in the 25-30 kHz range. 556 call sequences from the BBSH guild composed 11.9 percent of all calls recorded during the fall 2009 survey period. Certain types of calls by each species are easily distinguishable from the other based on minimum frequency and call profile, but other calls in this range have overlapping characteristics and are difficult to distinguish. Sixteen of these calls were identified as big brown bats and twelve as silver-haired bats. One review of post construction mortality data from wind power sites in the eastern US found big brown mortality to occur less frequently than silver-haired bat mortality (Arnett et al, 2008).

The HB guild consists of the hoary bat, the largest bat species in the northeast. Only 20 (0.4%) call sequences recorded in the Project area belonged to the hoary bat. Hoary bat calls are generally distinguishable from all other species in the region and are characterized by highly variable minimum frequencies often extending below 20 kHz, and a hooked profile similar to the eastern red bat.

The height of a detector may determine the number of call sequences and the species composition it records; for example, long-distance migratory species are more likely to be recorded at detectors deployed above canopy height (Arnett et al. 2006). Detectors in and around canopy height likely detect foraging individuals passing by the detector multiple times, whereas much less concentrated foraging likely occurs within the recording zone of met tower detectors, possibly resulting in fewer foraging bats being recorded multiple times. Two of the six detectors deployed during the fall 2009 survey were above tree canopy height and recorded a higher percentage of migratory species, (e.g., big brown bats and silver-haired bats) than the four tree detectors, which detected more Myotis and HFUN call sequences. Detectors at higher altitudes may often record lower detection rates since bats aren't remaining in those areas for long periods of time.

Recent studies have found that bat activity patterns are influenced by weather conditions (Arnett *et al*. 2006, Arnett *et al*. 2008, Reynolds 2006). Acoustic surveys have documented a decrease in bat activity rates as wind speed increase and temperatures decrease, and bat activity has been shown to correlate negatively to low nightly mean temperatures (Hayes 1997, Reynolds 2006). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett *et al*. 2005). These patterns suggest that during the fall, bats are more likely to migrate on nights with low wind speeds (less than 4 to 6 m/s) and generally warm temperatures. Thus, several weather variables can individually affect bat activity, as does the interaction among variables (i.e., warm nights with low wind speeds). Met tower wind speed data collected at Little Bull Hill during the fall 2009 survey indicated that the nights with the highest amount of bat activity occurred when the mean nightly temperatures were near or above 15 °C and wind speeds below 5 m/s.

4.0 Diurnal Raptor Surveys

4.1 INTRODUCTION

The purpose of the fall raptor surveys is to document the species that occur in the vicinity of the Project and to record the specific flight heights, flight path locations, and other flight behaviors of raptors within the Project area. Survey methodology and level of effort were discussed before and during the spring raptor migration surveys. During this initial agency meeting, MDIFW indicated raptor surveys should note all bald eagle, northern harrier (*Circus cyaneus*) (special concern), great blue heron (*Ardea herodias*) (special concern), and osprey (*Pandion haliaetus*), activity, as these species are suspected to occur in the vicinity of the Project area.

In the eastern United States, raptor migration tends to concentrate along the shores of large bodies of water including lakes and the Atlantic Coast (Kellogg 2007) as well as along ridgelines, where raptors take advantage of updrafts which form along the side slopes of ridges. Updrafts allow raptors to fly long distances with minimal exertion (Berthold 2001). Raptors also use thermals, which are pockets of warm, rising air that form as the ground's surface is heated by the sun, in order to minimize energy expenditure during migration movements (Bildstein 2006). Thus, raptor surveys were conducted from prominent locations on ridges inside the proposed Project area.

4.2 METHODS

4.2.1 Field Surveys

The summer survey period was August 1 to August 27 and the fall migration survey period was September 2 to October 14. Field surveys were conducted on days with favorable raptor flight and observer visibility conditions. Days with significant precipitation or extensive fog were not sampled. During the fall migration period specifically, days following the passage of weather fronts bringing favorable weather, high atmospheric pressure, and northerly winds were targeted. Raptor migration is facilitated by tail winds (winds aligned with the preferred direction of travel), which "push" migrating raptors forward (Bildstein 2006); however, some raptors will fly in light or moderate headwinds. Therefore, days with southerly winds were also sampled as some raptors' flight behaviors differ in moderate to strong headwinds.

Field surveys were conducted from two locations in the summer—Sparrow Hill (also known as Beech Knoll) and Bull Hill. Fall surveys were conducted from a single location on top of Bull Hill (Figure 1-1). Sparrow Hill had views of the north shore of Molasses Pond. Bull Hill is located in the east-central portion of the Project area. Observation locations for both sites were positioned on ridge summits in areas with recent timber removal, allowing excellent views of nearby project ridges and, to a lesser extent, the heaths and ponds in the valley below.

Surveys methods were developed in consultation with MDIFW and USFWS and were largely based on Hawk Migration Association of North America (HMANA) methods (HMANA 2009).

Surveys were conducted from 9 am to 4 pm, during the peak hours of thermal development and raptor movement. During surveys, observers scanned the sky and surrounding landscape for raptors with binoculars or a spotting scope. Detailed observation and weather information were recorded on standardized datasheets, including:

- Observation date and time;
- Species, number of individuals, and age (if possible);
- If the raptor occurred within the Project area (as depicted in Figure 1-1);
- The flight positions of each bird in relation to topography of the area;
- The flight height (above ground) of each bird (within each different topographical flight position);
- The specific flight behaviors of each bird;
- The general flight direction of each bird;
- If the bird was actively migrating;
- Total amount of time the bird was observed flying under 145 m over a Project ridge, as well as other notes describing the general activity of each bird;
- Hourly weather observations, including wind speed and direction, temperature, sky conditions, percent cloud cover, and relative cloud height and type; and
- The flight paths of raptors observed were recorded on Project area maps.

Topographical flight positions were summarized into categories that describe the landscape surrounding the observation site (these positions apply to birds observed both within as well as outside the Project area: A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over slope of ridge, and D) flight path over a valley (see Figure 4-1 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

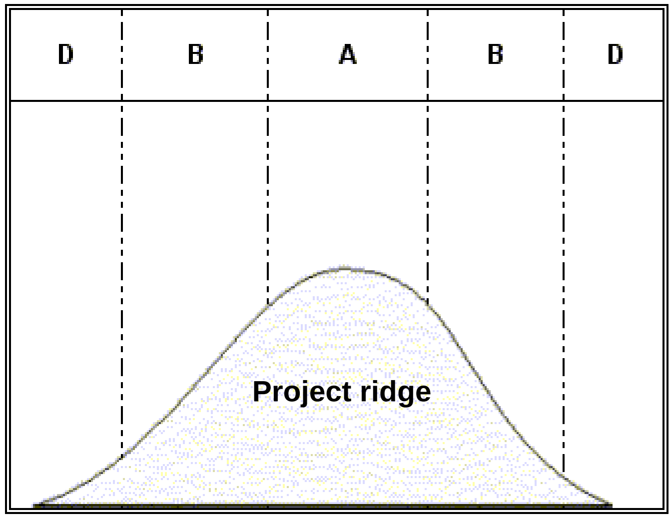


Figure 4-1. Raptor flight position categories in relation to the topography of the Project area and surrounding area.

Nearby objects with known heights, such as tree canopy, the met tower on Bull Hill, and the communication tower at Sparrow Hill, were each used to gauge flight height. Flight behaviors where categorized as: circle soaring, linear soaring (straight-line soaring or slow gliding in a 'thermal street' formed between updrafts), gliding (with wings partially closed and bent wrists), powered flight (flapping wings), banking (breaking with fully extended wings and tail fanned), diving (wings partially to mostly closed while in descent), kiting (using wind current to kite with partially closed wings and tail), hovering (maintaining a stationary altitude with some flapping and fanned tail while hunting and looking downward), aerial feeding (eating prey in flight while in a soar or slow glide), aerial hunting low over the ground, aerial display (territorial or courtship aerial display), or perched. These behaviors among others were used to describe birds as actively migrating or not-actively migrating.

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor. Priority was given to raptor observations; however, observers collected incidental data for other avian species observed including passerines and water birds.

4.2.2 Data Analysis

The raptor observation data was summarized separately for the summer and fall survey seasons. For each survey period, analysis included a summary of:

- The total number of individuals per species observed each survey day, and for the entire survey period;
- Daily passage rates (birds per hour) calculated for each survey day, as well as for the entire survey period;

- Hourly observation totals per species;
- The percentage of birds within each topographical flight position category;
- The average minimum flight height of birds within each topographical flight position category;
- The percentage of all birds that occurred within the Project area (as depicted in Figure 1-1);
- For all birds observed within the Project area, and within topographical positions where the turbines are to be located (A1, A2, A3, and B), flight heights were categorized as less than or greater than 145 m (476') above ground;
- The percentage of birds believed to be actively migrating; and
- A summary of the flight behaviors of all birds observed.

Observations made from the Bull Hill Project during the fall (migration) season were compared to fall 2009 data from HMANA hawk watch sites across New England and southern Canada (HMANA 2009). The hawk watch sites included for comparison are Cadillac Mountain, ME (approximately 26 miles from the Project); Greenlaw Mountain, NB; Harpswell Peninsula, ME; Pack Monodnock, NH; Pitcher Mountain, NH; and Putney Mountain, VT. Also provided for comparison of the fall migration surveys are the results of available regional fall surveys conducted at other proposed wind facilities in the northeast.

4.3 RESULTS

Summer surveys were conducted on six days (3 days at Bull Hill, 3 days at Sparrow Hill) from August 1 to August 27. Fall migration surveys were conducted on twelve survey days (all days at Bull Hill) from September 2 to October 14. Survey hours for each season totaled 46 and 87, respectively.

Surveys were generally conducted on clear days allowing for optimal visibility. However, for portions of some of the survey days, visibility was limited due to weather: fog reduced visibility for a few hours on August 26 and September 22, while rain showers reduced visibility the afternoon of August 11. Temperatures ranged from 4 to 30˚ Celsius (39 – 86 ˚F) during the survey period. Winds speed and direction was variable, without considerable difference between the survey seasons. Wind speeds under 9 mph (14 kph) occurred during 72 percent of observation hours and wind speeds in excess of 19 mph (31 kph) occurred during only 2 percent of observation hours. Wind direction during nine survey days was predominantly from the southwest; from the southeast during four survey days; from the northeast on one survey day; and from the northwest during four days. Similar numbers of birds were observed on days with headwinds and tailwinds.

Survey results are summarized in Table 4-1 and more detailed survey results are provided in Appendix C (Tables 3-7). No bald eagles were seen during summer habitat use surveys. A total of three bald eagles were observed during the fall migration survey period:

Table 4-1. Summary of raptor surveys conducted at the Bull Hill Wind Project in T16 MD, Maine, 2009

Summer Surveys	
Total number of raptors detected	24
Total number of raptor species detected	6
Total number of hours surveyed	46
Overall survey passage rate (birds/hour)	0.52
Total number of raptors detected in the Project area and below maximum turbine height (percent of total detections)	1 (4%)
Fall Migration Surveys	
Total number of raptors detected	124
Total number of raptor species detected	11
Total number of hours surveyed	87
Overall survey passage rate (birds/hour)	1.43
Total number of raptors detected in the Project area and below maximum turbine height (percent of total detections)	59 (98%)

During summer surveys, a total of 24 raptors were observed. Daily counts ranged from 2 to 6 raptors, and daily passage rates ranged from 0.25 to 0.86 birds/hour. Days with the highest raptor counts were August 13 (n=6) and August 26 (n=6) (Figure 4-2; Appendix B, Table 1). For the entire summer season, the observation rate was 0.52 birds/hour. Six[5] different species were observed (Figure 4-3; Appendix B, Table 2). There were no bald eagles observed during the summer surveys. No state listed species were observed during the summer. The majority of raptors observed in the summer were turkey vulture (*Cathartes aura*) (n=13; 11%) and red-tailed hawk (*Buteo jamaicensis;* n=6; 4.8 %).

During fall raptor migration surveys, a total of 124 raptors were observed. Daily counts ranged from 5 to 19 raptors, and daily passage rates ranged from 0.63 to 2.71 birds/hour. The highest count days in the fall occurred on September 22 (n=19) and October 12 (n=18) (Figure 4-2; Appendix B, Table 1). For the entire fall season, the observation rate was 1.43 birds/hour. Eleven different species were observed, not including 2 unidentified accipiters, 11 unidentified buteos, 1 unidentified falcon, and 3 unidentified raptors. The majority of raptors observed were sharp-shinned hawk (*Accipiter striatus*) (n=32; 26%) and turkey vulture (n=32; 26%). One state endangered species, peregrine falcon (*Falco peregrinus*), was observed in the Project area during the fall, as well as two state special concern species, bald eagle and northern harrier. For more information on the observations of special concern species, refer to Section 4.3.1.

[5] While turkey vultures (*Cathartes aura*) are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during hawk watch surveys.

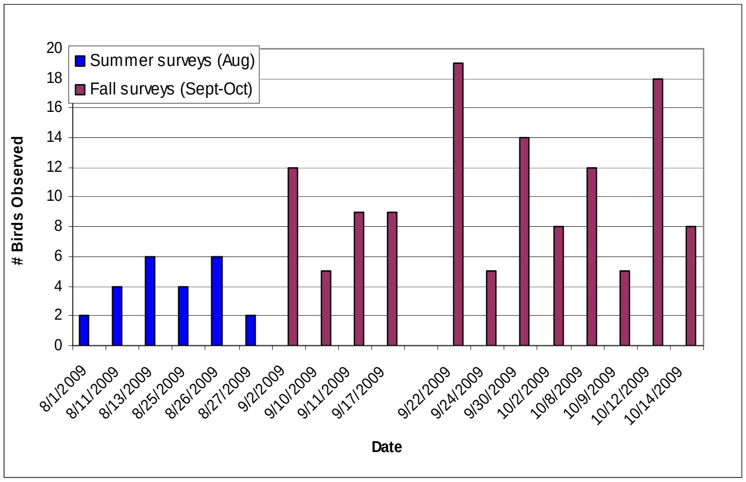


Figure 4-2. Total number of birds observed per survey day at Bull Hill, 2009

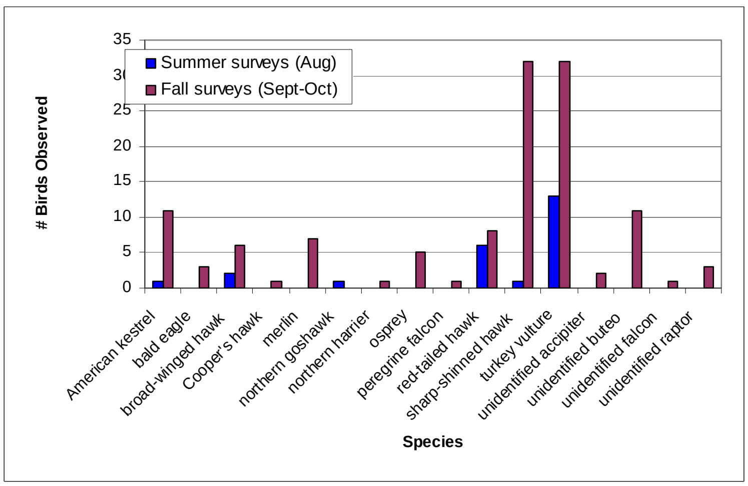


Figure 4-3. Number of individuals of species observed at Bull Hill, 2009

On a daily basis, the majority of observations occurred between 10:00 am and 12:00 pm during the initial period of thermal development for the day. The summer surveys show a clear peak in activity during this period, between 11:00 am and 12:00 pm, whereas the fall surveys have a more evenly distributed activity pattern throughout the day. Fall surveys have high activity mid-morning between 10:00 am and 12:00 pm and again in the afternoon between 1:00 pm and 4:00 pm (Figure 4-4; Appendix B, Table 2).

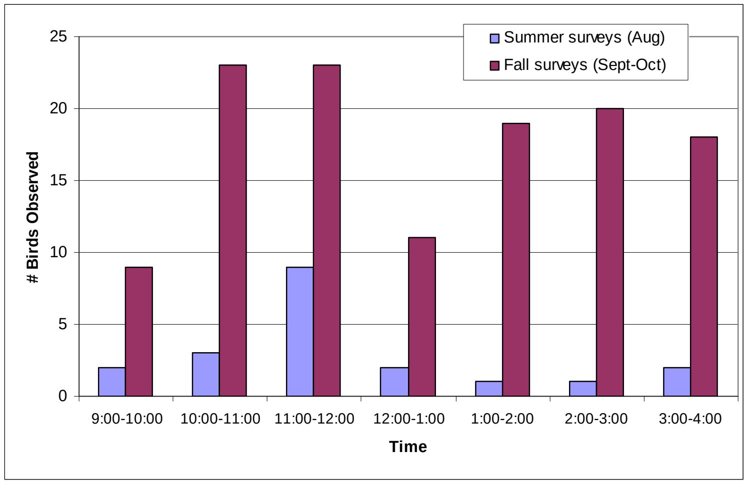


Figure 4-4. Number of individuals observed per survey hour at Bull Hill, 2009

Not all raptors observed during the survey seasons were observed moving through the proposed turbine areas (Project area), which is defined as horizontal position codes A1, A2, A3, and B on Bull Hill, Heifer Hill and Beech Knoll. Birds in flight position D (over the valley) were not considered within the Project area. During the summer, 4.2 percent (n=1) of all raptors seen were observed moving through the Project area. During the fall, 47.6 percent (n=59) of raptors were seen in the Project area.

One bird was observed passing over Project ridges in the summer, crossing the ridge (n=1; 100%) at a height of 100m. Of the birds passing over Project ridges in the fall, the highest percentage of birds either crossed ridges (n=65; 38%) or occurred along the slopes of ridges (n=50; 29%). Flight heights in these position categories averaged 40 and 43 meters, respectively (Table 4-2).

Table 4-2. Number of observations and average flight heights for each position category for birds observed at Bull Hill, 2009

		A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) slope	D) over valley[2]
summer	No. of position observations[1] (percent of total observations)	2 (6%)	8 (23%)	0 (0%)	21 (60%)	4 (11%)
summer	Average minimum flight height (m)	37.50	79.38	n/a	88.81	170.00
fall	No. of position observations[1]	13 (8%)	65 (38%)	6 (4%)	50 (29%)	37 (22%)
fall	Average minimum flight height (m)	11.85	39.85	36.67	43.30	68.92

[1] no. positions will be greater than no. individuals because many birds crossed multiple position categories
[2] this position category is considered outside of Project area

Those raptors observed in flight positions A1, A2, A3, and B and occurred below 145 m were categorized as flying below maximum turbine height. Of the 24 birds observed during the summer surveys, one red-tailed hawk, was observed within the Project area. (Table 4-3). The single bird flew below maximum turbine height for the duration of its observed flight. Sixty five of the 124 birds observed during fall surveys were only seen over the valley. Excluding these 65 birds, 59 birds (48%) were in the Project area and 58 (98%) were in the Project area and flew below maximum turbine height for at least a portion of their observed flight. During the fall raptor migration season, sharp-shinned hawk and American kestrel were the species most commonly observed flying below maximum turbine height (Table 4-3).

Table 4-3. Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A1, A2, A3, and B) above or below 145 m at Bull Hill 2009

	Summer habitat use surveys		Fall migration surveys	
Species	**145 m or greater**	**less than 145 m**	**145 m or greater**	**less than 145 m**
American kestrel	0	0	0	10
bald eagle	0	0	0	1
broad-winged hawk	0	0	0	3
Cooper's hawk	0	0	0	1
merlin	0	0	0	3
northern goshawk	0	0	0	0
northern harrier	0	0	1	0
osprey	0	0	0	1
peregrine falcon	0	0	0	1
red-tailed hawk	0	1	0	8
sharp-shinned hawk	0	0	0	21
turkey vulture	0	0	0	7
unidentified buteo	0	0	0	1
unidentified falcon	0	0	0	1
Grand Total:	**0**	**1**	**1**	**58**

The timing of the summer surveys overlapped with the beginning of fall migration. While many of the birds observed during the summer surveys were believed to be seasonally local, one broad-winged hawk (*Buteo platypterus*) was suspected to be actively migrating based on its flight behaviors and direction of travel. Fifty-three percent of birds during fall surveys were believed to be actively migrating. Turkey vulture and sharp-shinned hawk are among species observed in the fall which were suspected to be seasonally local.

The most common flight behaviors for raptors observed during fall surveys were linear soaring, circle soaring and powered flight, which is consistent with migrating birds. The behavior most commonly observed was linear soaring (n=61; 37%) followed by powered flight (n=59; 36%) (Figure 4-5; Appendix C Table 4). Behaviors for raptors observed during summer were more diverse, including more behaviors associated with foraging. All behaviors displayed by individual birds were recorded; therefore the number of behavioral observations exceeds the number of individuals observed.

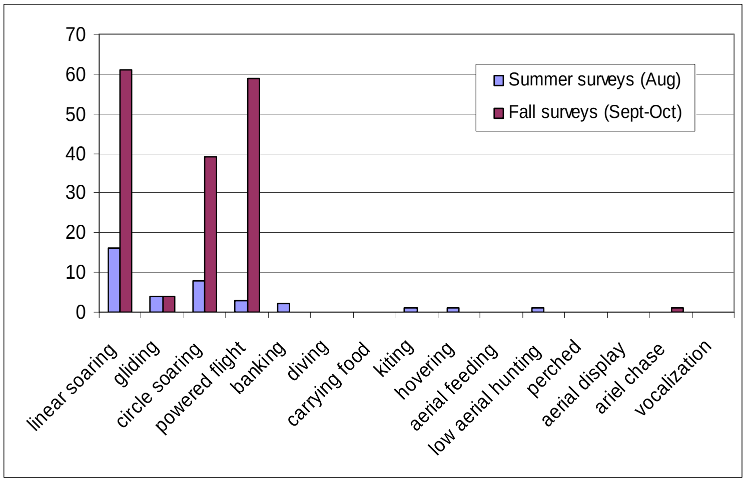


Figure 4-5. Number of observations of flight behaviors at Bull Hill, 2009

4.3.1 Rare, Threatened or Endangered Species

There were no state listed species observed during the summer surveys. In the fall one state endangered species, peregrine falcon, was observed in the Project area on October 9. The falcon was flying over tree canopy, approximately 15 m above ground, moving northwest over Bull Hill. Two state species of special concern were observed during the fall surveys—bald eagle and northern harrier. A total of three bald eagles were observed during the fall migration survey period: a sub-adult was seen on September 17 circling on a thermal (at 150 to 200 m) near Sparrow Hill, moving west; an adult was seen on October 2, outside of the Project area, circling at 70 m over the valley and moving northeast; and a sub-adult IV was seen crossing through the Project area over Bull Hill on October 14 at 30 m above ground level, moving north. A male northern harrier was observed crossing the Project area on September 17 flying at a height of 200 m.

4.3.2 Incidental Bird Observations

A total of 20 different non-raptor avian species of were observed incidentally during the summer and fall surveys. Table 4-4 lists the different species observed; none were water birds. Two incidental species that were observed in the Project area, American redstart (*Setophaga ruticilla*) and chestnut-sided warbler (*Dendroica pensylvanica*), are listed as state species of special concern.

Table 4-4. Incidental birds seen at Bull Hill, 2009	
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American redstart	*Setophaga ruticilla*
American robin	*Turdus migratorius*
American woodcock	*Scolopax minor*
Baltimore oriole	*Icterus galbula*
black-capped chickadee	*Poecile atricapilla*
blue jay	*Cyanocitta cristata*
black-throated green warbler	*Dendroica virens*
cedar waxwing	*Bombycilla cedrorum*
common raven	*Corvus corax*
chestnut-sided warbler	*Dendroica pensylvanica*
dark-eyed junco	*Junco hyemalis*
downy woodpecker	*Picoides pubescens*
hairy woodpecker	*Picoides villosus*
mourning dove	*Zenaida macroura*
northern flicker	*Colaptes auratus*
pileated woodpecker	*Dryocopus pileatus*
song sparrow	*Melospiza melodia*
white-throated sparrow	*Zonotrichia albicollis*

4.4 DISCUSSION

Summer Bald Eagle and Raptor Surveys

A primary goal of the summer surveys was to document the occurrence within, and use of, the Project area by bald eagle, and other raptor species, during the late-fledging period. Although bald eagles have historically nested in the area, and there was a non-breeding pair present at a nest site within three miles of the Project in 2009, there were no bald eagles, or other raptor species of conservation concern, observed during the summer surveys. Additionally, no osprey were observed during the summer survey despite the location of a nest roughly 2 kilometers west of Little Bull Hill on the transmission line.

The majority of birds observed during the summer survey period were suspected to be seasonally local to the area, with the exception of one migrant. The summer 2009 observation rate, 0.52 birds/hour, is not necessarily applicable to passage rates documented at HMANA or proposed wind facilities during the migration seasons. The summer observation rate likely included multiple observations of some of the same individual raptors that were seasonally local to the area. Conversely, while migration passage rates may include some observations of local birds, these rates predominantly consist of observations of migrants passing through the area.

Many of the observed flights during the summer season were believed to be associated with raptors traveling between foraging locations, and a few raptors were believed to be actively hunting in the area based on their behaviors. The majority of birds observed were not within the

Project area. The flight height of the single bird that flew within the Project area was below the proposed maximum rotor-swept zone. Relatively low flight heights would be expected during the summer as most flights observed likely involved small-scale, localized flights between foraging locations.

Fall Migration Surveys

The majority of birds observed during the fall surveys were suspected to be actively migrating based on flight behavior; however, 47 percent were suspected to be seasonally local to the Project area or stopping over in the area during migration. The fall passage rates at HMANA hawk watch sites in the region varied between 2.8 birds/hour (Harpswell Peninsula, Maine) and 18.4 birds/hour (Pitcher Mountain, ME), and was 10.78 birds/hour at Cadillac Mountain, roughly 26 miles from the Project (Appendix C, Table 5). The Bull Hill fall passage rate (1.4 birds/hour) is among the lower passage rates reported there. It should be noted that observers at HMANA sites typically do not count birds suspected to be local to the area while observers at Bull Hill included all raptors observed in the seasonal passage rate. Also available for comparison are the public results of fall surveys conducted at other proposed wind energy developments in the northeast. The seasonal passage rate recorded at Bull Hill is within the range of passage rates recorded for other publicly available sties in forested habitats in the northeast (Appendix C, Table 6).

There were three observations of bald eagle made during the fall surveys. One of these eagles occurred at locations within the Project area. The bald eagle observation rate within the Project area during fall surveys was low, 0.01 eagles/hour. The eagle observed within the Project area during fall was observed below the maximum turbine height of 145 m. Although the results of the 2009 summer and fall surveys indicate an infrequent occurrence of bald eagle within the Project area, bald eagles do occasionally occur within the Project area at heights below maximum turbine height. During the fall surveys, one state endangered species, peregrine falcon, was observed, as well as two state special concern species, bald eagle and northern harrier.

The majority of raptors observed during the fall surveys at Bull Hill were observed outside the Project area. Observer location within the Project area may have biased these results as birds closer to the observer may be more easily detected. The flight paths of raptors observed at Bull Hill varied between survey dates and were influenced by varying wind direction and weather. During raptor migration, flight pathways and flight heights along ridges, side slopes, and across valleys may vary seasonally, daily, or hourly. Raptors may shift and use different ridgelines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration paths as well as flight heights. Wind strongly affects the propensity of raptors to congregate along ‘leading lines’ or topographic features (Richardson 1998). Wind, air temperature, and cloud cover influence the development of updrafts and thermals used by raptors while making long-distance flights.

The range of the percent of flight heights below the maximum turbine height at other wind sites in the region is 9 to 82 percent; the percent of flights of birds within the Project area below turbine height at Bull Hill falls above the range of these results (Appendix C, Table 6). However, the reported range in flight heights at other projects likely includes birds flying anywhere in the observation area and not the Project area, only. In addition, variations in flight heights among sites, and among survey days at a single site are due to variable weather conditions and the particular flight behaviors of different raptor species. Typically, *accipiters* and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. *Buteos* tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors (*accipiters* in particular) typically fly lower than usual during windy or inclement conditions. Local birds may fly at lower altitudes while making small scale movements between foraging locations (Barrios and Rodriguez, 2004).

Despite generally low flight heights documented during raptor surveys in the region, studies have documented high raptor collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain et al. 2006). As most raptors are diurnal, raptors may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

Pre-construction raptor studies can provide baseline data regarding the species of raptor that occur and the general flight behaviors of birds traveling through the area. However, currently there is no clear relationship between pre-construction visual surveys and post-construction mortality data for the prediction of raptor collision risk at wind sites.

5.0 Literature Cited

Able, K.P. 1973. The role of weather variables and flight direction in determining the magnitude of nocturnal migration. Ecology 54(5):1031–1041.

Alerstam, T. 1978. Reoriented bird migration in coastal areas: Dispersal to suitable resting grounds? OIKOS 30: 405-408.

Alerstam, T. 1990. Bird Migration. Cambridge University Press, Cambridge, United Kingdom.

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.

Arnett, E. B., J. P. Hayes, and M. M. P. Huso. 2006. An evaluation of the use of acoustic monitoring to predict bat fatality at a proposed wind facility in south central Pennsylvania. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Takersley Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61-78.

Batschelet, E. 1965. Statistical Methods for the Analysis of Problems in Animal Orientation and Certain Biological Rhythms. AIBS Monograph. American Institute of Biological Sciences. Washington, DC.

Barrios, L. and A. Rodriguez. 2004. Behavioral and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81.

(BCI) Bat Conservation International. 2001. Bats in Eastern Woodlands. http://www.batcon.org/nabcp/newsite/forrep.pdf. Accessed on November 2007.

Berthold, P. 2001. Bird Migration. A General Survey. 2nd edn. Oxford: Oxford University Press.

Bildstein, K.L. 2006. Migrating Raptors of the World: Their Ecology and Conservation. Cornell University Press. Ithaca, NY.

Bingman, V.P., K.P. Able, and P. Kerlinger. 1982. Wind drift, compensation, and the use of landmarks by nocturnal bird migrants. Animal Behavior 30:49–53.

Bruderer, B. 1997. Migratory directions of birds under the influence of wind and topography. From the 1997 Spring Conference of the Royal Institute of Navigation, Oxford 21-23, April 1997.

Bruderer, B., and A. Boldt. 2001. Flight characteristics of birds: I. Radar measurements of speeds. Ibis. 143:178–204.

Chamberlain, D.E., M.R. Rehfisch, A.D. Fox, M. Desholm, and S.J. Anthony. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis: 148, pp. 198-202.

Cooper, B.A., R.H. Day, R.J. Ritchie, and C.L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 62(3):367-377.

Fortin, D., F. Liechti and B. Bruderer. 1999. Variation in the nocturnal flight behaviour of migratory birds along the northwest coast of the Mediterranean Sea. Ibis 141: 480-488.

Gannon, W.L., R.E. Sherwin, and S. Haywood. 2003. On the importance of articulating assumptions when conducting acoustic studies of habitat use by bats. Wild. Soc. Bull. 31 (1):45–61.

Gauthreaux, S.A., Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187–204.

Gauthreaux, S.A., Jr., and K.P. Able. 1970. Wind and the direction of nocturnal songbird migration. Nature 228:476–477.

Gawler, S.C. and A.R. Cutko. 2004. Natural Landscapes of Maine: A Classification of Vegetated Natural Communities and Ecosystems, Maine Natural Areas Program, Maine Department Of Conservation, Augusta, Maine.O'Farrell, M.J., and W.L. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. Journal of Mammalogy 80(1):24–30.

Hagstrum, J. 2000. Infrasound and the avian navigational map. The Journal of Experimental Biology 203: 1103-1111.

Harmata, A., K. Podruzny, J. Zelenak, and M. Morrison. 1999. Using marine surveillance radar to study bird movements and impact assessment. Wildlife Society Bulletin 27(1):44–52.

Hassler, S.S., R.R. Graber, and F.C. Bellrose. 1963. Fall migration and weather, a radar study. The Wilson Bulletin 75(1):56–77.

Hayes, J. P. 1997. Temporal variation in activity of bats and the design of echolocation-monitoring studies. Journal Of Mammalogy 78:514-524.

Hayes, J.P. 2000. Assumptions and practical considerations in the design and interpretation of echolocation-monitoring studies. Acta Chiropterologica 2(2):225-236.

(HMANA) Hawk Migration Association of North America [Internet]. 2009. Available at http://www.hmana.org/index.php

Kellogg, S (Ed.). 2007. Eastern Flyway Report: Eastern Continental Flyway. In Hawk Migration Studies (Vol. XXXIII, No. 1, pp.13). Hawk Migration Association of North America.

Kerlinger, P. 1995. How Birds Migrate. Stackpole Books. Mechanicsburg, PA.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, J.M. Szewczak. 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. Journal of Wildlife Management 71:2449-2486.

Larkin, R.P. 1991. Flight speeds observed with radar, a correction: slow “birds” are insects. Behavioral Ecology and Sociobiology. 29:221–224.

McMahon, J. S. 1990. The biophysical regions of Maine: patterns in the landscape and vegetation. M.S. Thesis, Univ. of Maine, Orono. 120 pp.

McMahon, J. 1998 (July). An Ecological Reserves System Inventory. Augusta, ME. ME State Planning Office. 122 pp.

O’Farrell, M.J., B.W. Miller, and W.L. Gannon. 1999. Qualitative identification of free-flying bats using the anabat detector. Journal of Mammalogy 80(1):11–23.

Reynolds, D. S. 2006. Monitoring the potential impacts of a wind development site on bats in the Northeast. Journal of Wildlife Management 70(5):1219 – 1227.

Richardson, W.J. 1972. Autumn migration and weather in eastern Canada: a radar study. American Birds 26(1):10–16.

Richardson, W.J. 1998. Bird migration and wind turbines: migration timing, flight behavior, and collision risk. Proceedings: National Avian-Wind Power Planning Meeting III, sponsored by Avian Workgroup of the National Wind Coordinating Committee, June 2000.

Stantec Consulting. 2009. Critical Issues Analysis Blue Sky East Wind Project, T 16 MD, Maine August 2009. Prepared for Blue Sky East, LLC.

Whitfield, D.P. and M. Madders. 2006. A review of the impacts of wind farms on hen harriers (*Circus cyaneus*) and an estimation of collision avoidance rates. Natural Research, LTD, Natural Research Information Note 1 (Revised).

Appendix A

Radar survey results

Appendix A Table 1. Survey dates, results, level of effort, and weather - Fall 2009

Date	Passage rate	Flight Direction	Flight Height (m)	% below 145 m	Hours of Survey	Temperature (C)	Wind Speed (m/s)	Wind Direction (degrees)
9/1	823	293	399	26%	11	12.63	3.68	281.284
9/2	503	337	208	45%	11	13.33	6.22	250.137
9/3	422	346	225	41%	11	14.31	5.55	215.355
9/8	1007	233	333	14%	10	13.81	7.41	300.754
9/9	871	272	334	19%	9	9.83	6.37	46.199
9/10	188	11	232	37%	11	7.51	4.42	155.014
9/11	536	320	230	33%	12	13.10	2.70	219.826
9/16	679	256	321	20%	12	7.46	3.11	28.726
9/17	191	358	318	21%	12	7.90	5.56	19.041
9/23	277	4	293	14%	11	16.55	5.81	203.333
9/24	1108	223	482	4%	11	10.23	5.68	321.913
9/28	521	318	240	30%	10	14.09	5.91	168.903
9/29	286	313	302	6%	12	11.20	6.87	174.808
9/30	331	247	247	29%	13	7.68	4.41	224.135
10/1	312	244	326	12%	12	6.68	2.73	261.606
10/5	751	235	449	12%	13	7.84	7.47	298.312
10/6	1500	272	413	15%	13	8.14	5.56	265.274
10/8	660	235	556	4%	13	6.33	4.81	319.545
10/14	762	250	558	7%	12	-1.26	6.98	310.5
10/15	594	247	531	7%	13	-0.43	6.31	330.021
Entire Season	**614**	**260**	**356**	**14%**	**11.6**	**9**	**5**	**264.116**

Stantec

Appendix A Table 2. Summary of passage rates by hour, night, and for entire season.																	
Night of	**Passage Rate (targets/km/hr) by hour after sunset**													**Entire Night**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Mean**	**Median**	**Stdev**	**SE**
9/01	461	1489	993	861	646	543	956	1013	929	934	225	N/A	N/A	823	929	339	102
9/02	404	926	1029	634	391	350	354	480	386	468	116	N/A	N/A	503	404	266	80
9/03	379	604	550	506	497	334	400	414	544	389	21	N/A	N/A	422	414	158	48
9/08	718	1913	1786	1139	1020	994	866	810	386	443	N/A	N/A	N/A	1007	930	505	160
9/09	421	1140	1184	1021	990	879	886	714	604	N/A	N/A	N/A	N/A	871	886	251	84
9/10	51	346	339	207	232	229	236	89	107	90	146	N/A	N/A	188	207	100	30
9/11	450	654	626	626	707	587	686	671	609	475	304	38	N/A	536	617	196	57
9/16	421	651	707	850	1111	1277	969	677	589	364	496	36	N/A	679	664	341	98
9/17	161	233	223	223	253	210	245	240	217	170	108	13	N/A	191	220	70	20
9/23	17	432	450	407	386	296	364	9	N/A	134	271	0	N/A	277	296	167	53
9/24	659	1246	1393	1429	1436	1214	1468	1568	1325	279	171	N/A	N/A	1108	1325	498	150
9/28	204	1021	1246	1000	611	543	189	64	154	N/A	N/A	179	N/A	521	373	433	137
9/29	114	596	768	518	382	407	264	113	118	39	51	57	N/A	286	191	245	71
9/30	240	700	939	480	177	354	339	630	268	90	26	57	0	331	268	287	80
10/01	56	213	523	529	414	313	307	399	329	364	132	167	N/A	312	321	148	43
10/05	175	525	1911	1911	1243	886	754	814	550	346	266	314	64	751	550	608	169
10/06	268	1779	1961	2507	1916	2018	2039	1068	1343	2161	1529	907	7	1500	1779	752	209
10/08	393	996	1461	1718	1018	496	482	557	546	386	329	112	86	660	496	497	138
10/14	161	689	982	975	1364	1368	1064	1079	532	300	318	307	N/A	762	832	432	125
10/15	489	714	818	868	714	796	793	700	493	550	432	229	121	594	700	233	65
Entire Season	**312**	**843**	**994**	**920**	**775**	**705**	**683**	**605**	**528**	**443**	**291**	**186**	**56**	**614**	**486**	**492**	**32**
	0 indicates no targets counted for that hour									N/A indicates no data for that hour							

Appendix A Table 3. Mean Nightly Flight Direction		
Night of	**Mean Flight Direction**	**Circular Stdev**
9/01	292.96	66.17
9/02	336.61	59.12
9/03	345.87	87.84
9/08	233.28	44.77
9/09	272.27	48.58
9/10	11.48	84.28
9/11	320.49	109.05
9/16	256.38	57.00
9/17	357.94	79.31
9/23	4.36	93.09
9/24	223.08	30.29
9/28	317.71	58.13
9/29	312.79	57.89
9/30	247.11	77.12
10/01	243.68	41.25
10/05	234.52	59.89
10/06	272.25	44.60
10/08	235.28	43.82
10/14	249.85	58.12
10/15	246.52	32.27
Entire Season	**259.90**	**65.53**

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season.

Night of	Mean Flight Height (m) by hour after sunset													Entire Night				% of targets below 145 meters
	1	2	3	4	5	6	7	8	9	10	11	12	13	Mean	Median	STDV	SE	
9/01	279	491	517	453	526	367	444	471	301	269	273	N/A	N/A	399	444	103	31	26%
9/02	190	189	183	221	206	217	192	173	196	255	266	N/A	N/A	208	196	30	9	45%
9/03	164	264	243	166	201	240	272	281	205	213	N/A	N/A	N/A	225	227	42	13	41%
9/08	287	385	404	346	338	370	337	317	287	257	N/A	N/A	N/A	333	337	47	15	14%
9/09	282	336	375	438	394	326	296	307	255	N/A	N/A	N/A	N/A	334	326	59	20	19%
9/10	166	340	327	300	179	274	150	236	253	169	152	N/A	N/A	232	236	72	22	37%
9/11	251	233	290	201	237	216	219	256	240	194	224	195	N/A	230	228	28	8	33%
9/16	269	260	269	350	380	384	350	328	339	292	273	355	N/A	321	333	46	13	20%
9/17	361	378	384	354	375	358	337	271	351	224	240	188	N/A	318	353	68	20	21%
9/23	433	290	228	303	282	306	267	281	N/A	291	248	N/A	N/A	293	286	55	17	14%
9/24	453	538	525	557	538	527	561	567	506	346	N/A	184	N/A	482	527	118	35	4%
9/28	219	225	266	235	254	231	263	269	N/A	N/A	N/A	194	N/A	240	235	25	8	30%
9/29	340	353	381	354	357	310	288	299	211	231	224	280	N/A	302	305	57	17	6%
9/30	175	199	222	314	262	261	350	207	183	234	306	--	--	247	234	57	17	29%
10/01	361	422	459	478	424	451	376	300	192	225	175	204	172	326	361	119	33	12%
10/05	253	521	500	438	557	570	605	546	549	519	441	205	140	449	519	152	42	12%
10/06	222	534	600	579	610	561	529	471	441	280	248	168	131	413	471	177	49	15%
10/08	398	438	452	483	524	701	661	644	672	667	617	569	401	556	569	112	31	4%
10/14	413	489	545	609	608	573	628	616	614	621	564	417	N/A	558	591	78	22	7%
10/15	368	517	628	628	630	635	575	521	550	523	485	498	342	531	523	95	26	7%
Entire Season	**294**	**370**	**390**	**390**	**394**	**394**	**385**	**368**	**353**	**323**	**316**	**288**	**237**	**356**	**327**	**143**	**9**	**14%**
-- indicates no targets counted for that hour														N/A indicates no data for that hour				

Appendix A Table 5. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities on Forested Ridge landscapes in the Northeast using X-band mobile radar systems (2004-present)

Year	Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Fall 2004										
2004	Sheffield, Caledonia Cty, VT	18	176	Forested ridge	91	19-320	200	566	(125 m) 1%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Fall 2005										
2005	Kibby, Franklin Cty, ME (Range 1)	12	101	Forested ridge	201	12-783	196	352	(125 m) 12%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2005	Stamford, Delaware Cty, NY	48	418	Forested ridge	315	22-784	251	494	(110 m) 3%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Kibby, Franklin Cty, ME (Valley)	5	13	Forested ridge	452	52-995	193	391	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2005	Mars Hill, Aroostook Cty, ME	18	117	Forested ridge	512	60-1092	228	424	(120 m) 8%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
2005	Deerfield, Bennington Cty, VT	32	324	Forested ridge	559	3-1736	221	395	(100 m) 13%	Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2005	Kibby, Franklin Cty, ME (Mountain)	12	115	Forested ridge	565	109-1107	167	370	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Fall 2006										
2006	Stetson, Washington Cty, ME	12	77	Forested ridge	476	131-1192	227	378	(125 m) 13%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Lempster, Sullivan Cty, NH	32	290	Forested ridge	620	133-1609	206	387	(125 m) 8%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Fall 2007										
2007	Errol, Coos County, NH	29	232	Forested ridge	366	54-1234	223	343	(125 m) 15%	Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
2007	Lincoln, Penobscot Cty, ME	22	231	Forested ridge	368	82-953	284	343	(120 m) 13%	Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
2007	Roxbury, Oxford Cty, ME	20	220	Forested ridge	420	88-1006	227	365	(130 m) 14%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
2007	Allegany, Cattaraugus Cty, NY	46	n/a	Forested ridge	451	n/a	230	382	(150 m) 14%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Fall 2008										
2008	Georgia Mountain, VT	21	n/a	Forested ridge	326	56-700	230	371	(120 m) 7%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind.
2008	Oakfield, Penobscot Cty, ME	20	n/a	Forested ridge	501	116-945	200	309	(125 m) 18%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Fall 2009										
2009	Bull Hill, Hancock Cty, ME	20	n/a	Forested ridge	614	188-1500	260	357	(175 m) 20%	*this report*

Appendix B

Bat survey results

Appendix B Table 1. Summary of acoustic bat data and weather during each survey night at the Met High detector – Fall, 2009

Night of	Operational?	BBSH			HB	MYSP	RBTB			UNKN			Total	Wind Speed (m/s)	Temperature (celsius)
		BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN			
07/14/09	1												**0**	4.49	12.35
07/15/09	1												**0**	5.03	12.44
07/16/09	1												**0**	2.75	16.16
07/17/09	1												**0**	3.93	16.18
07/18/09	1												**0**	3.49	18.18
07/19/09	1												**0**	5.31	16.74
07/20/09	1												**0**	4.18	17.10
07/21/09	1												**0**	4.18	16.36
07/22/09	1												**0**	4.23	16.81
07/23/09	1												**0**	6.40	15.28
07/24/09	1												**0**	5.11	15.20
07/25/09	1												**0**	2.84	15.43
07/26/09	1												**0**	4.88	18.07
07/27/09	1												**0**	4.19	17.48
07/28/09	1												**0**	5.76	18.09
07/29/09	1												**0**	6.42	19.22
07/30/09	1												**0**	3.47	20.03
07/31/09	1												**0**	5.04	17.33
08/01/09	1												**0**	5.48	17.94
08/02/09	1												**0**	4.41	15.32
08/03/09	1												**0**	3.36	17.52
08/04/09	1												**0**	5.08	17.09
08/05/09	1												**0**	5.87	17.48
08/06/09	1												**0**	4.58	15.98
08/07/09	1												**0**	7.14	11.78
08/08/09	1												**0**	4.05	14.23
08/09/09	1												**0**	7.04	15.96
08/10/09	1		1										**1**	4.98	19.78
08/11/09	1												**0**	4.07	17.24
08/12/09	1												**0**	3.42	16.29
08/13/09	1												**0**	5.04	14.89
08/14/09	1												**0**	5.06	19.18
08/15/09	1												**0**	5.75	20.13
08/16/09	1												**0**	4.86	20.58
08/17/09	1												**0**	6.13	21.10
08/18/09	1												**0**	6.54	20.60
08/19/09	1												**0**	5.03	19.79
08/20/09	1				1								**1**	4.22	18.90
08/21/09	1												**0**	6.94	21.04
08/22/09	1												**0**	5.93	20.94
08/23/09	1												**0**	4.66	18.80
08/24/09	1				1								**1**	5.28	17.37
08/25/09	1												**0**	6.94	18.33
08/26/09	1												**0**	7.57	12.96
08/27/09	1												**0**	4.22	11.18
08/28/09	1												**0**	5.25	11.73
08/29/09	1												**0**	8.56	10.80
08/30/09	1												**0**	4.69	14.33
08/31/09	1												**0**	5.08	11.04
09/01/09	1												**0**	3.68	12.63
09/02/09	1												**0**	6.22	13.33
09/03/09	1												**0**	5.55	14.31
09/04/09	1												**0**	6.00	15.91
09/05/09	1												**0**	6.28	10.34
09/06/09	1												**0**	5.37	9.19
09/07/09	1												**0**	5.91	11.70
09/08/09	1												**0**	7.41	13.81
09/09/09	1												**0**	6.37	9.83
09/10/09	1												**0**	4.42	7.51
09/11/09	1												**0**	2.70	13.10
09/12/09	1				2						1		**3**	2.30	15.23
09/13/09	1												**0**	6.25	11.89
09/14/09	1												**0**	5.12	12.64
09/15/09	1												**0**	6.08	8.39
09/16/09	1												**0**	3.11	7.46
09/17/09	1												**0**	5.56	7.90
09/18/09	1												**0**	8.60	8.38
09/19/09	1												**0**	6.08	7.24
09/20/09	1										1		**1**	5.47	11.92
09/21/09	1					1							**1**	5.19	11.18
09/22/09	1												**0**	4.88	14.36
09/23/09	1												**0**	5.81	16.55
09/24/09	1						1						**1**	5.68	10.23

(*continued*)

Appendix B Table 1 (cont.)															
09/25/09	1												**0**	5.63	3.31
09/26/09	1												**0**	7.58	7.80
09/27/09	1												**0**	9.80	14.87
09/28/09	1												**0**	5.91	14.09
09/29/09	1												**0**	6.87	11.20
09/30/09	1												**0**	4.41	7.68
10/01/09	1												**0**	2.73	6.68
10/02/09	1												**0**	3.56	7.53
10/03/09	1												**0**	8.64	12.25
10/04/09	1												**0**	5.17	11.37
10/05/09	1												**0**	7.47	7.84
10/06/09	1												**0**	5.56	8.14
10/07/09	1												**0**	7.36	7.58
10/08/09	1												**0**	4.81	6.33
10/09/09	1												**0**	4.31	10.96
10/10/09	1												**0**	6.65	2.65
10/11/09	1												**0**	8.45	3.36
10/12/09	1												**0**	3.75	4.52
10/13/09	1												**0**	7.20	0.32
10/14/09	1												**0**	6.98	-1.26
10/15/09	1												**0**	6.31	-0.43
By Species		**0**	**1**	**0**	**4**	**1**	**1**	**0**	**0**	**0**	**2**	**0**	**9**		
By Guild		**1**			**4**	**1**	**1**			**2**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Appendix B Table 2. Summary of acoustic bat data and weather during each survey night at the Met Low detector – Fall, 2009

Night of	Operational?	BBSH			HB	MYSP	RBTB			UNKN			Total	Wind Speed (m/s)	Temperature (celsius)
		BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN			
07/14/09	1					1							**1**	4.49	12.35
07/15/09	1												**0**	5.03	12.44
07/16/09	1												**0**	2.75	16.16
07/17/09	1												**0**	3.93	16.18
07/18/09	1												**0**	3.49	18.18
07/19/09	1												**0**	5.31	16.74
07/20/09	1												**0**	4.18	17.10
07/21/09	1												**0**	4.18	16.36
07/22/09	1					1							**1**	4.23	16.81
07/23/09	1												**0**	6.40	15.28
07/24/09	1												**0**	5.11	15.20
07/25/09	1												**0**	2.84	15.43
07/26/09	1												**0**	4.88	18.07
07/27/09	1												**0**	4.19	17.48
07/28/09	1												**0**	5.76	18.09
07/29/09	1												**0**	6.42	19.22
07/30/09	1												**0**	3.47	20.03
07/31/09	1												**0**	5.04	17.33
08/01/09	1												**0**	5.48	17.94
08/02/09	1												**0**	4.41	15.32
08/03/09	1												**0**	3.36	17.52
08/04/09	1												**0**	5.08	17.09
08/05/09	1												**0**	5.87	17.48
08/06/09	1												**0**	4.58	15.98
08/07/09	1												**0**	7.14	11.78
08/08/09	1												**0**	4.05	14.23
08/09/09	1												**0**	7.04	15.96
08/10/09	1												**0**	4.98	19.78
08/11/09	1												**0**	4.07	17.24
08/12/09	1				1								**1**	3.42	16.29
08/13/09	1												**0**	5.04	14.89
08/14/09	1												**0**	5.06	19.18
08/15/09	1												**0**	5.75	20.13
08/16/09	1												**0**	4.86	20.58
08/17/09	1												**0**	6.13	21.10
08/18/09	1	1											**1**	6.54	20.60
08/19/09	1	2		1									**3**	5.03	19.79
08/20/09	1	1											**1**	4.22	18.90
08/21/09	1												**0**	6.94	21.04
08/22/09	1												**0**	5.93	20.94
08/23/09	1												**0**	4.66	18.80
08/24/09	1			1	1						2		**4**	5.28	17.37
08/25/09	1	1											**1**	6.94	18.33
08/26/09	1												**0**	7.57	12.96
08/27/09	1												**0**	4.22	11.18
08/28/09	1			1							1		**2**	5.25	11.73
08/29/09	1												**0**	8.56	10.80
08/30/09	1												**0**	4.69	14.33
08/31/09	1												**0**	5.08	11.04
09/01/09	1												**0**	3.68	12.63
09/02/09	1												**0**	6.22	13.33
09/03/09	1								1				**1**	5.55	14.31
09/04/09	1					1							**1**	6.00	15.91
09/05/09	1												**0**	6.28	10.34
09/06/09	1												**0**	5.37	9.19
09/07/09	1												**0**	5.91	11.70
09/08/09	1					1							**1**	7.41	13.81
09/09/09	1												**0**	6.37	9.83
09/10/09	1												**0**	4.42	7.51
09/11/09	1									1			**1**	2.70	13.10
09/12/09	1				3					1	2		**6**	2.30	15.23
09/13/09	1									1			**1**	6.25	11.89
09/14/09	1												**0**	5.12	12.64
09/15/09	1												**0**	6.08	8.39
09/16/09	1												**0**	3.11	7.46
09/17/09	1												**0**	5.56	7.90
09/18/09	1												**0**	8.60	8.38
09/19/09	1												**0**	6.08	7.24
09/20/09	1					2							**2**	5.47	11.92
09/21/09	1												**0**	5.19	11.18
09/22/09	1												**0**	4.88	14.36
09/23/09	1					1				1			**2**	5.81	16.55
09/24/09	1										2		**2**	5.68	10.23
09/25/09	1												**0**	5.63	3.31

(*continued*)

Appendix B Table 2 (cont.)

09/26/09	1												**0**	7.58	7.80
09/27/09	1												**0**	9.80	14.87
09/28/09	1	1											**1**	5.91	14.09
09/29/09	1												**0**	6.87	11.20
09/30/09	1												**0**	4.41	7.68
10/01/09	1												**0**	2.73	6.68
10/02/09	1												**0**	3.56	7.53
10/03/09	1												**0**	8.64	12.25
10/04/09	1												**0**	5.17	11.37
10/05/09	1									1			**1**	7.47	7.84
10/06/09	1												**0**	5.56	8.14
10/07/09	1								1				**1**	7.36	7.58
10/08/09	1												**0**	4.81	6.33
10/09/09	1												**0**	4.31	10.96
10/10/09	1												**0**	6.65	2.65
10/11/09	1												**0**	8.45	3.36
10/12/09	1												**0**	3.75	4.52
10/13/09	1												**0**	7.20	0.32
10/14/09	1												**0**	6.98	-1.26
10/15/09	1												**0**	6.31	-0.43
10/16/09	1												**0**	6.69	2.04
10/17/09	1												**0**	8.01	1.14
10/18/09	1												**0**	8.85	1.21
10/19/09	1												**0**	3.39	3.09
10/20/09	1												**0**	6.06	6.59
10/21/09	1												**0**	5.69	3.70
10/22/09	1												**0**	8.88	0.57
10/23/09	1												**0**	8.19	3.09
10/24/09	1												**0**	9.87	12.64
10/25/09	1												**0**	7.56	3.35
10/26/09	1										1		**1**	5.64	1.89
10/27/09	1												**0**	6.99	2.37
10/28/09	1												**0**	5.64	2.04
10/29/09	1												**0**	3.85	4.75
10/30/09	1												**0**	7.28	7.02
10/31/09	1												**0**		
11/01/09	1												**0**		
11/02/09	1												**0**		
11/03/09	1												**0**		
11/04/09	1												**0**		
By Species		**6**	**0**	**3**	**5**	**7**	**0**	**0**	**2**	**5**	**8**	**0**	**36**		
By Guild		**9**			**5**	**7**	**2**			**13**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Appendix B Table 3. Summary of acoustic bat data and weather during each survey night at the NE Tree detector – Fall, 2009

Night of	Operational?	BBSH			HB	MYSP	RBTB			UNKN			Total	Wind Speed (m/s)	Temperature (celsius)
		BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN			
07/14/09	1	2				2			1	30	1		**36**	4.49	12.35
07/15/09	1							1		6			**7**	5.03	12.44
07/16/09	1					1				10			**11**	2.75	16.16
07/17/09	1									4			**4**	3.93	16.18
07/18/09	1									6			**6**	3.49	18.18
07/19/09	1	2				3				29			**34**	5.31	16.74
07/20/09	1	10				36				48	5		**99**	4.18	17.10
07/21/09	1									3			**3**	4.18	16.36
07/22/09	1	18				28				168	9		**223**	4.23	16.81
07/23/09	1	5				1				7	2		**15**	6.40	15.28
07/24/09	1					4				19			**23**	5.11	15.20
07/25/09	1	12				3				10	5		**30**	2.84	15.43
07/26/09	1												**0**	4.88	18.07
07/27/09	1	1				6			1	33	9		**50**	4.19	17.48
07/28/09	1					3				10	2		**15**	5.76	18.09
07/29/09	1									5	2		**7**	6.42	19.22
07/30/09	1	10				2				18	5		**35**	3.47	20.03
07/31/09	1	23				2				46	5		**76**	5.04	17.33
08/01/09	1	2				5				9			**16**	5.48	17.94
08/02/09	1								1	4	1		**6**	4.41	15.32
08/03/09	0												**0**	3.36	17.52
08/04/09	0												**0**	5.08	17.09
08/05/09	0												**0**	5.87	17.48
08/06/09	0												**0**	4.58	15.98
08/07/09	0												**0**	7.14	11.78
08/08/09	0												**0**	4.05	14.23
08/09/09	0												**0**	7.04	15.96
08/10/09	0												**0**	4.98	19.78
08/11/09	0												**0**	4.07	17.24
08/12/09	1					24			2	9			**35**	3.42	16.29
08/13/09	1					30				19			**49**	5.04	14.89
08/14/09	1					37				8			**45**	5.06	19.18
08/15/09	1	2				22			2	9	1		**36**	5.75	20.13
08/16/09	1	1				18			3	12			**34**	4.86	20.58
08/17/09	1	2				6			5	3			**16**	6.13	21.10
08/18/09	1					3				8			**11**	6.54	20.60
08/19/09	1	2				7			2	9			**20**	5.03	19.79
08/20/09	1	1				13			4	11			**29**	4.22	18.90
08/21/09	1					2				1			**3**	6.94	21.04
08/22/09	1					5				2	2		**9**	5.93	20.94
08/23/09	1									2			**2**	4.66	18.80
08/24/09	1	1				11				8			**20**	5.28	17.37
08/25/09	1					3				2			**5**	6.94	18.33
08/26/09	1					5			1	9			**15**	7.57	12.96
08/27/09	1					3				2	1		**6**	4.22	11.18
08/28/09	1					7				3			**10**	5.25	11.73
08/29/09	1												**0**	8.56	10.80
08/30/09	1	1				1				4			**6**	4.69	14.33
08/31/09	1	1				1				2			**4**	5.08	11.04
09/01/09	1					6				1			**7**	3.68	12.63
09/02/09	1		1			4				4			**9**	6.22	13.33
09/03/09	1					2							**2**	5.55	14.31
09/04/09	1					6				2			**8**	6.00	15.91
09/05/09	1					1				2			**3**	6.28	10.34
09/06/09	1					1			2	1			**4**	5.37	9.19
09/07/09	1					3				2			**5**	5.91	11.70
09/08/09	1					3				5			**8**	7.41	13.81
09/09/09	1					2							**2**	6.37	9.83
09/10/09	1												**0**	4.42	7.51
09/11/09	1					9							**9**	2.70	13.10
09/12/09	1					7							**7**	2.30	15.23
09/13/09	1												**0**	6.25	11.89
09/14/09	1					8				3			**11**	5.12	12.64
09/15/09	1												**0**	6.08	8.39
09/16/09	1												**0**	3.11	7.46
09/17/09	1					2							**2**	5.56	7.90
09/18/09	1												**0**	8.60	8.38
09/19/09	1												**0**	6.08	7.24
09/20/09	1					5				19			**24**	5.47	11.92
09/21/09	1												**0**	5.19	11.18
09/22/09	1												**0**	4.88	14.36
09/23/09	1					1				1			**2**	5.81	16.55
09/24/09	1												**0**	5.68	10.23
09/25/09	1												**0**	5.63	3.31

(*continued*)

Appendix B Table 3 (cont.)

09/26/09	1												**0**	7.58	7.80
09/27/09	1												**0**	9.80	14.87
09/28/09	1	1								1			**2**	5.91	14.09
09/29/09	1												**0**	6.87	11.20
09/30/09	1					2							**2**	4.41	7.68
10/01/09	1												**0**	2.73	6.68
10/02/09	1												**0**	3.56	7.53
10/03/09	1												**0**	8.64	12.25
10/04/09	1									1			**1**	5.17	11.37
10/05/09	1					1	1			1			**3**	7.47	7.84
10/06/09	1												**0**	5.56	8.14
10/07/09	1												**0**	7.36	7.58
10/08/09	1									1			**1**	4.81	6.33
10/09/09	1												**0**	4.31	10.96
10/10/09	1												**0**	6.65	2.65
10/11/09	1												**0**	8.45	3.36
10/12/09	1												**0**	3.75	4.52
10/13/09	1												**0**	7.20	0.32
10/14/09	1												**0**	6.98	-1.26
10/15/09	1												**0**	6.31	-0.43
10/16/09	1												**0**	6.69	2.04
10/17/09	1												**0**	8.01	1.14
10/18/09	1												**0**	8.85	1.21
10/19/09	1												**0**	3.39	3.09
10/20/09	1					1							**1**	6.06	6.59
10/21/09	1												**0**	5.69	3.70
10/22/09	1												**0**	8.88	0.57
10/23/09	1												**0**	8.19	3.09
10/24/09	1												**0**	9.87	12.64
10/25/09	1												**0**	7.56	3.35
10/26/09	1												**0**	5.64	1.89
10/27/09	1												**0**	6.99	2.37
10/28/09	1												**0**	5.64	2.04
10/29/09	1												**0**	3.85	4.75
10/30/09	1												**0**	7.28	7.02
10/31/09	1												**0**		
11/01/09	1												**0**		
11/02/09	1												**0**		
11/03/09	1												**0**		
By Species		**97**	**1**	**0**	**0**	**358**	**1**	**1**	**24**	**632**	**50**	**0**	**1164**		
By Guild		**98**			**0**	**358**	**26**			**682**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Appendix B Table 4. Summary of acoustic bat data and weather during each survey night at the Radar Tree detector – Fall, 2009

Night of	Operational?	BBSH			HB	MYSP	RBTB			UNKN			Total	Wind Speed (m/s)	Temperature (celsius)
		BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN			
07/14/09	1					1				1			**2**	4.49	12.35
07/15/09	1									11			**11**	5.03	12.44
07/16/09	1												**0**	2.75	16.16
07/17/09	1												**0**	3.93	16.18
07/18/09	1									1			**1**	3.49	18.18
07/19/09	1									4			**4**	5.31	16.74
07/20/09	1									2			**2**	4.18	17.10
07/21/09	1												**0**	4.18	16.36
07/22/09	1									22			**22**	4.23	16.81
07/23/09	1					1				6			**7**	6.40	15.28
07/24/09	1					6							**6**	5.11	15.20
07/25/09	1	9				2				2	1		**14**	2.84	15.43
07/26/09	1									1			**1**	4.88	18.07
07/27/09	1	74				38			2	9	13		**136**	4.19	17.48
07/28/09	1	6				10			1	4			**21**	5.76	18.09
07/29/09	1	3				2					1		**6**	6.42	19.22
07/30/09	1	22				14			1	13	1		**51**	3.47	20.03
07/31/09	1	139				9				8	4		**160**	5.04	17.33
08/01/09	1	6				6			1	8			**21**	5.48	17.94
08/02/09	1					1				2			**3**	4.41	15.32
08/03/09	1	1				19				6			**26**	3.36	17.52
08/04/09	1	6				3							**9**	5.08	17.09
08/05/09	1	15				22				12			**49**	5.87	17.48
08/06/09	1	1				10				11			**22**	4.58	15.98
08/07/09	1					11				4			**15**	7.14	11.78
08/08/09	1	5				12			1	3			**21**	4.05	14.23
08/09/09	1					1			1	2			**4**	7.04	15.96
08/10/09	1	38	9			45			3	13	1		**109**	4.98	19.78
08/11/09	1	5				80			1	31	1		**118**	4.07	17.24
08/12/09	1					8				11			**19**	3.42	16.29
08/13/09	1	1				11				7			**19**	5.04	14.89
08/14/09	1					23				12			**35**	5.06	19.18
08/15/09	1	1		2		20				6	9		**38**	5.75	20.13
08/16/09	1					11				5			**16**	4.86	20.58
08/17/09	1					3				6	1		**10**	6.13	21.10
08/18/09	1					8				2	1		**11**	6.54	20.60
08/19/09	1					19				7			**26**	5.03	19.79
08/20/09	1	1				9				3			**13**	4.22	18.90
08/21/09	1					1				1	1		**3**	6.94	21.04
08/22/09	1					4		1		2			**7**	5.93	20.94
08/23/09	1					4				1			**5**	4.66	18.80
08/24/09	1	1				11				4			**16**	5.28	17.37
08/25/09	1					3				1			**4**	6.94	18.33
08/26/09	1	1				3				1			**5**	7.57	12.96
08/27/09	1	1				3				1			**5**	4.22	11.18
08/28/09	1					3				2	1		**6**	5.25	11.73
08/29/09	1												**0**	8.56	10.80
08/30/09	1	1											**1**	4.69	14.33
08/31/09	1					15				6	1		**22**	5.08	11.04
09/01/09	1					1				2			**3**	3.68	12.63
09/02/09	1												**0**	6.22	13.33
09/03/09	1												**0**	5.55	14.31
09/04/09	1					5			5	2			**12**	6.00	15.91
09/05/09	1					16			1	1			**18**	6.28	10.34
09/06/09	1												**0**	5.37	9.19
09/07/09	1												**0**	5.91	11.70
09/08/09	1	5				5			3	4	7		**24**	7.41	13.81
09/09/09	1					36			2	4			**42**	6.37	9.83
09/10/09	1												**0**	4.42	7.51
09/11/09	1					3							**3**	2.70	13.10
09/12/09	1					2				3			**5**	2.30	15.23
09/13/09	1					4			2	3			**9**	6.25	11.89
09/14/09	1					1			1	2	1		**5**	5.12	12.64
09/15/09	1					4							**4**	6.08	8.39
09/16/09	1					1							**1**	3.11	7.46
09/17/09	1					1							**1**	5.56	7.90
09/18/09	1												**0**	8.60	8.38
09/19/09	1					3			1				**4**	6.08	7.24
09/20/09	1								2	1			**3**	5.47	11.92
09/21/09	1					2			1				**3**	5.19	11.18
09/22/09	1								2	1			**3**	4.88	14.36
09/23/09	1					2				6			**8**	5.81	16.55
09/24/09	1					1				2			**3**	5.68	10.23
09/25/09	1												**0**	5.63	3.31
09/26/09	1									1			**1**	7.58	7.80

(*continued*)

Appendix B Table 4 (cont.)

09/27/09	1												**0**	9.80	14.87
09/28/09	1					4			1	2			**7**	5.91	14.09
09/29/09	1					1			1				**2**	6.87	11.20
09/30/09	1								1				**1**	4.41	7.68
10/01/09	1					1							**1**	2.73	6.68
10/02/09	1									1			**1**	3.56	7.53
10/03/09	1												**0**	8.64	12.25
10/04/09	1					1				1	1		**3**	5.17	11.37
10/05/09	1												**0**	7.47	7.84
10/06/09	1												**0**	5.56	8.14
10/07/09	1												**0**	7.36	7.58
10/08/09	1												**0**	4.81	6.33
10/09/09	1												**0**	4.31	10.96
10/10/09	1												**0**	6.65	2.65
10/11/09	1												**0**	8.45	3.36
10/12/09	1												**0**	3.75	4.52
10/13/09	1												**0**	7.20	0.32
10/14/09	1			1		1							**2**	6.98	-1.26
10/15/09	1												**0**	6.31	-0.43
10/16/09	1												**0**	6.69	2.04
10/17/09	1												**0**	8.01	1.14
10/18/09	1												**0**	8.85	1.21
10/19/09	1												**0**	3.39	3.09
10/20/09	1												**0**	6.06	6.59
10/21/09	1												**0**	5.69	3.70
10/22/09	1												**0**	8.88	0.57
10/23/09	1												**0**	8.19	3.09
10/24/09	1												**0**	9.87	12.64
10/25/09	1									1			**1**	7.56	3.35
10/26/09	1												**0**	5.64	1.89
10/27/09	1												**0**	6.99	2.37
10/28/09	1												**0**	5.64	2.04
10/29/09	1												**0**	3.85	4.75
10/30/09	1												**0**	7.28	7.02
10/31/09	1												**0**		
11/01/09	1												**0**		
11/02/09	1												**0**		
11/03/09	1												**0**		
11/04/09	1												**0**		
By Species		**342**	**9**	**3**	**0**	**547**	**0**	**1**	**34**	**291**	**45**	**0**	**1272**		
By Guild		**354**			**0**	**547**	**35**			**336**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Stantec

Appendix B Table 5. Summary of acoustic bat data and weather during each survey night at the SE Tree detector – Fall, 2009

Night of	Operational?	BBSH			HB	MYSP	RBTB			UNKN			Total	Wind Speed (m/s)	Temperature (celsius)
		BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN			
07/14/09	1												**0**	4.49	12.35
07/15/09	1	6				6				1	1		**14**	5.03	12.44
07/16/09	1									5			**5**	2.75	16.16
07/17/09	1					2							**2**	3.93	16.18
07/18/09	1	1				2				2			**5**	3.49	18.18
07/19/09	1					18			1	5	1		**25**	5.31	16.74
07/20/09	1					9				4			**13**	4.18	17.10
07/21/09	1	2				2				1	2		**7**	4.18	16.36
07/22/09	1					6				4			**10**	4.23	16.81
07/23/09	1					2				2	1		**5**	6.40	15.28
07/24/09	1					4				2			**6**	5.11	15.20
07/25/09	1												**0**	2.84	15.43
07/26/09	1												**0**	4.88	18.07
07/27/09	1					8			4				**12**	4.19	17.48
07/28/09	1	1				2				2			**5**	5.76	18.09
07/29/09	1	1								2			**3**	6.42	19.22
07/30/09	1	1				19			1	4			**25**	3.47	20.03
07/31/09	1					9			2	5			**16**	5.04	17.33
08/01/09	1	2				23				3			**28**	5.48	17.94
08/02/09	1				1	11				1			**13**	4.41	15.32
08/03/09	1	2				21			1	5	2		**31**	3.36	17.52
08/04/09	1	3				5				2			**10**	5.08	17.09
08/05/09	1	5	1			18				4			**28**	5.87	17.48
08/06/09	1	1			1	40			1	3	1		**47**	4.58	15.98
08/07/09	1				1	20			2	1			**24**	7.14	11.78
08/08/09	1	1				35				1			**37**	4.05	14.23
08/09/09	1				1	5							**6**	7.04	15.96
08/10/09	1	3	1			36			1	1			**42**	4.98	19.78
08/11/09	1	4				14			1	4	1		**24**	4.07	17.24
08/12/09	1	1				9			1	2			**13**	3.42	16.29
08/13/09	1	4				11				7			**22**	5.04	14.89
08/14/09	1	4	1		1	6				6			**18**	5.06	19.18
08/15/09	1	3				10			1	6			**20**	5.75	20.13
08/16/09	1	3				6			1	2			**12**	4.86	20.58
08/17/09	1	2				9			1	6			**18**	6.13	21.10
08/18/09	1					7				4			**11**	6.54	20.60
08/19/09	1	3	1			7				3			**14**	5.03	19.79
08/20/09	1	1		1		17				5			**24**	4.22	18.90
08/21/09	1					5				2			**7**	6.94	21.04
08/22/09	1					24				3			**27**	5.93	20.94
08/23/09	1									1			**1**	4.66	18.80
08/24/09	1					13				1			**14**	5.28	17.37
08/25/09	1					4			1	1			**6**	6.94	18.33
08/26/09	1					2			1	2			**5**	7.57	12.96
08/27/09	1												**0**	4.22	11.18
08/28/09	1					2				1			**3**	5.25	11.73
08/29/09	1												**0**	8.56	10.80
08/30/09	1									1			**1**	4.69	14.33
08/31/09	1												**0**	5.08	11.04
09/01/09	1	1		3		1				3			**8**	3.68	12.63
09/02/09	1					1			1	3	1		**6**	6.22	13.33
09/03/09	1								2	4			**6**	5.55	14.31
09/04/09	1	2		2						5			**9**	6.00	15.91
09/05/09	1					3			1	1			**5**	6.28	10.34
09/06/09	1												**0**	5.37	9.19
09/07/09	1					1				1			**2**	5.91	11.70
09/08/09	1					5			1	3			**9**	7.41	13.81
09/09/09	1									1			**1**	6.37	9.83
09/10/09	1												**0**	4.42	7.51
09/11/09	1									3			**3**	2.70	13.10
09/12/09	1					5				3			**8**	2.30	15.23
09/13/09	1					1							**1**	6.25	11.89
09/14/09	1									2			**2**	5.12	12.64
09/15/09	1								1	1			**2**	6.08	8.39
09/16/09	1												**0**	3.11	7.46
09/17/09	1					1				1			**2**	5.56	7.90
09/18/09	1												**0**	8.60	8.38
09/19/09	1												**0**	6.08	7.24
09/20/09	1									4			**4**	5.47	11.92
09/21/09	1	1							1	1			**3**	5.19	11.18
09/22/09	1					6			1	1			**8**	4.88	14.36
09/23/09	1					3				1			**4**	5.81	16.55
09/24/09	1												**0**	5.68	10.23
09/25/09	1					1							**1**	5.63	3.31

(*continued*)

Appendix B Table 5 (cont.)

09/26/09	1					1				1			**2**	7.58	7.80
09/27/09	1												**0**	9.80	14.87
09/28/09	1	1				1			4	3			**9**	5.91	14.09
09/29/09	1					1				1			**2**	6.87	11.20
09/30/09	1					1				1			**2**	4.41	7.68
10/01/09	1												**0**	2.73	6.68
10/02/09	1									1			**1**	3.56	7.53
10/03/09	1												**0**	8.64	12.25
10/04/09	1					1							**1**	5.17	11.37
10/05/09	1												**0**	7.47	7.84
10/06/09	1									2			**2**	5.56	8.14
10/07/09	1												**0**	7.36	7.58
10/08/09	1									1			**1**	4.81	6.33
10/09/09	1												**0**	4.31	10.96
10/10/09	1												**0**	6.65	2.65
10/11/09	1										1		**1**	8.45	3.36
10/12/09	1								1				**1**	3.75	4.52
10/13/09	1												**0**	7.20	0.32
10/14/09	1												**0**	6.98	-1.26
10/15/09	1												**0**	6.31	-0.43
10/16/09	1												**0**	6.69	2.04
10/17/09	1												**0**	8.01	1.14
10/18/09	1												**0**	8.85	1.21
10/19/09	1												**0**	3.39	3.09
10/20/09	1										1		**1**	6.06	6.59
10/21/09	1												**0**	5.69	3.70
10/22/09	1												**0**	8.88	0.57
10/23/09	1												**0**	8.19	3.09
10/24/09	1												**0**	9.87	12.64
10/25/09	1												**0**	7.56	3.35
10/26/09	1												**0**	5.64	1.89
10/27/09	1					1							**1**	6.99	2.37
10/28/09	1												**0**	5.64	2.04
10/29/09	1												**0**	3.85	4.75
10/30/09	1												**0**	7.28	7.02
10/31/09	1												**0**		
11/01/09	1												**0**		
11/02/09	1												**0**		
11/03/09	1												**0**		
11/04/09	1												**0**		
By Species		**59**	**4**	**6**	**5**	**483**	**0**	**0**	**33**	**165**	**12**	**0**	**767**		
By Guild		**69**			**5**	**483**	**33**			**177**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Appendix B Table 6. Summary of acoustic bat data and weather during each survey night at the SW Tree detector – Fall, 2009

Night of	Operational?	BBSH			HB	MYSP	RBTB			UNKN			Total	Wind Speed (m/s)	Temperature (celsius)
		BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN			
07/14/09	1					11				8	1		**20**	4.49	12.35
07/15/09	1					11							**11**	5.03	12.44
07/16/09	1					5				5			**10**	2.75	16.16
07/17/09	1					7			1	22			**30**	3.93	16.18
07/18/09	1					1				5			**6**	3.49	18.18
07/19/09	1	1				10				7			**18**	5.31	16.74
07/20/09	1					11				11			**22**	4.18	17.10
07/21/09	1	1			1	3				3			**8**	4.18	16.36
07/22/09	1	1				10				4			**15**	4.23	16.81
07/23/09	1					9				3	1		**13**	6.40	15.28
07/24/09	1					16				3			**19**	5.11	15.20
07/25/09	1					5				2			**7**	2.84	15.43
07/26/09	1					4				1			**5**	4.88	18.07
07/27/09	1	1				18				13			**32**	4.19	17.48
07/28/09	1					16				8			**24**	5.76	18.09
07/29/09	1					5				4			**9**	6.42	19.22
07/30/09	1	2				46				25			**73**	3.47	20.03
07/31/09	1					13			3	8			**24**	5.04	17.33
08/01/09	1	1				23			2	11			**37**	5.48	17.94
08/02/09	1					9				8			**17**	4.41	15.32
08/03/09	1					44				8			**52**	3.36	17.52
08/04/09	1					6				3			**9**	5.08	17.09
08/05/09	1					48			1	17			**66**	5.87	17.48
08/06/09	1				1	41				12			**54**	4.58	15.98
08/07/09	1					24				4			**28**	7.14	11.78
08/08/09	1				2	29				6	1		**38**	4.05	14.23
08/09/09	1				1	7				2			**10**	7.04	15.96
08/10/09	1					43			2	16			**61**	4.98	19.78
08/11/09	1	2				48			1	17			**68**	4.07	17.24
08/12/09	1				1	17				10	1		**29**	3.42	16.29
08/13/09	1					45				5			**50**	5.04	14.89
08/14/09	1					48			1	8			**57**	5.06	19.18
08/15/09	1					25			1	9			**35**	5.75	20.13
08/16/09	1	2	1			22				17			**42**	4.86	20.58
08/17/09	1					22			2	8			**32**	6.13	21.10
08/18/09	1					13				6			**19**	6.54	20.60
08/19/09	1	4				33				11			**48**	5.03	19.79
08/20/09	1					26				11			**37**	4.22	18.90
08/21/09	1					3				2			**5**	6.94	21.04
08/22/09	1					14				7			**21**	5.93	20.94
08/23/09	1					4							**4**	4.66	18.80
08/24/09	1	2				16				10			**28**	5.28	17.37
08/25/09	1					6				6			**12**	6.94	18.33
08/26/09	1	1				11			1	5	1		**19**	7.57	12.96
08/27/09	1					12				1	1		**14**	4.22	11.18
08/28/09	1					2				1			**3**	5.25	11.73
08/29/09	1												**0**	8.56	10.80
08/30/09	1	2								2	2		**6**	4.69	14.33
08/31/09	1					4				3	2		**9**	5.08	11.04
09/01/09	1					4	1			1			**6**	3.68	12.63
09/02/09	1					4				1			**5**	6.22	13.33
09/03/09	1	1								2			**3**	5.55	14.31
09/04/09	1					12				3			**15**	6.00	15.91
09/05/09	1	1				7				4			**12**	6.28	10.34
09/06/09	1												**0**	5.37	9.19
09/07/09	1	1				2				1			**4**	5.91	11.70
09/08/09	1	1				18				10			**29**	7.41	13.81
09/09/09	1					2							**2**	6.37	9.83
09/10/09	1					1							**1**	4.42	7.51
09/11/09	1					3				3			**6**	2.70	13.10
09/12/09	1					4				3			**7**	2.30	15.23
09/13/09	1					9				3			**12**	6.25	11.89
09/14/09	1									2			**2**	5.12	12.64
09/15/09	1					6				2			**8**	6.08	8.39
09/16/09	1					1				1			**2**	3.11	7.46
09/17/09	1												**0**	5.56	7.90
09/18/09	1					3							**3**	8.60	8.38
09/19/09	1												**0**	6.08	7.24
09/20/09	1									2			**2**	5.47	11.92
09/21/09	1									1			**1**	5.19	11.18
09/22/09	1					2				2	1		**5**	4.88	14.36
09/23/09	1									1			**1**	5.81	16.55
09/24/09	1					2			5	1			**8**	5.68	10.23
09/25/09	1								2				**2**	5.63	3.31

(*continued*)

Appendix B Table 6 (cont.)

09/26/09	1									1			**1**	7.58	7.80
09/27/09	1												**0**	9.80	14.87
09/28/09	1					2				2			**4**	5.91	14.09
09/29/09	1									2			**2**	6.87	11.20
09/30/09	1					2				1			**3**	4.41	7.68
10/01/09	1												**0**	2.73	6.68
10/02/09	1					1							**1**	3.56	7.53
10/03/09	1												**0**	8.64	12.25
10/04/09	1					3				1			**4**	5.17	11.37
10/05/09	1												**0**	7.47	7.84
10/06/09	1												**0**	5.56	8.14
10/07/09	1												**0**	7.36	7.58
10/08/09	1					1			1				**2**	4.81	6.33
10/09/09	1												**0**	4.31	10.96
10/10/09	1												**0**	6.65	2.65
10/11/09	1												**0**	8.45	3.36
10/12/09	1												**0**	3.75	4.52
10/13/09	1												**0**	7.20	0.32
10/14/09	1												**0**	6.98	-1.26
10/15/09	1												**0**	6.31	-0.43
By Species		**24**	**1**	**0**	**6**	**935**	**1**	**0**	**23**	**408**	**11**	**0**	**1409**		
By Guild		**25**			**6**	**935**	**24**			**419**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Appendix B Table 7. Summary of available fall bat detector surveys in the northeast at forest edge habitat (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or Low Tower detectors (10 m or below)										
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	114	7/12	11/2	12291	107.8	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	53	8/2	10/16	5360	101.1	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	107	7/12	11/2	8996	84.1	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	7.5	34	9/20	10/31	27	0.8	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	2	42	9/20	10/31	2	0	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	10	29	9/9	10/24	2	0.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	3	44	9/9	10/24	384	8.7	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	2	33	8/19	9/20	154	4.7	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	2	58	8/15	10/15	280	4.8	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	2	13	8/9	8/21	148	11.4	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	5	4	8/9	8/21	1	0.3	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	3	13	8/9	8/21	524	40.3	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	10	13	8/9	8/21	1576	121.2	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
MET Tower Detectors										
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	45	46	8/22	10/18	7	0.2	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	20	58	8/22	10/18	93	1.6	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	45	59	8/22	10/19	18	0.4	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	20	59	8/22	10/19	252	5.1	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	95	7/12	11/2	66	0.7	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	106	7/12	11/2	155	1.5	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	72	6/20	10/25	18	0.3	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	76	6/20	10/25	0	0	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	20	44	6/20	10/25	4	0.1	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.

(*continued*)

Appendix B Table 7. Summary of available fall bat detector surveys in the northeast at forest edge habitat (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	20	6/20	10/25	0	0	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Redington	Redington, Franklin Cty, ME	forest edge	15	21	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	15	48	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	30	29	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	30	37	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	73	6/28	10/16	8	0.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	76	6/28	10/16	170	2.2	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	15	105	6/28	10/16	108	1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	15	107	6/28	10/16	651	6.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	15	42	9/20	10/31	14	0.3	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	40	43	9/9	10/24	16	0.4	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2005	Clayton	Clayton, Jefferson Cty, NY	forest edge	30	0	8/19	9/20	0	0	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	15	43	8/15	10/15	293	6.8	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	30	54	8/15	10/15	285	5.3	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2004	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	15	6	9/10	9/15	30	0.23	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2004	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	30	5	10/17	10/21	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Mars Hill	Mars Hill, Aroostook Cty, ME	forest edge	20	22	8/31	9/21	25	n/a	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
2005	Mars Hill	Mars Hill, Aroostook Cty, ME	forest edge	20	22	8/31	9/21	25	n/a	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.

Appendix C

Regional Raptor Survey results

Stantec

Appendix C Table 1. Daily totals of raptor species observed and daily passage rates during Fall, 2009 at Bull Hill Wind Power Project

	Summer surveys (n=6; total bird observations=24)							Fall surveys (n=12; total bird observations=124)												
Species	Aug-09	Aug-09	Aug-09	Aug-09	Aug-09	Aug-09	Summer total	Sep-09	Sep-09	Sep-09	Sep-09	Sep-09	Sep-09	Sep-09	Oct-09	Oct-09	Oct-09	Oct-09	Oct-09	Fall Totals
American kestrel	1						1			1			1			4	2	2	1	11
bald eagle							0				1				1				1	3
broad-winged hawk		1	1				2		1	1	1	3								6
Cooper's hawk							0								1					1
merlin							0							3	2			2		7
northern goshawk				1			1													0
northern harrier							0				1									1
osprey							0					3		1				1		5
peregrine falcon							0										1			1
red-tailed hawk		1	1		3	1	6					1	1	1		1		2	2	8
sharp-shinned hawk		1					1	4	1	1	2	5	1			6	1	8	3	32
turkey vulture	1	1	4	3	3	1	13	5	3	6	2	5	2	6		1		2		32
unidentified accipiter							0				1						1			2
unidentified buteo							0	2			1	2		3	2			1		11
unidentified falcon							0												1	1
unidentified raptor							0	1							2					3
Daily Totals	**2**	**4**	**6**	**4**	**6**	**2**	**24**	**12**	**5**	**9**	**9**	**19**	**5**	**14**	**8**	**12**	**5**	**18**	**8**	**124**
Daily Passage Rates:	**0.25**	**0.50**	**0.75**	**0.57**	**0.86**	**0.25**	**0.52**	**1.50**	**0.63**	**1.13**	**1.29**	**2.71**	**0.71**	**2.00**	**1.14**	**1.71**	**0.71**	**2.57**	**1.14**	**1.43**

Appendix C Table 2. Hourly summary of raptor observations at Bull Hill during summer and fall surveys, 2009

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00	5:00-6:00	Grand Total
Summer 2009; Eagle habitat use surveys										
American kestrel								1		1
broad-winged hawk	1								1	2
northern goshawk		1								1
red-tailed hawk	1		3	1	1					6
sharp-shinned hawk								1		1
turkey vulture		2	6	1		1	2	1		13
Hourly totals, Spring:	2	3	9	2	1	1	2	3	1	24
Fall 2009; Raptor migration surveys										
American kestrel	2	3	1	1	1	2	1			11
bald eagle			1	1		1				3
broad-winged hawk	1	2	2		1					6
Cooper's hawk	1									1
merlin		1			1	4	1			7
northern harrier			1							1
osprey		2	1				2			5
peregrine falcon				1						1
red-tailed hawk		1	1		1	3	2			8
sharp-shinned hawk	2	6	10	5	3	5	1			32
turkey vulture	2	3	4	2	6	5	9	1		32
unidentified accipiter	1		1							2
unidentified buteo		5	1		5					11
unidentified falcon				1						1
unidentified raptor					1		2			3
Hourly totals, Fall:	**9**	**23**	**23**	**11**	**19**	**20**	**18**	**1**	**0**	124

Appendix C Table 3. Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A1, A2, A3, and B) above or below 145 m at Bull Hill 2009

	Summer habitat use surveys		Fall migration surveys	
Species	**145 m or greater**	**less than 145 m**	**145 m or greater**	**less than 145 m**
American kestrel	0	0	0	10
bald eagle	0	0	0	1
broad-winged hawk	0	0	0	3
Cooper's hawk	0	0	0	1
merlin	0	0	0	3
northern goshawk	0	0	0	0
northern harrier	0	0	1	0
osprey	0	0	0	1
peregrine falcon	0	0	0	1
red-tailed hawk	0	1	0	8
sharp-shinned hawk	0	0	0	21
turkey vulture	0	0	0	7
unidentified buteo	0	0	0	1
unidentified falcon	0	0	0	1
Grand Total:	**0**	**1**	**1**	**58**
Percent of Total Seasonal Observations:	**0.00%**	**100.00%**	**1.69%**	**98.31%**

Appendix C Table 4. Summary of raptor flight behaviors, Bull Hill, 2009

Species	linear soaring	gliding	circle soaring	powered flight	banking	diving	carrying food	kiting	hovering	aerial feeding	low aerial hunting	perched	aerial display	aerial chase	vocalization	Grand Total
Summer 2009; Eagle habitat use surveys																
American kestrel	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
broad-winged hawk	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
northern goshawk	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2
red-tailed hawk	4	1	1	0	2	0	0	1	0	0	0	0	0	0	0	9
sharp-shinned hawk	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
turkey vulture	10	1	6	1	0	0	0	0	1	0	0	0	0	0	0	19
Behavior totals, Spring:	**16**	**4**	**8**	**3**	**2**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**36**
Fall 2009; Raptor migration surveys																
American kestrel	3	1	0	10	0	0	0	0	0	0	0	0	0	0	0	14
bald eagle	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	6
broad-winged hawk	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	5
Cooper's hawk	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
merlin	4	0	0	6	0	0	0	0	0	0	0	0	0	0	0	10
osprey	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
northern harrier	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4
peregrine falcon	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
red-tailed hawk	3	0	4	4	0	0	0	0	0	0	0	0	0	0	0	11
sharp-shinned hawk	11	2	4	17	0	0	0	0	0	0	0	0	0	1	0	35
turkey vulture	25	0	15	12	0	0	0	0	0	0	0	0	0	0	0	52
unidentified accipiter	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3
unidentified buteo	6	1	6	3	0	0	0	0	0	0	0	0	0	0	0	16
unidentified falcon	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
unidentified raptor	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Behavior totals, Fall:	**61**	**4**	**39**	**59**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**164**

Appendix C Table 5. Summary of Regional Outbound (August to November, 2009) Migration Surveys[1]

Site Number	Location	Site Topography	Distance (miles)[2]	Observation Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	ML	PG	UR	UB	UA	UF	UE	TOTAL	BIRDS / HOUR
1	Bull Hill, Fall 2009 raptor survey	inland ridge	- -	87	0	32	5	3	1	32	1	0	0	6	8	0	0	11	7	1	3	11	2	1	0	124	1.43
2	Cadillac Mountain; Acadia NP, ME	coastal ridge	26	282.75	0	74	154	33	132	1569	20	20	2	225	74	0	1	557	74	35	64	3	3	7	0	3047	10.78
3	Greenlaw Mountain; Saint Andrews, NB	coastal ridge	60	256.75	0	99	111	46	39	593	11	13	5	1457	152	0	0	129	38	13	55	3	1	1	3	2769	10.78
4	Harpswell Peninsula/Casco Bay; Harpswell, ME	coastal lowland	113	224.25	0	63	301	51	125	1910	83	10	11	532	55	0	0	602	216	101	39	3	3	19	0	4124	18.39
5	Pack Monadnock; Peterborough, NH	inland ridge	225	420.75	0	80	182	51	88	1196	133	25	129	4322	421	0	6	135	56	30	77	14	8	8	2	6963	16.55
6	Pitcher Mountain; Stoddard, NH	inland ridge	228	55	0	3	0	14	4	9	0	3	4	0	106	0	2	0	1	0	3	1	0	0	4	154	2.80
7	Putney Mountain, Putney, VT	inland ridge	250	391.5	0	164	144	44	41	1080	110	23	41	3627	421	3	5	129	25	35	2	0	0	1	0	5895	15.06

[1] Data obtained from http://hawkcount.org; accessed 1 December 2009.

[2] Straight-line distance from Bull Hill raptor observation location to HMANA site.

Appendix C Table 6. Summary of available fall raptor survey results at forested ridge wind sites in the east

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Ave. Passage Rate (Raptors/Hr)	(Turbine Ht) % Raptors Below Turbine Height	Seasonal Passage Rate (raptors/hr)	Reference
Fall 1996										
Searsburg, Bennington County, VT	Forested ridge	Sept. 11 - Nov. 3	20	80	430	12	5.38	n/a	5.4	Kerlinger, Paul. 1996. A Study of Hawk Migration at Green Mountain Power Corporation's Searsburg, Vermont, Wind Powewer Site: Autumn 1996. Prepared for the Vermont Public Service Board, Green Mountain Power, National Renewable Ener gy Laboratory, VERA.
Fall 2004										
Deerfield, Bennington Cty, VT (Existing Facility)	Forested ridge	Sept. 2 - Oct. 31	10	60	147	11 for both sites combined	2.45	(100 m) 9% for both sites combined	2.5	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Deerfield, Bennington Cty, VT (Western Expansion)	Forested ridge	Sept. 2 - Oct. 31	10	57	725	11 for both sites combined	12.72	(100 m) 9% for both sites combined	12.7	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Sheffield, Caledonia Cty, VT	Forested ridge	Sept. 11 - Oct. 14	10	60	193	10	3.2	(125 m) 31%	3.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Fall 2005										
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 17 - Oct. 15*	6	18	49	5	4.37	n/a	4.4	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Moresville, Deleware Cty, NY	Forested ridge	Aug. 31 - Nov. 3	11	72	228	11	3.2	n/a	3.2	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Mars Hill, Aroostook Cty, ME	Forested ridge	Sept. 9 - Oct. 13	8	42.5	115	13	1.52	(120 m) 42%	1.5	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan County, NH	Forested ridge	Fall 2005	10	80	264	10	3.3	(125 m) 40%	3.3	Woodlot Alternatives, Inc. 2007. Lempster Wind Farm Wildlife Habitat Summary and Assessment. Prepared for Lempster Wind, LLC.
Fall 2006										
Stetson, Penobscot Cty, ME	Forested ridge	Sept. 14 - Oct. 26	7	42	86	11	2.05	(125 m) 63%	2.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Lincoln, Penobscot Cty, ME	Forested ridge	Sept. 13 - Oct. 16	12	89	144	12	1.8	(120 m) 82%	1.8	Woodlot Alternatives, Inc. 2007. Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V.
Fall 2007										
Roxbury, Oxford Cty, ME	Forested ridge	Sept. 3 - Oct. 15	14	86	96	12	1.1	n/a	1.1	Stantec Consulting. 2008. Fall 2007 Migration Survey Report Visual, Acoustic, and Radar Surveys of Bird and Bat Migration conducted at the proposed Record Hill Wind Project In Roxbury, Maine. Prepared for Independence Wind, LLC.
Errol, Coos Cty, NH	Forested ridge	Sept. 5 - Oct. 16	11	68	44	9	0.7	n/a	0.7	Stantec Consulting. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	Sept. 12 - Dec. 1	24	147	769	12	5.2	(125 m) 65%	5.2	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Greenland, Grant Cty, WV	Forested ridge	Sept. 12 - Dec. 1	27		858	13	5.9	(125 m) 67%	5.9	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 21 - Oct. 28	6	n/a	n/a	n/a	4.37	n/a	4.4	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Allegany, Cattaraugus Cty, NY	Forested ridge	Sept. 8 - Oct. 11	11	63.78	125	10	1.96	(150 m) 78%	2.0	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

continued

Appendix C Table 6 *cont.*										
Fall 2009										
Bull Hill, Hancock Cty, ME	Forested ridge	Sept. 2 - Oct. 14	12	87	124	11	1.43	(145 m) 98%****	1.43	*this report*
*Calculated for spring and fall combined.										
**Calculated for spring and fall 2006 and 2007 combined.										
***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.										
**** %of raptors observed in project area below turbine height. Previous percentages may be of all raptors observed.										

Spring 2010 Avian and Bat Survey Report

Spring 2010
Avian and Bat Survey Report

for the Bull Hill Wind Project
In T16 MD, Maine

Prepared for

Blue Sky East Wind, LLC
179 Lincoln Street, Suite 500
Boston, MA 02111

Prepared by

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Stantec

August 2010

Executive Summary

In advance of permitting activities for the proposed Bull Hill Wind Project (Project) in T16 MD, Maine, Blue Sky East Wind, LLC contracted Stantec Consulting Services Inc. (Stantec) to perform bird and bat scientific surveys for the purpose of evaluating 2009 summer and fall activity and spring, summer and fall 2010 activity within the Project area. This report covers information gathered in spring and summer 2010. The results of the 2009 surveys were presented in the report titled Summer and Fall 2009 Avian and Bat Survey Report, dated January 2010. Survey methods and work plans, including nocturnal marine radar surveys, bat detector surveys, and raptor migration field surveys, were developed in consultation with state and federal wildlife agencies.

Nocturnal Marine Radar Survey

Radar surveys were conducted during 20 nights in spring 2010 (between April 20 and May 24) to characterize nocturnal migration activity in the Project area. Surveys were conducted using X-band radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar was located on the summit of Bull Hill and provided adequate visibility of the surrounding airspace to characterize migration.

The overall mean passage rate for the entire spring survey period was 387 ± 21 targets per kilometer per hour (t/km/hr), and nightly passage rates varied from 43 ± 16 t/km/hr on May 10 to 879 ± 76 t/km/hr on April 30. Mean flight direction through the Project area for the season was 48° ± 49°. The seasonal mean flight height of targets was 217 ± 8 meters (m; 712 ft [']) above the radar site, and nightly flight heights ranged from 100 ± 10 m to 358 ± 53 m. The percent of targets observed flying below 145 m (476'; the highest height of potential turbine types) was 38 percent for the entire season.

Bat Detector Survey

The goal of the acoustic surveys was to characterize seasonal patterns in bat activity levels and examine how weather conditions influence bat activity at the Project. Six Anabat® acoustic bat detectors were deployed in the Project area on April 15 and operated until July 14 to document bat activity. Two detectors were deployed on the Little Bull Hill meteorological tower (met tower), and four were deployed in trees throughout the Project area. Detectors were deployed at relatively low heights where increased bat activity levels are generally documented, particularly during the non-migratory periods. Data were summarized by guild and species and tallied per detector on an hourly and nightly basis.

Detectors operated properly for most of the season, resulting in 467 detector nights of data between April 15 and July 14. During this survey period, 2,703 call sequences were recorded, resulting in a detection rate of 0.4 bat call sequences per detector night for the met tower detectors combined, and 8.6 bat call sequences per detector night for the tree detectors combined. The Radar Tree Detector had the highest monthly detection rate (39.5 call sequences per detector night) in July.

Raptor Migration Field Survey

Raptor migration surveys were conducted during 3 days in winter 2010 (March 19, March 25 and April 6) from Sparrow Hill to target eagle activity in the Project area. In addition, a total of 12 surveys were conducted in spring 2010 (April 21 to May 23) from Bull Hill to document diurnal migration activity in the Project area. Visual observation surveys were conducted from 9 am to 4 pm from a prominent location in the Project area.

A total of 104.25 raptor migration survey hours (winter and spring surveys combined) were conducted and a total of 55 raptors, representing nine species were observed. Broad-winged hawk (*Buteo platypterus*) and turkey vulture (*Cathartes aura*) represent the most commonly observed species. Daily counts ranged from 0 to 15 raptors and the overall passage rate was 0.53 raptors per hour (raptors/hour). Of the total raptors observed, 27 percent (n=15) were observed in areas where turbines will be located. All observations of raptors within the Project area were documented at heights less than 145 m for at least a portion of their flight through the turbine areas.

Two raptor species of state special concern were observed in winter and spring 2010: six bald eagle (*Haliaeetus leucocephalus*) observations were recorded and one eagle was seen as the observer was leaving the Project after a survey. All bald eagle observations were outside the Project area. Five northern harrier (*Circus cyaneus*) observations were made during the spring surveys. One observation of northern harrier occurred within the Project area.

Table of Contents

EXECUTIVE SUMMARY E.1

1.0 INTRODUCTION 1
1.1 PROJECT BACKGROUND 1
1.2 PROJECT AREA DESCRIPTION 1

2.0 NOCTURNAL RADAR SURVEY 4
2.1 INTRODUCTION 4
2.2 DATA COLLECTION METHODS 4
2.2.1 Radar Data 4
2.2.2 Weather Data 7
2.3 DATA ANALYSIS METHODS 7
2.3.1 Radar Data 7
2.4 RESULTS 7
2.4.1 Passage Rates 8
2.4.2 Flight Direction 9
2.4.3 Flight Altitude 10
2.4.4 Weather Data 12
2.5 DISCUSSION 12

3.0 ACOUSTIC BAT SURVEY 14
3.1 INTRODUCTION 14
3.2 DATA COLLECTION METHODS 14
3.2.1 Acoustic Detector Site Selection 14
3.3 DATA ANALYSIS METHODS 18
3.4 RESULTS 20
3.4.1 Timing of Activity 20
3.4.2 Species Composition 23
3.5 DISCUSSION 25

4.0 DIURNAL RAPTOR SURVEYS 27
4.1 INTRODUCTION 27
4.1.1 Study Area Description 27
4.2 METHODS 29
4.3 RAPTOR DATA COLLECTION METHODS 29
4.3.1 Field Surveys 29
4.3.2 Weather Data 30
4.4 RAPTOR DATA ANALYSIS METHODS 31
4.5 RESULTS 31
4.5.1 Weather Summary 31
4.5.2 Raptor Data 32
4.5.3 Hourly observations 34

4.5.4 Raptor locations 34
4.5.5 Raptor behaviors 35
4.5.6 Flight heights 37
4.6 SPECIAL CONCERN SPECIES 38
4.7 INCIDENTAL NON-RAPTOR OBSERVATIONS 39
4.8 DISCUSSION 41

5.0 LITERATURE CITED 43

Tables

Table 3-1 Summary of bat detector field survey effort and results
Table 3-2 Distribution of detections by guild for detectors at Bull Hill, Spring/Summer 2010
Table 4-1 A summary of the Spring 2010 survey effort and results for the Bull Hill Wind Project in Washington County, Maine
Table 4-2 Raptor behaviors summarized by location in study area and flight position during Spring 2010 at the Bull Hill Wind Project
Table 4-3 Observations of raptors suspected to be actively migrating during Spring 2010 at the Bull Hill Wind Project
Table 4-4 Number of observations and average flight heights for each position category for birds observed during Spring 2010 at the Bull Hill Wind Project
Table 4-5 Non-raptor avian species observed incidentally during Spring 2010 raptor migration surveys at the Bull Hill Wind Project

Figures

Figure 1-1 2010 Radar, Raptor and Acoustic Survey Location Map
Figure 2-1 Screenshots from actual radar files for the Bull Hill Wind Project showing ground clutter in horizontal mode and vertical mode
Figure 2-2 An example of ground clutter “hiding” a section of the radar beam, allowing adequate detection of targets
Figure 2-3 Detection Range of the radar in vertical mode
Figure 2-4 Nightly passage rates observed during Spring 2010 at the Bull Hill Wind Project.
Figure 2-5 Hourly passage rates for entire season during Spring 2010 at the Bull Hill Wind Project
Figure 2-6 Mean flight direction for the entire season during Spring 2010 at the Bull Hill Wind Project
Figure 2-7 Mean nightly flight height of targets during Spring 2010 at the Bull Hill Wind Project
Figure 2-8 Percent of targets observed flying below a height of 145 m (476’) during Spring 2010 at the Bull Hill Wind Project
Figure 2-9 Whisker plot depicting the middle 50 percent and outliers of targets’ flight heights for each survey night during Spring 2010 at the Bowers Wind Project
Figure 2-10 Hourly target flight height distribution during Spring 2010 at the Bull Hill Wind Project
Figure 3-1 Monthly detection rates per detector at the tree detectors at Bull Hill, 2010
Figure 3-2 Monthly detection rates per detector at met tower detectors at Bull Hill, 2010

Figure 3-3	Hourly bat call sequence detections at the Bull Hill, 2010.
Figure 3-4	Total nightly bat call sequence detections at Bull Hill, 2010
Figure 4-1	Raptor flight position categories in relation to the topography of the study area
Figure 4-2	Survey totals of raptors observed during Spring 2010 surveys at the Bull Hill Wind Project
Figure 4-3	Number of observations of raptor species observed during Spring 2010 surveys at the Bull Hill Wind Project
Figure 4-4	Number of observations of raptors per survey hour during Spring 2010 surveys at the Bull Hill Wind Project
Figure 4-5	Number of observations of raptor species within different study area location categories during Spring 2010 surveys at Bull Hill Wind Project
Figure 4-6	Number of observations of raptor species observed within Project area at heights above and below 145 m during Spring 2010 surveys at Bull Hill Wind Project

Appendices

Appendix A	Radar Survey Data Tables
Appendix B	Bat Survey Data Tables
Appendix C	Raptor Survey Data Tables

PN19560500*

* *This report was prepared by Stantec Consulting Services Inc. for Blue Sky East Wind, LLC. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.*

1.0 Introduction

Blue Sky East, LLC. (Blue Sky East), an affiliate of First Wind, is considering construction of a commercial-scale wind energy project located in T16 MD, Hancock County, Maine (Figure 1-1). The Bull Hill Wind Farm (the Project) includes two separate turbine arrays on lower elevation hillsides: one on Bull Hill and one on Heifer Hill. The Project is currently in the preliminary planning stage, which includes planning strategic placement of up to 18 turbines, access roads, meteorological towers, a substation and a collection line. The proposed turbines would have a height of up to 145 meters (m; 476 feet [']) to the tip of a fully extended blade[1].

Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of results; and the conclusions reached based on those results.

1.1 PROJECT BACKGROUND

In advance of permitting activities for the Project, Blue Sky East contracted Stantec to perform bird and bat scientific surveys for the purpose of evaluating 2009 summer and fall activity and spring, summer and fall 2010 activity near and within the Project area. Results of the 2009 surveys may be found in the report titled Summer and Fall 2009 Avian and Bat Survey Report, dated January 2010. This report describes the work conducted by Stantec during spring 2010, including radar surveys, raptor surveys and acoustic bat surveys. Aerial nest surveys targeting bald eagle nests were also completed in spring 2010; the results of these surveys were summarized in the 2010 Bald Eagle Aerial Survey memo dated June 11, 2010, and therefore will not be included in this report.

On July 30, 2009, prior to initiation of field surveys, Blue Sky East and Stantec presented a draft work plan for comprehensive natural resource surveys during an initial agency consultation with biologists from the Maine Department of Inland Fisheries and Wildlife (MDIFW) and the United States Fish and Wildlife Service (USFWS). Since that meeting, ongoing consultation regarding survey methodology and preliminary results occurred throughout the spring survey season.

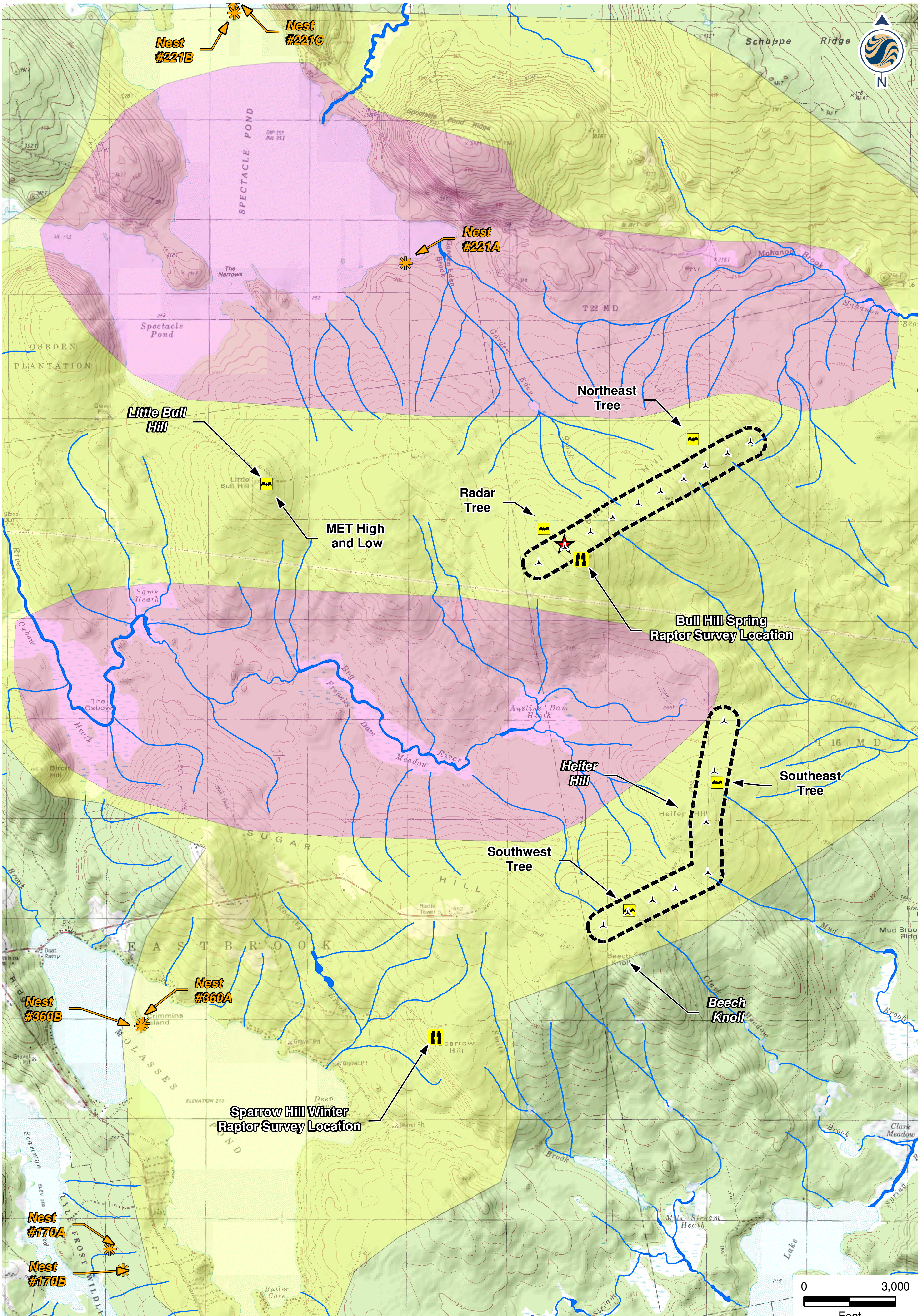
1.2 PROJECT AREA DESCRIPTION

The Project area consists of a series of coastal low elevation hills around Bull and Heifer Hill (Figure 1-1). At 255 meters (837') above sea level, Bull Hill has the highest elevation in the Project area and like the other peaks, consists of gently sloping to moderately steep topography. An existing network of well-maintained logging roads is present throughout the Project area and the effects of past and current timber harvesting are evident across the entire Project area, from large clear-cuts to small selective harvesting areas. Aside from the roads and skidder trails, the Project area is almost entirely undeveloped.

[1] All data in this report were analyzed based on a maximum turbine height of 145 m. This turbine height is based on the largest potential turbine type under consideration during early stages of project development. A different turbine type would require re-analysis to determine the number of targets in the rotor swept area.

The Project is located in the Eastern Lowlands biophysical region. This region is characterized by extensive lowlands with elevations generally below 600'. The region also contains the largest concentration of peatlands, marshes, and swamps in the state. The representative vegetation communities present within the Project area include: forested uplands and wetlands, scrub-shrub wetlands, emergent wetlands, and stream systems. Examples of these wetland communities present near the Project area include: Oxbow Heath, Frenchs Dam Meadow, and Austins Dam Heath. These communities are large, open wetland systems with dense ericaceous shrubs amidst areas of open water; stands and even individual dead standings trees appear to be infrequent based on initial visits to these areas. Forested communities are representative throughout and dominate higher elevations within the Project area, while wetland systems are most common at lower elevations. The proposed Project area includes a variety of natural community types including, but not limited to, Beech-Birch-Maple Forest, Spruce-Northern Hardwoods Forest, and Red Oak-Northern Hardwoods-White Pine Forest. Dominant canopy species present in the Project area include white pine (*Pinus strobus*), red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), red oak (*Quercus rubra*), white ash (*Fraxinus americana*), paper birch (*Betula papyrifera*), and gray birch (*Betula populifolia*). Common shrub species include hobblebush (*Viburnum lantanoides*), witch-hazel (*Hamamelis virginiana*), American beech (*Fagus grandifolia*), and the aforementioned tree species. Herbaceous species present in the Project area include Canada mayflower (*Maianthemum canadense*), partridgeberry (*Mitchella repens*), wintergreen (*Gaultheria procumbens*), bunchberry (*Cornus canadensis*), bracken fern (*Pteridium aquilinum*), wild sarsaparilla (*Aralia nudicaulis*), starflower (*Trientalis borealis*), and evergreen wood fern (*Dryopteris intermedia*). The majority of wetlands in the area are forested, with occasional scrub-shrub and emergent wetlands associated with disturbance from timber harvesting. Streams are primarily high-gradient, fast-moving perennial and intermittent streams that exhibit heavy flow in spring and during rain events, and little to no flow during the summer and dry periods.

The Project area is located between the Union River and Narraguagus River watersheds. These rivers and associated perennial streams are Designated Critical Habitat for the federally-listed Atlantic salmon (*Salmo salar*). The Project area is not within designated critical habitat for Canada lynx (*Lynx canadensis*). The Project area does not intersect any state-mapped wildlife areas, such as Inland Waterfowl and Wading Bird Habitat or Deer Wintering Areas.



195600500

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

Legend

- Proposed Turbine Layout (7-16-10)
- Radar Location
- Bat Detector
- Bald Eagle Nests
- Areas Visible During Raptor Survey
- Areas Not Visible During Raptor Survey
- Bull Hill Turbine Delineation Limit (7-16-10)
- USGS River and Streams

Client/Project
Blue Sky East Wind, LLC
Bull Hill
Eastbrook and T16 MD, Maine

Figure No.
1-1

Title
2010 Radar, Raptor, & Acoustic Survey Location Map
August 5, 2010

00500-F001-1-EagleRaptor-Survey-Viewshed.mxd

2.0 Nocturnal Radar Survey

2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize Spring 2010 nocturnal migration patterns. The majority of North American passerines (songbirds) migrate at night; the strategy of migrating at night may have evolved to take advantage of more stable atmospheric conditions for their flapping flight (Kerlinger 1995). Additionally, cooler nighttime temperatures may provide a more efficient medium to regulate body temperature during more active, flapping flight and reduce predation risk while in flight (Alerstam 1990, Kerlinger 1995). Documenting the patterns of nocturnal migrants requires the use of radar or other non-visual technologies. The goal of the surveys was to document the overall passage rates for nocturnal migration in the Project area, including the number of migrants, their flight direction, and their flight altitude.

Radar surveys were conducted from sunset to sunrise on 20 nights between April 20 and May 24, 2010. The radar was deployed on Bull Hill at an elevation of 188 m (616'; Figure 1-1), at the same location as in fall 2009. Efforts were made to maximize the airspace sampled by elevating the antenna to reduce the amount of the radar beam reflected back by surrounding vegetation; such reflection may cause ground clutter obstructions on the radar screen. The elevated radar resulted in an unobstructed view of the surrounding airspace within the radar's range settings. There was relatively little ground clutter interference, as the radar site was located in a large clearing with relatively short, regenerating spruce trees. The location on Bull Hill provided a good view of the airspace in most directions.

2.2 DATA COLLECTION METHODS

2.2.1 Radar Data

Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. Insects can be identified and removed from the migration calculations based on flight speed; however, it cannot readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen (not including insects) were identified as "targets." The radar has an "echo trail" function which captures past echoes of flight trails, enabling determination of flight speed and direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5') waveguide antenna, deployed 7.3 m (24') above ground. The antenna has a vertical beam width of 20° (10° above and below horizontal).

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas (Figure 2-1).

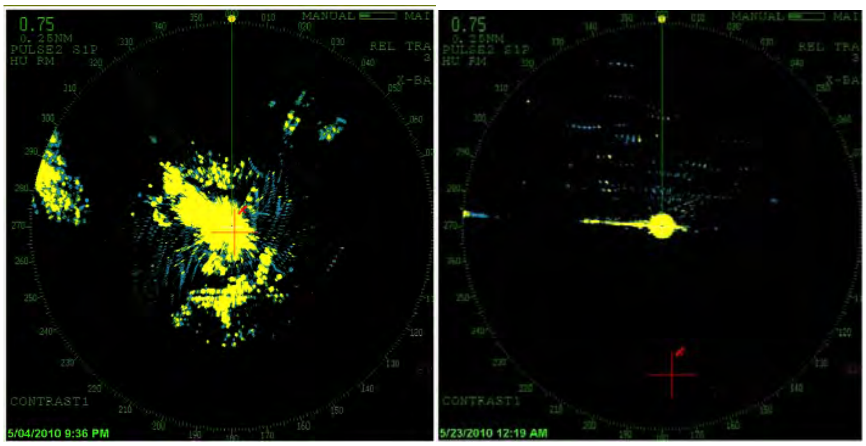


Figure 2-1. Screenshots from actual radar files for the Bull Hill Wind Project showing ground clutter in horizontal mode (left) and vertical mode (right). Although the radar records three-dimensional space, it is translated by the radar screen into a two dimensional representation, which can cause targets to be obscured from view.

However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar (Figure 2-2). These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen. However, targets traveling into and out of the ground clutter areas can be tracked. The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

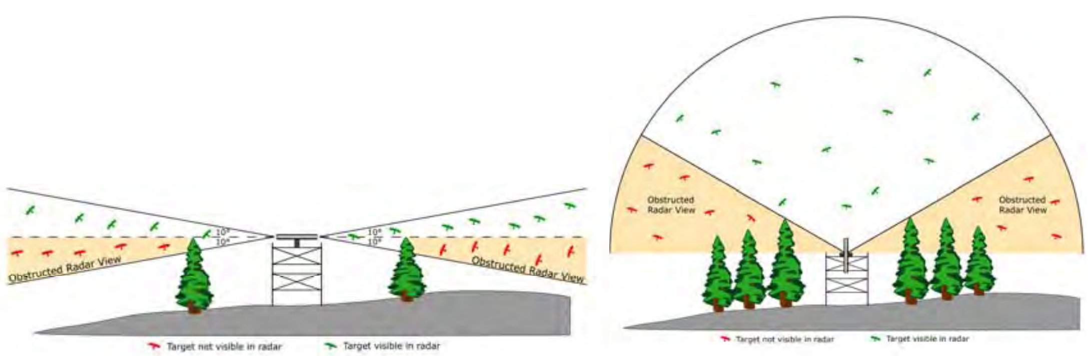


Figure 2-2. An example of a tree of a specific height that causes ground clutter, but "masks" a section of the radar beam, allowing adequate detection of targets beyond it (left). The effect of ground clutter on target detection in vertical mode is also shown (right).

Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the project site (Figure 2-1). By analyzing the echo trail, the flight direction and flight speed of targets can be determined.

In vertical mode, the radar unit is tilted 90° to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20° radar beam (Figure 2-3). Both modes of operation were used during each hour of sampling.

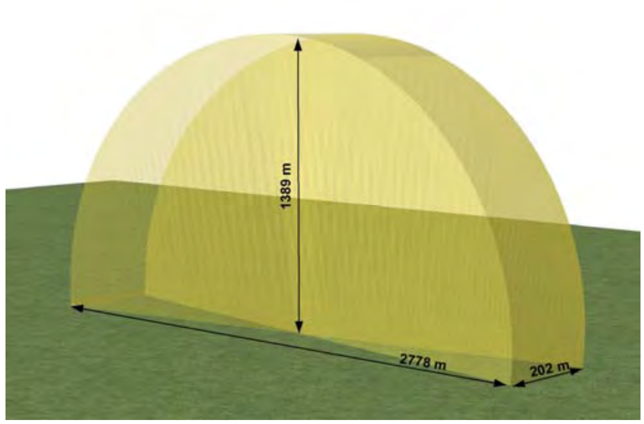


Figure 2-3. Detection Range of the radar in vertical mode

The radar was operated at a range of 1.4 km (0.75 nautical miles) to ensure detection of small targets. When radar is operated at ranges greater than 1.4 km, larger birds can be detected but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets; consequently, 1.4 km is the appropriate detection range for this type of study.

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. A stratified random sample set was developed by randomly selecting 6 horizontal samples and 6 vertical samples per hour of survey. This sampling schedule allowed for randomization of sample selection and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

2.2.2 Weather Data

Temperature, wind speed and direction were recorded by an on-site met tower[2]. In addition, in order to consider the atmospheric influences on migration, regional surface weather map images were interpreted to determine the dates that daytime pressure systems (high, low, or none) moved through the region. Surface weather maps, prepared by the National Centers for Environmental Prediction, the Hydro-meteorological Prediction Center, and the National Weather Service, were downloaded daily for the majority of the survey window.

2.3 DATA ANALYSIS METHODS

2.3.1 Radar Data

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 175 m (574'), the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

2.4 RESULTS

Radar surveys were conducted during 20 nights between April 20 and May 24, 2010 (Appendix A Table 1) resulting in 184 total hours surveyed.

[2] Met tower data was not available at the time of this report and was therefore not used in data analysis. Once this information becomes available, further analysis may be done. However, regional data from surface weather maps was summarized for this report.

2.4.1 Passage Rates

Nightly passage rates varied from 43 targets per kilometer per hour (t/km/hr) on May 10 to 879 t/km/h on April 30, and the overall passage rate for the entire survey period was 387 t/km/hr (Figure 2-4, Appendix A Table 1). Individual hourly passage rates varied between nights and throughout the season, and ranged from 0 t/km/hr on the 2nd hour of May 10 to 1486 t/km/hr on the 2nd hour of May 4 (Appendix A Table 2). For the entire season, passage rates gradually increased after sunset, were typically highest during the fifth hour after sunset, and then steadily declined until sunrise (Figure 2-5).

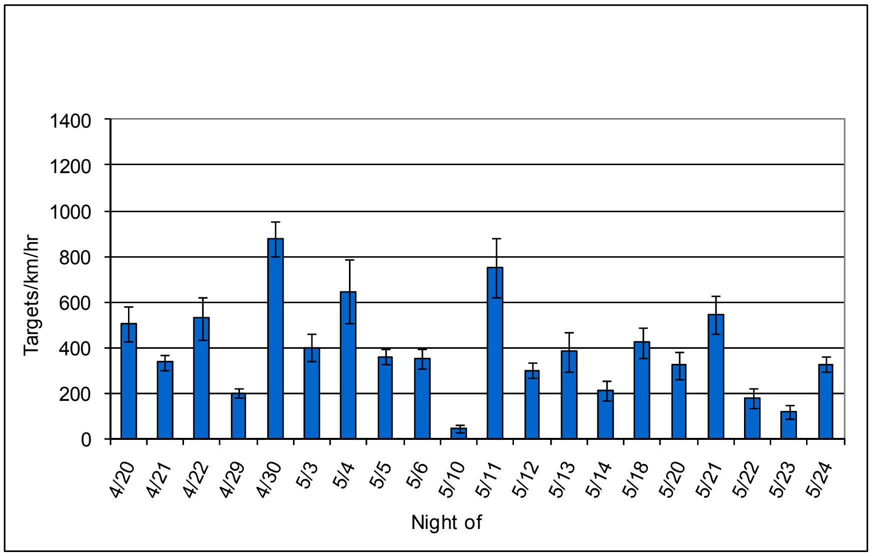


Figure 2-4. Nightly passage rates observed (error bars ± 1 SE) during Spring 2010 at the Bull Hill Wind Project.

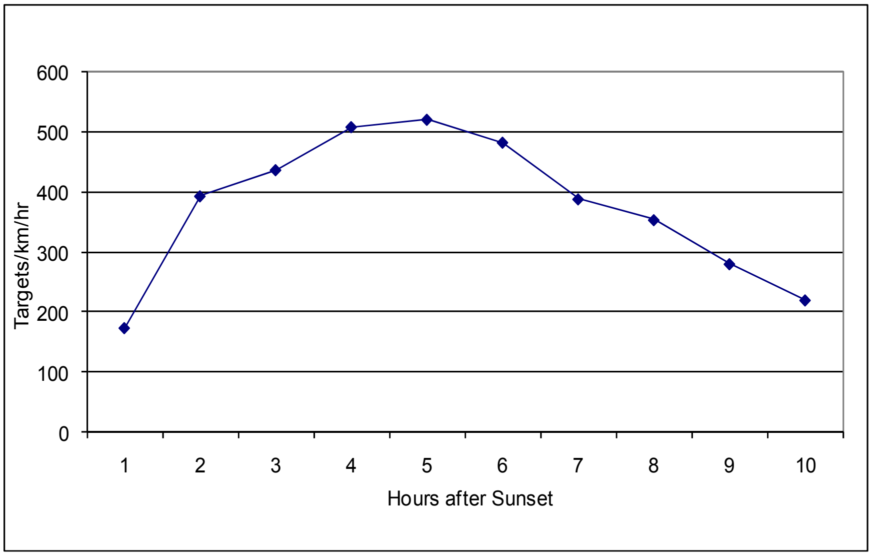


Figure 2-5. Hourly passage rates for entire season during Spring 2010 at the Bull Hill Wind Project

2.4.2 Flight Direction

Mean flight direction through the Project area was 48° ± 49° (Figure 2-6). Overall, the mean flight direction was toward the northeast, but varied between nights (Appendix A Table 3).

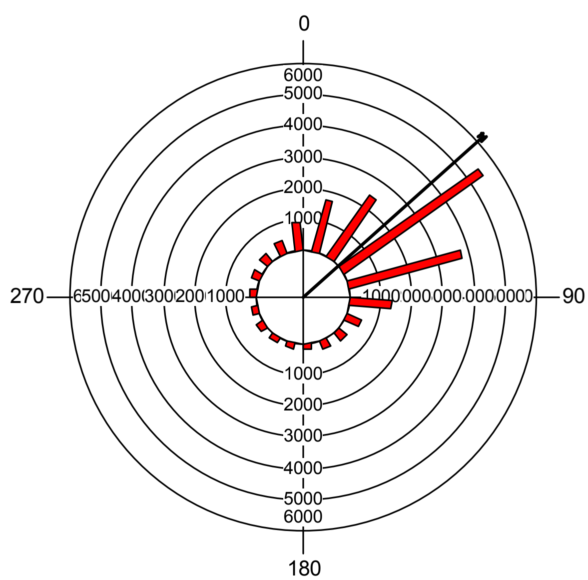


Figure 2-6. Mean flight direction for the entire season during Spring 2010 at the Bull Hill Wind Project (the bracket along the margin of the histogram is the 95% confidence interval)

2.4.3 Flight Altitude

The seasonal average mean flight height of all targets was 217 ± 8 m above the radar site. The average nightly flight height ranged from 100 m on May 12 to 358 m on April 21 (Figure 2-7, Appendix A Table 4). The percent of targets observed flying below 145 m was 38 percent for the season and varied nightly from 19 percent on May 23 to 82 percent on May 10 (Figure 2-8).

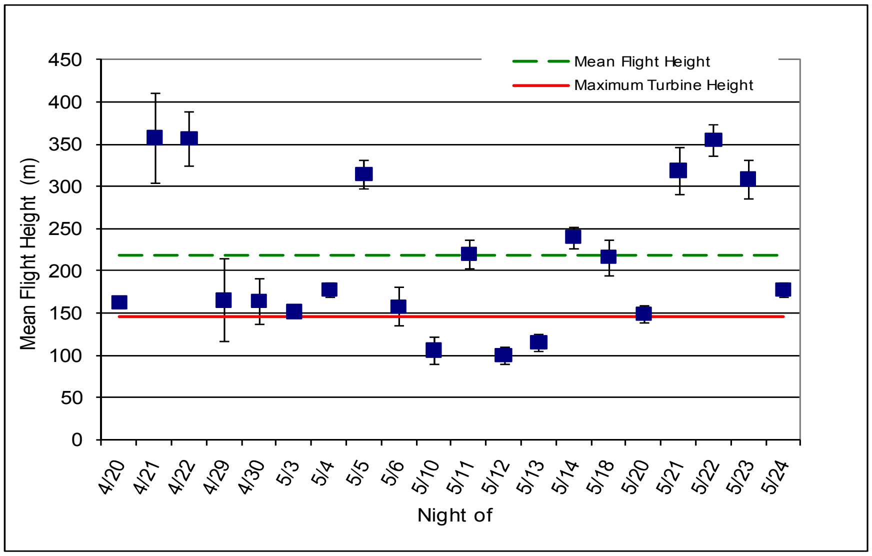


Figure 2-7. Mean nightly flight height of targets during Spring 2010 at the Bull Hill Wind Project (error bars ± 1 SE)

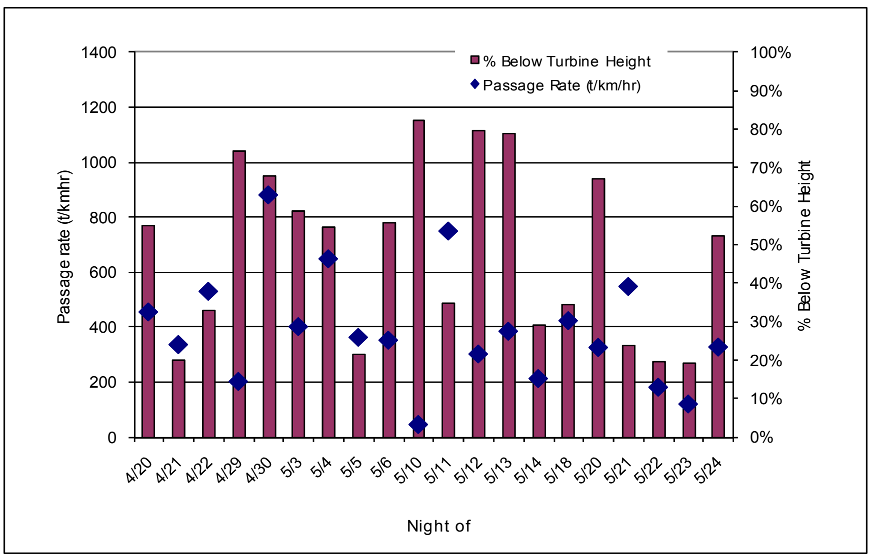


Figure 2-8. Percent of targets observed flying below a height of 145 m (476') during Spring 2010 at the Bull Hill Wind Project

Figure 2-9 displays nightly flight heights in a different format to highlight the range in individual flight heights of all targets recorded each survey night. This figure is different from Figure 2-7 which shows only the mean flight height for all targets each survey night. The "blocks" seen on Figure 2-9 depict the middle 50 percent of targets. The horizontal bar within each block depicts the median value for nightly flight height for all targets. The error bars depict the statistical outliers, or those 25 percent of birds flying well below the mean and well above the mean. The proposed turbine height is depicted as a red line.

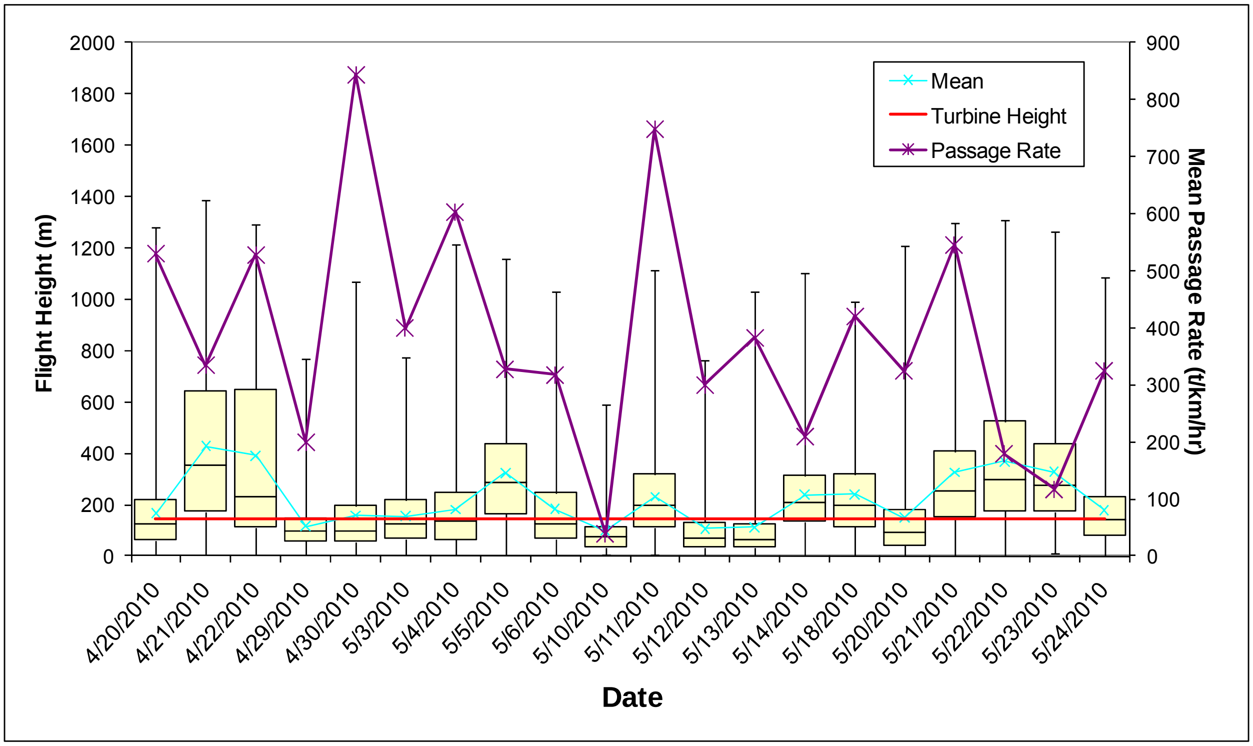


Figure 2-9. Whisker plot depicting the middle 50% and outliers of targets' flight heights for each survey night during Spring 2010 at the Bowers Wind Project

For the entire season, the mean hourly flight heights were typically highest during the second hour after sunset and generally decreased until sunrise (Figure 2-10).

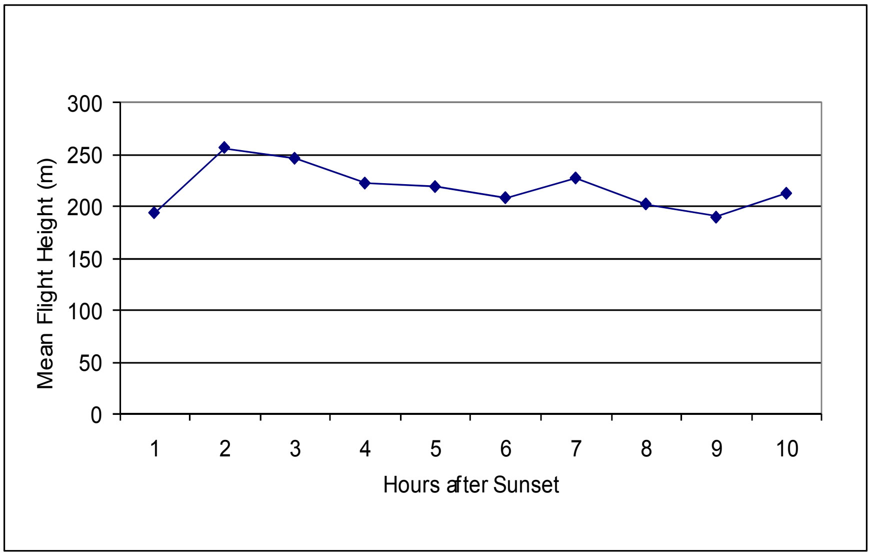


Figure 2-10. Hourly target flight height distribution during Spring 2010 at the Bull Hill Wind Project

2.4.4 Weather Data

Analysis of regional surface weather maps reveals that spring 2010 surveys were conducted during periods of high atmospheric pressure and favorable conditions for migration.

2.5 DISCUSSION

Radar surveys are designed and carried out to sample migration activity over a given point in order to provide baseline site data prior to the construction and operation of proposed commercial wind projects. The results of this nocturnal radar survey provide a snapshot of avian migration in space and time; in this case, over Bull Hill during dates typical for spring migration in eastern Maine. Spring radar surveys in the Project area documented patterns in nocturnal migration similar to those documented at recent radar surveys conducted in the eastern US (Appendix A Table 5). These include highly variable passage rates between nights, a generally northward flight direction, and flight heights typically averaging over 200 m. Within nights, migration activity was generally greatest five hours after sunset and declined steadily through the end of the night.

The radar site was located within a clearing near the highest point of Bull Hill surrounded by fairly short, regenerating spruce trees. Consequently, the radar site had good visibility and was capable of detecting targets within nearly all of its theoretical detection range. Within the spring radar survey at Bull Hill, nightly average mean passage rates were highly variable, ranging from 43 to 879 t/km/hr. This indicates that nocturnal migration was pulsed, presumably related to seasonal timing and regional weather conditions. The average passage rate at the Project (387 t/km/hr) is within the range of results of other radar studies conducted in the east (110 m to 1020 m, Appendix A Table 5). Comparison of passage rates between radar surveys at the Project and similar surveys conducted at other sites must be done with caution, as differences in passage rates are due to a large part to differences in radar view between sites, and not necessarily the amount of migration above a radar site. Indeed, characteristics of individual radar sites, particularly the topography, local landscape conditions, and vegetation surrounding a radar survey location, can dramatically influence the ability of any radar unit to detect targets and the subsequent calculation of passage rate. These differences should be recognized as one of the more significant limiting factors in making direct site-to-site comparisons in passage rates.

The average flight height (217 m) is near the low end of the range of average flight heights recorded at other radar studies conducted in the east (210 m to 552 m), however the average flight height is above the proposed turbine height (145 m). The emerging body of studies characterizing nocturnal bird movements shows a relatively consistent pattern in flight altitude, with most birds appearing to fly at altitudes of several hundred meters or more above the ground (Figure 2-9; Appendix A Table 5). Comparison of flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. Where radar surveys have been conducted at any Project, it is expected that some target activity will be observed within the turbine elevation zone. In addition, the majority of hourly and nightly mean flight heights of targets documented at the Project were found to be well above the height of the proposed turbines.

Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). The night with the highest passage rate (April 30) occurred on a night following five nights of low pressure bringing snow and rain to the region. Flight heights were relatively low on this night, possibly due to lingering low cloud cover and relatively strong northwest winds (average wind speed of 9 mph). Relatively high passage rates on two days (May 4 and May 11) occurred during two nights when high pressure systems were either present or had passed through the region the night before, respectively. The majority of targets flying on these nights flew well above the proposed turbine height (Figure 2-9).

In summary, results at the Project are within the range of results recorded at other radar studies conducted in the east, and provide a sample of baseline migration activity over the Project during spring 2010 that is typical of data from other proposed projects on northeastern forested ridges.

3.0 Acoustic Bat Survey

3.1 INTRODUCTION

Acoustic sampling of bat activity has become a standard aspect of pre-construction surveys for proposed wind-energy development (Kunz *et al.* 2007). Acoustic surveys are snapshots of activity, and results cannot be used to determine the specific number of bats inhabiting an area. However, acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. While this data may be useful in predicting trends in post-construction mortality rates, the current lack of data on this topic precludes a quantitative prediction of risk. The objectives of acoustic surveys at Bull Hill were (1) to document bat activity patterns from April to mid July in airspace near the rotor zone of the proposed turbines, at an intermediate height, and near the ground; and (2) to document bat activity patterns in relation to weather factors, including wind speed and temperature.

Eight species of bats occur in Maine, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (BCI 2001). All eight bat species found in Maine are listed as species of Special Concern in Maine's Wildlife Action Plan due to the lack of information about the species in Maine and their apparent decline in recent years. Additionally, the eastern small-footed bat is listed as a Species of Greatest Conservation Need because only one hibernacula record and few summer records exist for the state of Maine. No bat hibernacula have been identified in the vicinity of the Project area.

3.2 DATA COLLECTION METHODS

3.2.1 Acoustic Detector Site Selection

Anabat II and Anabat SD1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the spring 2010 acoustic bat survey. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of the species of bats that could occur in the Project area. Anabat II detectors were coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards; newer SD1 model detectors do not require use of a ZCAIM. Anabat detectors are frequency division detectors, dividing the frequency of echolocation sounds made by bats by a factor of 16, then recording these sounds for subsequent analysis. The audio sensitivity setting of each Anabat system was set between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 to 30 meters (33' to 98').

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unmodified Anabat unit.

Six detectors were deployed for the duration of the spring survey period (Figure 1-1). Two detectors were suspended in a met tower on Little Bull Hill and four detectors were deployed in trees on either end of the northern and southern Project area ridgelines. Detectors were mobilized on April 15 and operated until July 14 when they were demobilized. Each detector was programmed to record nightly from 7:00pm to 7:00am. Maintenance visits were conducted approximately every two weeks to check the condition of the detectors and to download data to a computer for analysis.

Detector Descriptions:

In order to record bats flying above and below the turbine rotor zone, "met detectors" were deployed at a height of 50 and 35 m. Both were attached to a fixed pulley system suspended in the guy wires of the met Tower. Two guy lines were used to secure the detector in place and ensure the solar panel faced south. The tower clearing was approximately 50 m in diameter and the surrounding landscape was a relatively open forest canopy and understory with predominantly birch with a small component of spruce. No source of water or available snags was observed near the turbine clearing.

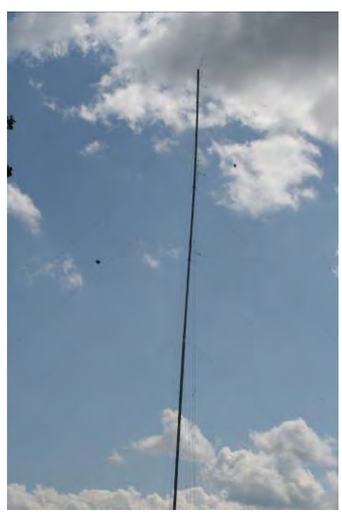


Photo 1 –Met Tower

The "Northeast Tree" detector was deployed at a height of 5 m high in a tree along the edge of a gravel logging road. The surrounding forest was a mix of hardwood and soft wood; birch was the dominant tree species. Undergrowth was a mix of raspberry and grasses. Logging trails perpendicular to the road were filled with slash left behind from recent a harvest. At least one snag was visible from the detector location. The surrounding forest canopy was predominantly young regenerating birch species and appeared to have been cut within the previous five year.

Photo 2 – Northeast (NE) Tree Detector

The "Radar Tree" detector was deployed approximately 3 m high in a tree at the end of a logging road that bisected a patch of young even-aged spruce. The detector was suspended over an old log landing filled with slash from a recent harvest. The logging road was heavily ditched on either side and standing water was frequently observed along the roadway. Several large snags were apparent from the detector location. The surrounding forest canopy was relatively open with very little ground clutter.

Photo 3 – Radar Tree Detector

The "Southeast Tree" detector was deployed at a height of approximately 3 m high in a tree along a logging road, at an intersection. The surrounding forest showed signs of recent harvest and was predominately red spruce, a small component of hardwood, and a few mature white pine throughout. The gravel logging roads were heavily ditched with signs of standing water along the roadway. A few large snags were visible from the detector location and an abandoned log landing filled with slash and planted in a mix of grasses was located a few hundred feet from the detector.

Photo 4 – Southeast (SE) Tree Detector

The "Southwest Tree" detector was suspended at a height of approximately 5 m high in a mature spruce along a gravel logging road at the edge of a log landing filled with slash. The surrounding forest was predominately red spruce with a small component of hardwood species and a relatively open forest canopy. The understory was a mix of raspberry and grasses. A few large snags were observed in the vicinity of the detector.

Photo 5 – Southwest (SW) Tree Detector

3.3 DATA ANALYSIS METHODS

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings with only one call were eliminated from analysis as has been done in similar studies (Arnett *et al*. 2006). Call sequences typically include a series of calls characteristic of normal flight or prey location ("search phase") and capture periods (feeding "buzzes").

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of bats that occur in the northeast. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al*. 2006), detection rates are summarized on both of these temporal scales. Nightly detection rates were summarized by month as well as for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al*. (2007). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would required much larger sample sizes (Arnett *et al*. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al*. 1999, O'Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[3] reflecting the bat community in the region of the Project area, as follows:

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz.

- **Myotis (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.

- **Eastern red bat/tri-colored bat[4] (RBTB)** – Eastern red bats and tri-colored 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.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

[3] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

[4] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

3.4 RESULTS

3.4.1 Timing of Activity

Detectors were deployed on April 15 and continued to record data through July 14, for a total survey period of 467 detector nights. The range of dates that each detector was deployed is summarized in Table 3-1. Throughout the season occasional equipment malfunction occurred causing a lapse in data collection. The majority of equipment malfunction occurred at the beginning of the survey period when bat activity levels were the lowest of the survey period. Collectively detectors recorded data 87 percent of the time they were deployed.

Activity levels peaked during mid July at all tree detectors except the SE tree detector which showed a slight decline from June to July 15 (Figure 3-1). Both met tower detectors recorded few calls throughout the survey period (Figure 3-2). While the met tower low detector recorded the highest activity level during July, the met tower high detector did not record calls during the month of July. The four tree detectors recorded 2,638 call sequences and had an overall detection rate of 8.6 call sequence per detector night. Detection rates of individual tree detectors ranged from 5.3 to 11.2 call sequences per detector night. The highest monthly detection rate occurring at a single tree detector was recorded during the month of July at the radar tree detector which had a detection rate of 39.5 call sequences per detector night. The met tower detectors recorded a total of 65 bat call sequences during the survey period resulting in an overall detection rate of 0.4 call sequences per detector night. Individual detector rates from the two met tower detectors ranged from 0.1 call sequence per night at the met high detector to 0.7 at the met low. The highest monthly met tower bat call detection rate was recorded at the low detector during the month of July and was 2.2 bat call sequences per detector night. The level of detection rates fluctuated throughout the night with the third hour after sunset being the busiest hour of recording (Figure 3-3). Activity levels declined after the third hour of sunset until a second smaller peak in activity occurred seven hours after sunset.

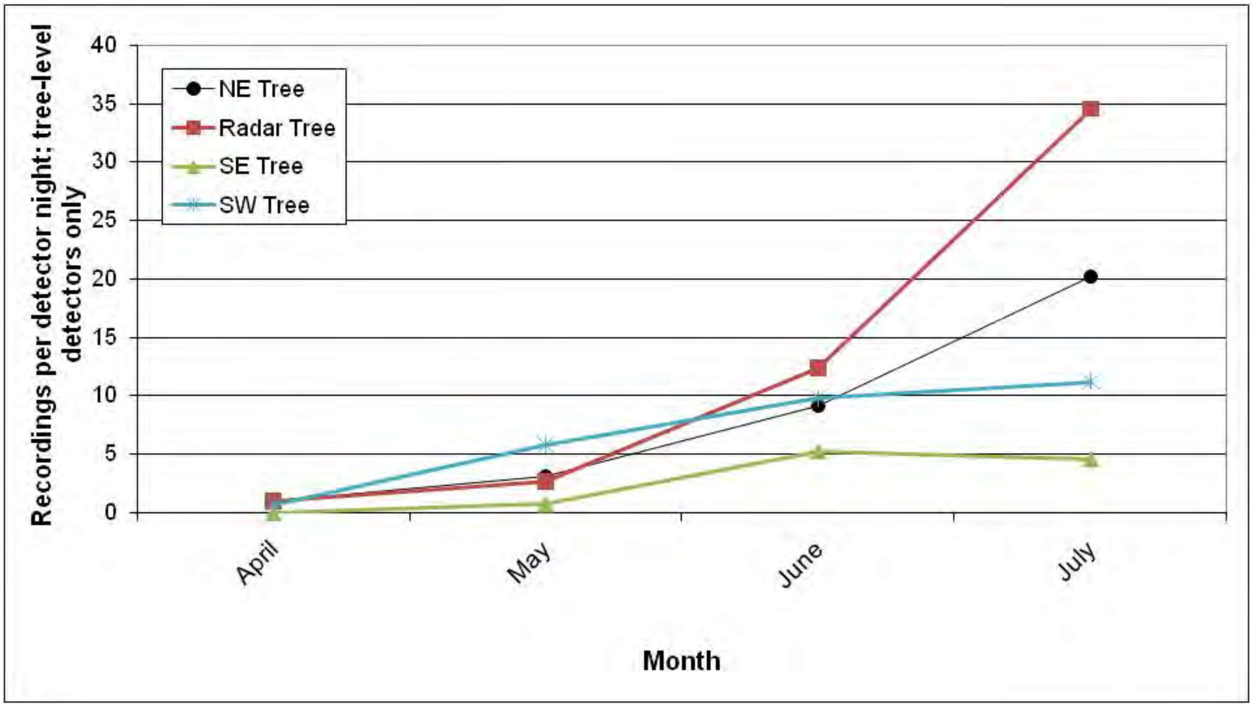


Figure 3-1. Monthly detection rates per detector at the tree detectors at Bull Hill, 2010

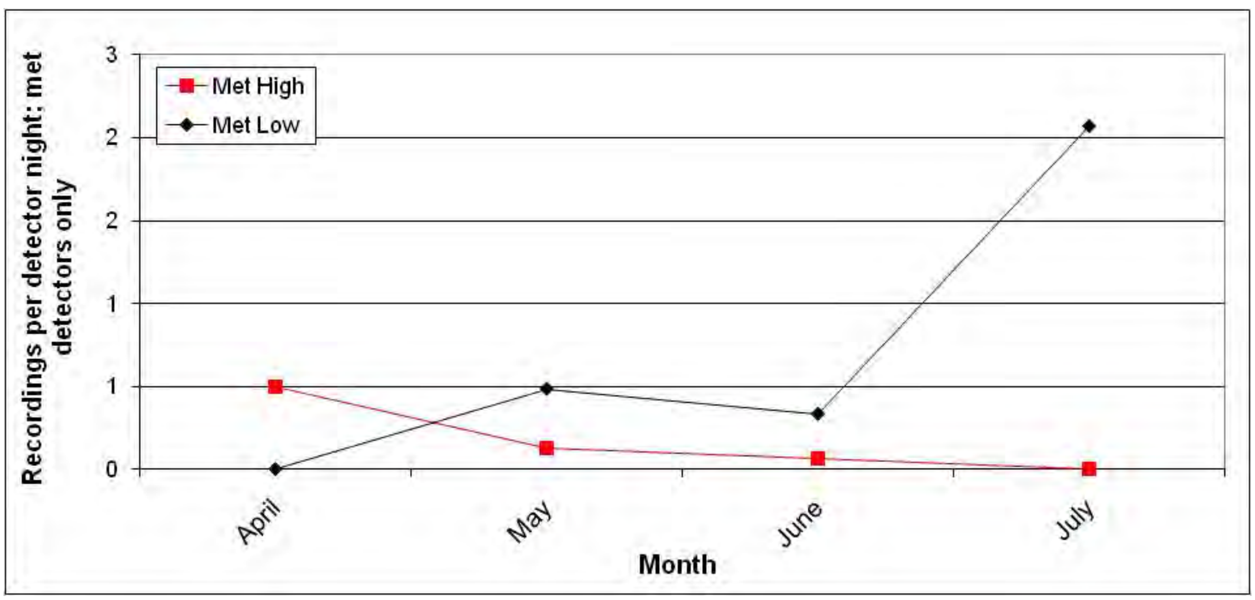


Figure 3-2. Monthly detection rates per detector at met tower detectors at Bull Hill, 2010

Table 3-1. Summary of bat detector field survey effort and results						
Location	**Dates Deployed**	**Calendar Nights**	**Detector-Nights***	**Recorded Sequences**	**Detection Rate ****	**Maximum Sequences recorded *****
Met High	April 15 to July 14	91 81		9	0.1	3
Met Low	April 15 to July 14	91 79		56	0.7	8
NE Tree	April 15 to July 14	91 91		711	7.8	121
Radar Tree	April 15 to July 14	91 91		1023	11.2	181
SE Tree	April 15 to July 14	91 47		250	5.3	57
SW Tree	April 15 to July 14	91 78		654	8.4	33
Overall Results		***546***	***467***	***2703***	5.8 --	
* One detector-night is equal to a one detector successfully operating throughout the night.						
** Number of bat echolocation sequences recorded per detector-night.						
*** Maximum number of bat passes recorded from any single detector for a detector-night.						

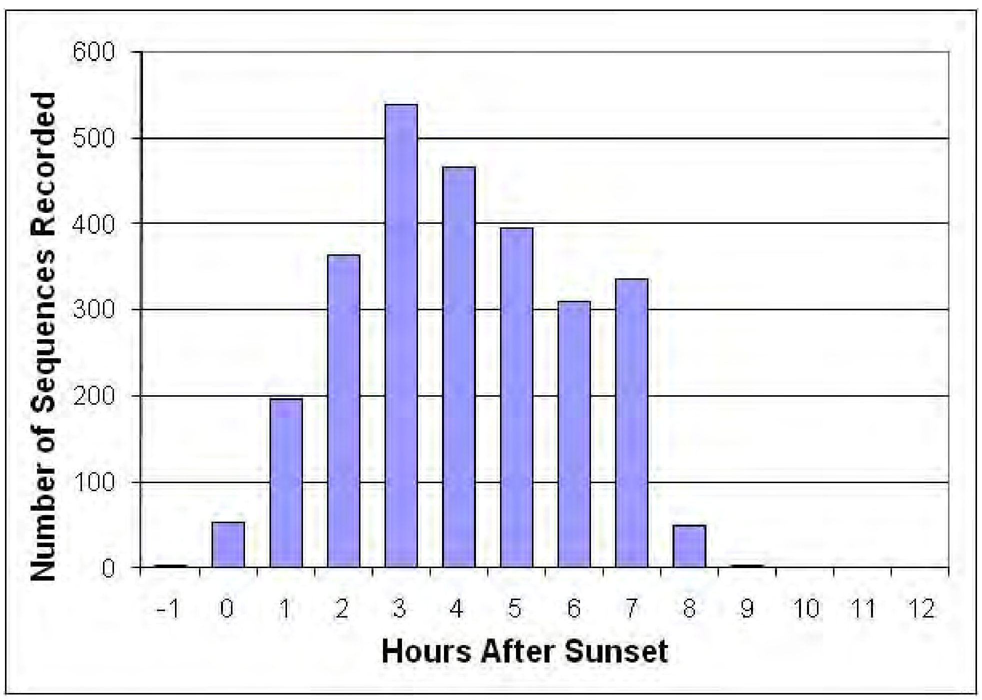


Figure 3-3. Hourly bat call sequence detections at the Bull Hill, 2010.

3.4.2 Species Composition

The met tower detectors recorded species from all guilds except the RBTB guild (Table 3-2). The unknown guilds represented the largest number of calls recorded by the both met tower detectors (n=47), followed by the MYSP guild (n=14). The tree detectors recorded calls from all five represented guilds, MYSP being the most frequently recorded (n=1350), followed by the UNKN guild (n=969). The unknown species guild can be broken down into low-frequency and high-frequency calls (Figure 3-4).

Table 3-2. Distribution of detections by guild for detectors at Bull Hill, Spring/Summer 2010.

Detector	Guild					Total
	BBSH	HB	MYSP	RBTB	UNKN	
Met High	1	0	1 0 7			9
Met Low	1	2	13 0 40			56
NE Tree	18	2	321	0	370	711
Radar Tree	190	7	599	7	220	1,023
SE Tree	18	3	77	1	151	250
SW Tree	33	30	353	10	228	654
Total Met Detections	2	2	14 0 47			65
Total Tree Detections 259		42	1350	18	969	2638
Met Detector Guild Compostion %	3.08% 3.08%		21.54%	0.00% 72.31%		--
Tree Detector Guild Compostion %	9.82% 1.59%		51.18%	0.68% 36.73%		--

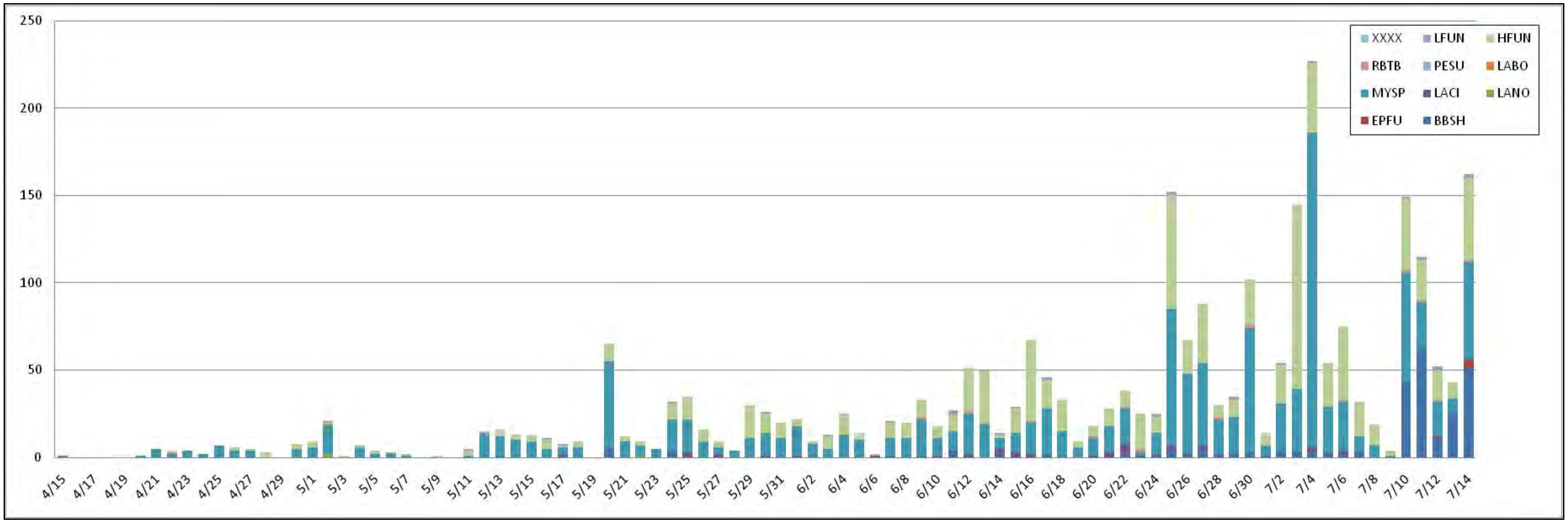


Figure 3-4. Total nightly bat call sequence detections at Bull Hill, 2010

Appendix B provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix B Tables 1 through 6 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Analook files for all 2,703 recorded call sequences can be made available upon request.

3.5 DISCUSSION

Bat activity was variable among detector heights and locations during the spring and summer 2010 survey period, yet patterns in bat activity within the Project area emerged from this survey period. Nightly activity rates were lowest during the first few weeks of the survey period in April when nightly temperatures remained low. An increase in nightly bat activity corresponded with a seasonal increase in mean nightly temperatures recorded. Recent studies have found that bat activity patterns are influenced by weather conditions (Arnett *et al*. 2006, Arnett *et al*. 2008, Reynolds 2006). Acoustic surveys have documented a decrease in bat activity rates as wind speed increase and temperatures decrease, and bat activity has been shown to correlate negatively to low nightly mean temperatures (Hayes 1997, Reynolds 2006). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett *et al*. 2005).

The met tower detectors recorded an overall detection rate of 0.4 bat call sequences per detector night. Combined, the tree detectors recorded an overall detection rate of 8.6 call sequences per detector night. The largest overall peak in bat activity rates was recorded during July 4, 69 percent of which were MYSP calls recorded at the Radar Tree detector. It is important to note that detector location, height, and surrounding habitats can significantly affect detection rates.

The Radar Tree detector recorded the highest average monthly detection rate of all six detectors during the month of July, 2010 (36.9 bat call sequences per night), 84 percent of which were from the MYSP guild. When considering the level of activity documented by acoustic surveys, the numbers of recorded bat call sequences cannot be directly correlated with the number of bats in an area because acoustic detectors do not allow for differentiation between individuals.

Each file recorded by the six detectors was individually assessed to separate potential bat call sequences from static and other ambient noise resulting in 2,703 call files extracted. All calls were provisionally categorized into one of the five possible guilds; however some calls contained enough detail to be labeled to the species level. Several bat species of the northeast produce calls that exhibit unique characteristics. Such distinguishable details usually include the frequency and shape of a call. When a call file lacks sufficient detail to indentify species or in cases when the call has characteristics of one or more species, a guild labels is applied.

Certain species, such as the eastern red bat and hoary bat, have easily identifiable calls. Other species, such as the big brown bat and silver-haired bat, are difficult to distinguish acoustically. Similarly, certain members of the Myotis genus, such as the little brown bat, are far more common and have slightly more distinguishable calls than other species. A total of 1,364 Myotis call sequences (50.5% of total call sequences recorded) were detected at the Project in spring, 2010. Both Myotis and RBTB calls fall within the range of the HFUN category and are often identified as such when less than five calls are recorded. During the spring, 2010 season, 1,364 Myotis calls were labeled to guild while only 18 RBTB calls were labeled to guild, which likely indicates that more of the 985 HFUN calls were from the Myotis guild than the RBTB guild.

The RBTB guild includes the tri-colored bat and eastern red bat. Only 18 call sequences, 0.7 percent of total call sequences recorded by detectors during the spring survey, belonged to the RBTB guild. None of these calls had enough detail to be identified as eastern red bats or tri-colored bats. Eastern red bats have relatively unique calls which span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Tri-colored bats tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. Although both species do have distinct call characteristics their calls most often appear similar making differentiation difficult resulting in the RBTB classification.

The BBSH guild includes the big brown bat and silver-haired bat, both of which produce search-phase calls with minimum frequencies in the 25-30 kHz range. 261 call sequences from the BBSH guild composed 9.7 percent of all calls recorded during the spring 2010 survey period. Certain types of calls by each species are easily distinguishable from the other based on minimum frequency and call profile, but other calls in this range have overlapping characteristics and are difficult to distinguish. Eight of these calls were identified as big brown bats and three as silver-haired bats. One review of post construction mortality data from wind power sites in the eastern US found big brown mortality to occur less frequently than silver-haired bat mortality (Arnett et al, 2008).

The HB guild consists of the hoary bat, the largest bat species in the northeast. Forty-four (1.6%) call sequences recorded in the Project area belonged to the hoary bat. Hoary bat calls are generally distinguishable from all other species in the region and are characterized by highly variable minimum frequencies often extending below 20 kHz, and a hooked profile similar to the eastern red bat.

The height of a detector may determine the number of call sequences and the species composition it records; for example, long-distance migratory species are more likely to be recorded at detectors deployed above canopy height (Arnett et al. 2006). Detectors in and around canopy height likely detect foraging individuals passing by the detector multiple times, whereas much less concentrated foraging likely occurs within the recording zone of met tower detectors, possibly resulting in fewer foraging bats being recorded multiple times. Typically detectors deployed in met towers record a higher percentage of migratory species, (e.g., big brown bats and silver-haired bats) than tree detectors, which usually detect more Myotis and HFUN call sequences. However, only two of the calls recorded in met tower detectors were from the BBSH guild at the Project and only two calls were identified as hoary bats.

Results of acoustic surveys must be interpreted with caution. It is important to acknowledge that numbers of recorded bat call sequences cannot be correlated with the number of bats in an area because acoustic detectors do not allow for differentiation between individuals (Hayes 2000). Methods surrounding acoustic bat surveys are continually evolving, and it there is currently little data aiding in the interpretation of number of calls per detector nights. Although interpretations are limited, the surveys represent a sample of activity and the general species groups that occur in the Project area, which are fairly typical when compared to these variables at other potential wind projects throughout the northeast.

4.0 Diurnal Raptor Surveys

4.1 INTRODUCTION

Three days of winter surveys and 12 days of spring season raptor migration surveys were conducted during 2010 at the Project. The primary purpose of the winter surveys was to document bald eagle (*Haliaeetus leucocephalus*) (a state-listed species of special concern) activity at or around Molasses Pond. All raptor species observed were documented.

The purpose of the spring raptor surveys to document the species that occur in the vicinity of the Project and to record the specific flight heights, flight path locations, and other flight behaviors of raptors within the Project area. Survey methodology and level of effort were discussed before and during the spring raptor migration surveys. During this initial agency meeting, MDIFW indicated raptor surveys should note all bald eagle, northern harrier (*Circus cyaneus*) (special concern), great blue heron (*Ardea herodias*) (special concern), and osprey (*Pandion haliaetus*), activity, as these species are suspected to occur in the vicinity of the Project area.

In the eastern United States, raptor migration tends to concentrate along the shores of large bodies of water including lakes and the Atlantic Coast (Kellogg 2007) as well as along ridgelines, where raptors take advantage of updrafts which form along the side slopes of ridges. Updrafts allow raptors to fly long distances with minimal exertion (Berthold 2001). Raptors also use thermals, which are pockets of warm, rising air that form as the ground's surface is heated by the sun, in order to minimize energy expenditure during migration movements (Bildstein 2006). Thus, raptor surveys were conducted from prominent locations on ridges inside the proposed Project area.

4.1.1 Study Area Description

For the purposes of this report, the 'study area' is considered the observable airspace as seen from the observation locations. The 'Project area' includes only those locations within the study area where turbines are to be located[6]. The Project area includes two separate turbine arrays on lower elevation hillsides: one on Bull Hill and one stretching across Heifer Hill and Beech Knoll (Figure 1-1). The observation locations during the winter surveys were performed from Sparrow Hill and spring 2010 surveys were performed from Bull Hill (Figure 1-1), both prominent

[6] Due to the change in turbine number and location on July 16, 2010, data collected during winter and spring migration surveys were reanalyzed to accurately report the number of birds observed within the Project area based on the updated turbine layout.

locations within the Project area. The view from Sparrow Hill provided an excellent 360 degree view. Accordingly, the observer had 100 percent visibility of all proposed turbine locations. The view from Bull Hill also provided an excellent 360 degree view. Accordingly, the observer had 100 percent visibility of all proposed turbine locations (Figure 1-1; Photo 4-1 and 4-2).

Photo 4-1. View of Molasses Pond from Sparrow Hill, the winter 2010 observation site.

Photo 4-2. View from Spring 2010 raptor survey location on Bull Hill.

The study area was categorized by the topographical positions which occur there (Figure 4-2). For clarification, locations within the Project boundary at Bull Hill include all topographical positions A, B, C, and D (Figure 4-1). However, proposed turbine locations at Bull Hill include the crests (A) and mid-slopes (B and C) of the Project ridges.

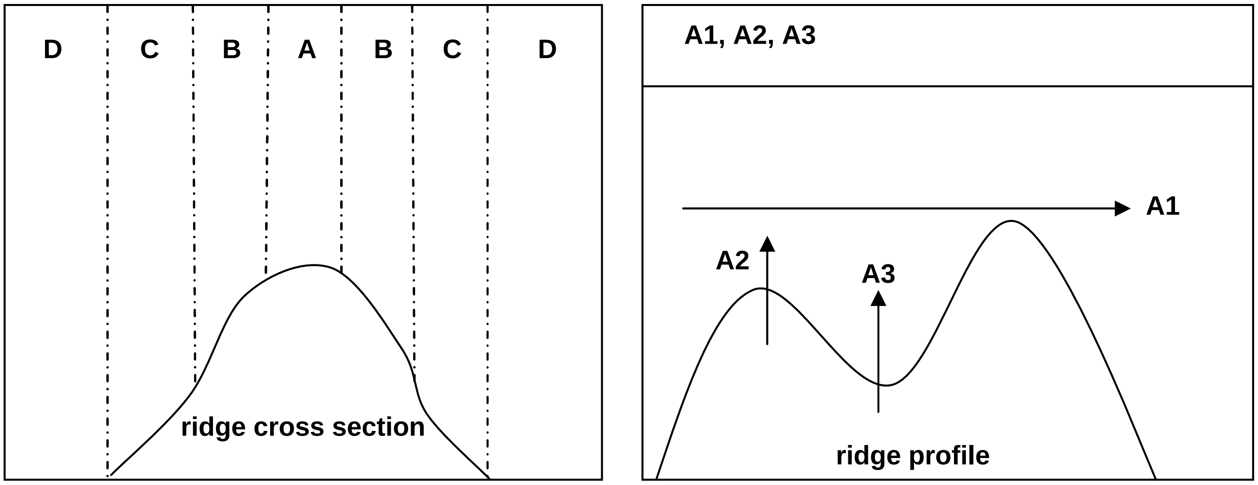


Figure 4-1. Raptor flight position categories in relation to the topography of the study area (codes apply to locations within and outside of Project area). A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley.

For the purposes of data summary, the study area has been categorized into four separate regions: the Project area on Bull Hill, the Project area on Beech Knoll and Heifer Hills, ridges outside of the Project area, and valleys outside the Project area.

4.2 METHODS

4.3 RAPTOR DATA COLLECTION METHODS

4.3.1 Field Surveys

Field surveys were conducted on 3 days in winter 2010 and 12 days during the spring survey period[7]. Visual observation survey methods were based on modified Hawk Migration Association of North America (HMANA) methods (HMANA 2007). Surveys were conducted for seven consecutive hours between 9:00 am and 4:00 pm, during the peak hours of thermal development and raptor movement.

During surveys the observer scanned the sky and surrounding landscape by naked eye or with binoculars. Each raptor observation, or pass, was documented. Each time a bird was observed it was recorded, regardless of whether it was suspected to be a local bird observed previously. Therefore, daily count totals include all observations, or passes, of birds observed throughout a survey day[8]. Detailed information for each observation was recorded on standardized data sheets, including:

[7] Data regarding bald eagles are summarized for the 3 winter surveys in this report; all raptor data collected during the 3 winter surveys were combined and analyzed with data from the 12 spring migration survey.
[8] It should be noted that HMANA observers typically do not count birds suspected to be local or seen previously that day; therefore, this should be considered when comparing results between datasets.

- Observation date and time;
- Species [9], number of individuals, and age (if possible);
- The location of each bird depicted on a topographical map;
- The flight height[10] and behaviors observed in each of the topographical positions where birds occurred[11];
- The general flight direction of each bird; and
- An estimate of the length of time birds spent below maximum turbine height.

Additionally, observations of non-raptor species including water birds were documented by the observer. Passerine observations made during the raptor surveys were also recorded by the observer, however these data were not collected uniformly or systematically.

4.3.2 Weather Data

Wind direction, wind speed, and the development of thermals largely influence raptor flight behaviors and flight paths. Therefore, throughout each survey day, the observer recorded hourly weather conditions including wind speed and direction, temperature, sky condition, percent cloud cover, cloud type, and relative cloud height.

Specific seasonal weather conditions result in accentuated raptor migration movements. Atmospheric instability and updrafts are conditions that accompany low pressure systems and storms and raptors will move in advance of these conditions (Drennan 1981). Additionally, soaring on southerly winds is more efficient for northbound migrants (Drennan 1981). Raptor migration in the spring is most intense during the approach of a low pressure system and a cold front, and on days with southerly winds and rising air temperatures (Drennan 1981). In order to consider the atmospheric influences on raptor activity during the days that were sampled in spring 2010, regional surface weather map images were interpreted to determine the dates that daytime pressure systems (high, low, or none) moved through the region. Surface weather maps, prepared by the National Centers for Environmental Prediction, the Hydro-meteorological Prediction Center, and the National Weather Service, were downloaded daily for the majority of the survey window. The Surface Weather Maps show station data and the analysis for 7:00 am, EST.

---

[9] Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor.

[10] Nearby objects with known heights, such as met towers and trees, were used to estimate flight height.

[11] As individual birds traveled through or in the vicinity of the Project, all topographical position categories in which a bird occurred were recorded.

4.4 RAPTOR DATA ANALYSIS METHODS

Raptor observation data were summarized by survey day. Data analysis included a summary of:

- Daily and seasonal observation rates (raptors observed per hour);
- Total observations of the different species observed;
- Hourly observation totals;
- The percentage of birds observed in the study area which occurred specifically within the Project area;
- The percentage of birds suspected to be actively migrating;
- A summary of flight behaviors observed in the topographical positions of the different locations of the study area;
- The average minimum flight height of birds within each topographical position category; and
- For those birds observed within proposed turbine areas (topographical positions A, B, and C), the percentage of birds seen below 145 m (390').

The daily results of the winter and spring 2010 surveys were compared to the daily results of available regional raptor surveys. Survey results are available from the following sites: Bradbury Mountain, Pownal, ME; Barre Falls, Barre, MA; Pitcher Mountain, Stoddard, NH; Pilgrim Heights, North Truro, MA; and Plum Island, Newburyport, MA.

4.5 RESULTS

4.5.1 Weather Summary

Among survey days, the average hourly temperature was 12° C (53° F). Temperatures ranged from 3° C to 23° C (38 to 74° F). Sky conditions varied from clear to partly cloudy to overcast. There were 3 survey days which experienced periods of reduced visibility: a total of 8 hourly periods (out of 104 total hours; 8 percent) during which drizzle and rain showers reduced visibility. Wind direction was variable among survey days. Wind was predominantly from the west on 4 survey days, from the southwest on 3 survey days, from the south on 2 survey days, from the northeast on 2 survey days, from the northwest on 2 survey days, and variable on 2 survey days. Wind speeds ranged from 0 to 36 kilometers per hour (kph) (0 to 24 miles per hour [mph]).

Analysis of regional surface weather maps showed variable weather conditions during the survey periods. High pressure and fair weather existed throughout the region on seven survey days, while unsettled weather and frontal systems moved through during eight days. Days with highest passage rates occurred in early May during approaching and passing low pressure systems.

4.5.2 Raptor Data

A total of fifteen survey days were sampled between March 19 and May 23, resulting in a total of 104.25 survey hours[12]. A total of 55 raptor observations were made. The seasonal passage rate was 0.53 raptors/hour. Table 4-1 summarizes 2010 raptor migration survey results.

Table 4-1. A summary of the Spring 2010 survey effort and results for the Bull Hill Wind Project in Washington County, Maine

Range of survey dates		**3/19/2010 to 5/23/2010**	
No. survey days		**15 days**	
Total survey hours		**104.25**	
Total raptor species observed		**9**	
Raptor species observed		**State Listing**	**In Project area? (Y/N)**
(Common Name)	**(Scientific Name)**		
American kestrel	*Falco sparverius*		Y
bald eagle	*Haliaeetus leucocephalus*	Special Concern	N
broad-winged hawk	*Buteo platypterus*		Y
merlin	*Falco columbarius*		Y
northern harrier	*Circus cyaneus*	Special Concern	Y
osprey	*Pandion haliaetus*		N
red-tailed hawk	*Buteo jamaicensis*		N
sharp-shinned hawk	*Accipiter striatus*		Y
turkey vulture	*Cathartes aura*		Y
Total no. observations of raptors in study area		**55**	
Seasonal passage rate (raptor observation/hour)		**0.53**	
Total no. observations of raptors within Project area (percent of total observations in study area)		**15 (27%)**	
Total no. observations of raptors seen in turbine areas below max turbine height (145 m) (percent of total observations in Project area only)		**15 (100%)**	

Daily passage rates ranged from 0 (4/22, 5/21 and 5/23/2010) to 2.14 (5/5/2010) raptors/hour. Survey day totals ranged from 0 to 15 observations per day. The day with the highest passage, May 5 (n=15), was characterized by moderate northwest winds, mild temperatures, and excellent thermal development evidenced by fair weather cumulus clouds. Raptor activity during the spring 2010 surveys peaked in early May (Figure 4-2; Appendix C Table 1).

12. To see the raptor observations recorded during the 3 winter survey days separately, see Appendix C Table 1.

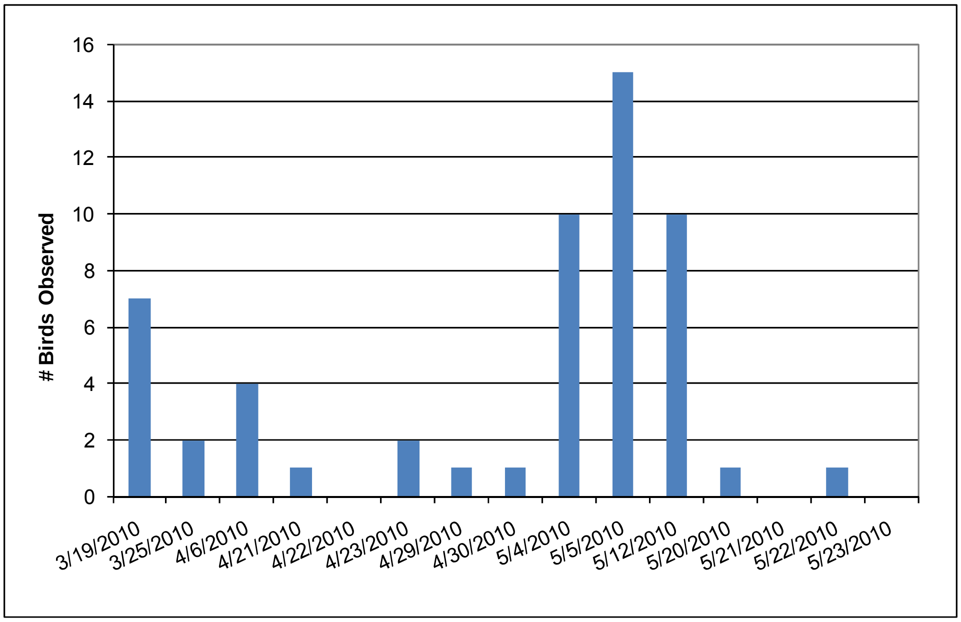


Figure 4-2. Survey totals of raptors observed during Spring 2010 surveys at the Bull Hill Wind Project.

There were nine species of raptors observed in the study area (not including the five unidentified individuals). The most common raptor species observed was broad-winged hawk (n=12; 22%). Other commonly observed species include turkey vulture (n=11, 20%), red-tailed hawk (n=6, 11%), and bald eagle (n=6, 11%) (Figure 4-3; Appendix C Table 1).

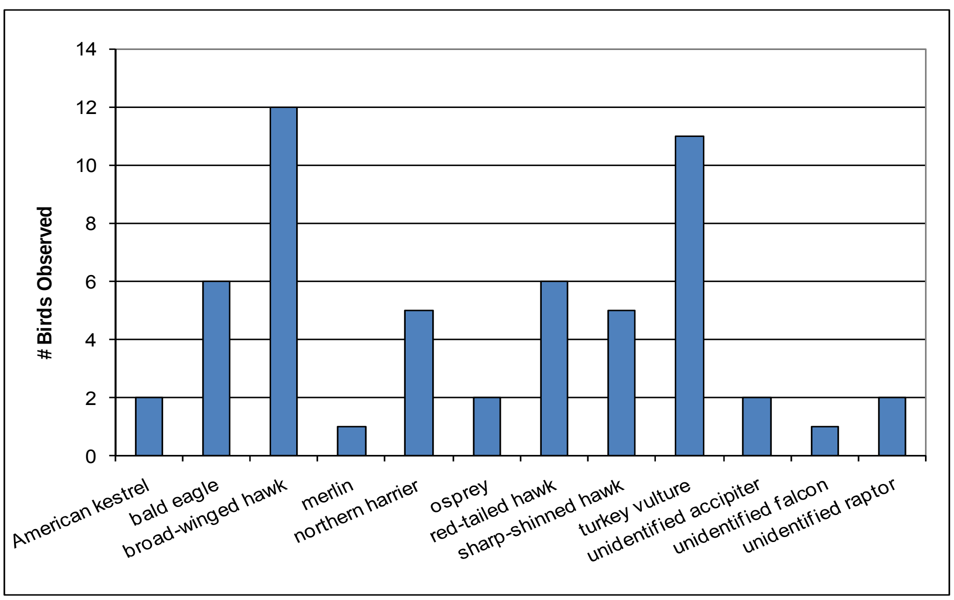


Figure 4-3. Number of observations of raptor species observed during Spring 2010 surveys at the Bull Hill Wind Project.

4.5.3 Hourly observations

Throughout the survey season, the majority of observations peaked in the morning hours between 9 am and 10 am and gradually decreased throughout the afternoon (Figure 4-4; Appendix C Table 2).

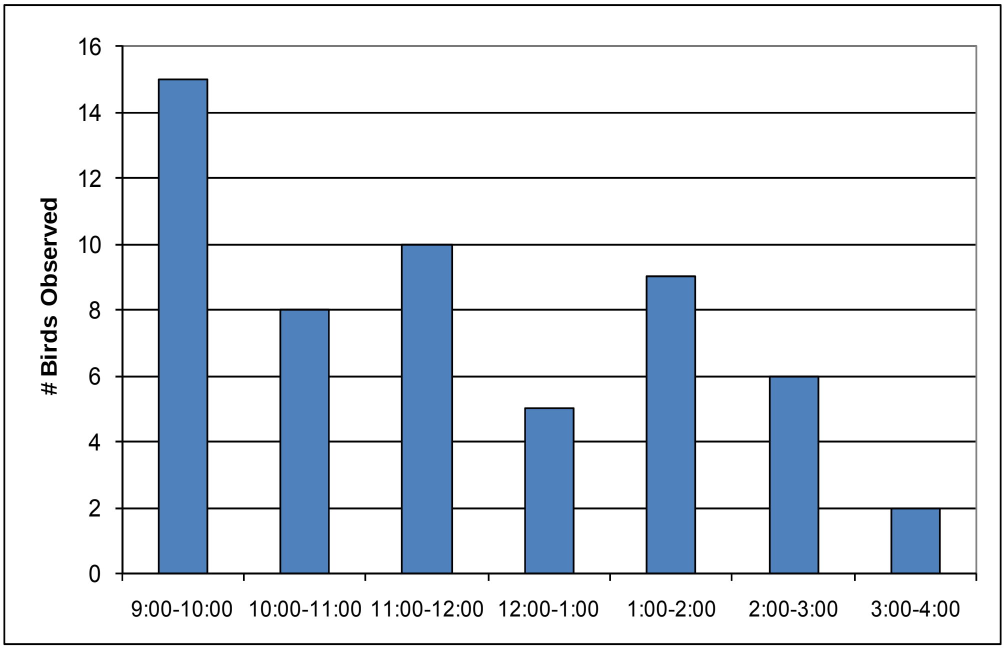


Figure 4-4. Number of observations of raptors per survey hour during Spring 2010 surveys at the Bull Hill Wind Project.

4.5.4 Raptor locations

Of the 55 total raptor observations made within the study area, 27 percent (n=15) occurred specifically within the Project area (Figure 4-5; Appendix C Table 3). Of the raptor observations within the Project area, all observations (n=15) occurred over Bull Hill (Figure 4-5; Appendix C Table 3).

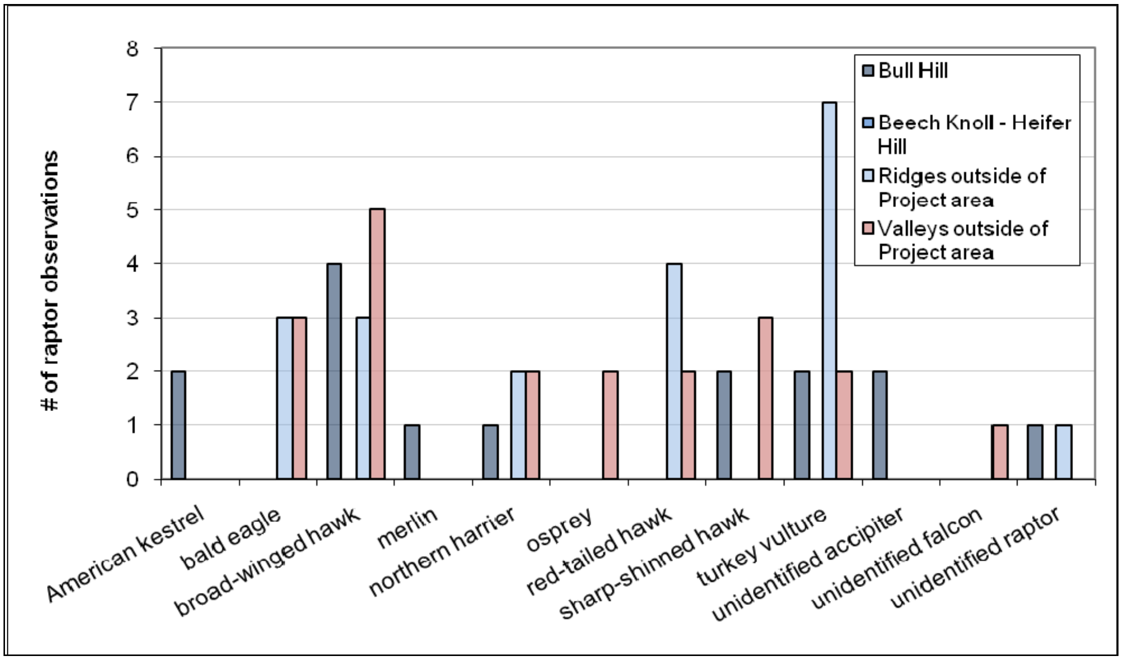
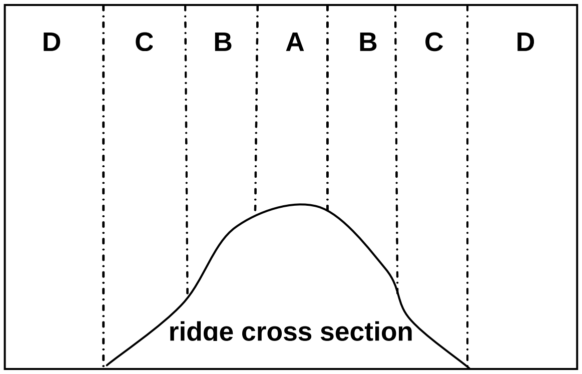


Figure 4-5. Number of observations of raptor species within different study area location categories during Spring 2010 surveys at Bull Hill Wind Project.

4.5.5 Raptor behaviors

Raptor behaviors observed in the topographical positions of the different study area location categories are summarized in Table 4-2. Note that there are more behavior observations than there were total raptors observed because some raptors exhibited multiple behaviors while passing through multiple topographical positions in the study area.



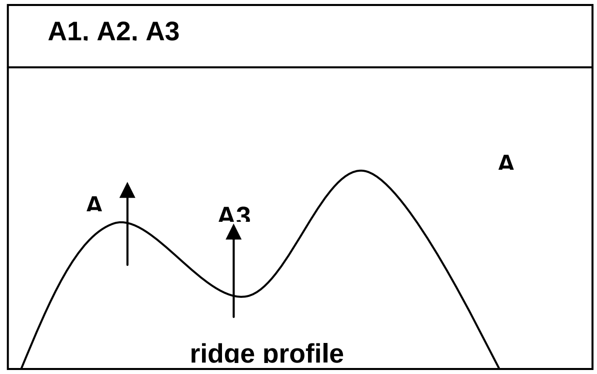


Table 4-2. Raptor behaviors summarized by location in study area and flight position during Spring 2010 at the Bull Hill Wind Project

Location in Study Area	Behavior	Soaring, Gliding						Powered Flight						Foraging Behaviors						Territorial or Courtship Behavior						Perched					
	Flight position where behavior observed	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D
	Bull Hill	7	0	0	3	2	2	5	1	0	3	2	0	2	0	0	1	0	0	2	0	0	0	0	0	2	0	0	0	0	0
	Little Bull Hill	2	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sparrow Hill	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Valley	1	0	0	6	8	14	0	0	0	3	2	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total behavior obs = 79	**11**	**1**	**0**	**10**	**10**	**17**	**5**	**1**	**1**	**7**	**4**	**3**	**3**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**

Raptors were considered actively migrating if their flight path was generally direct and in a northerly direction. Raptors were suspected to be stop-over or seasonally local birds if they were traveling in a non-direct manner and in a non-migratory direction, or if they exhibited perched or foraging flight behaviors. The raptors suspected to be actively migrating or not actively migrating are summarized in Table 4-3. Twenty-nine percent (n=16) of raptors observed during the spring 2010 surveys were suspected to be migrants based on the direction which they were flying (e.g. generally northward) and their flight behavior (i.e. powered flight). The majority of turkey vultures, the species most frequently observed during the surveys, were not actively migrating.

Table 4-3. Observations of raptors suspected to be actively migrating during Spring 2010 at the Bull Hill Wind Project

Species	actively migrating	not actively migrating	unknown
American kestrel	2	0	0
bald eagle	0	5	1
broad-winged hawk	8	4	0
merlin	0	1	0
northern harrier	1	4	0
osprey	0	2	0
red-tailed hawk	0	5	1
sharp-shinned hawk	2	2	1
turkey vulture	2	5	4
unidentified accipiter	0	0	2
unidentified falcon	1	0	0
unidentified raptor	0	1	1
Season Totals:	**16**	**29**	**10**

4.5.6 Flight heights

The average minimum flight heights of birds observed in the different topographical positions of the study area are summarized in Table 4-4 below.

Table 4-4. Number of observations and average flight heights for each position category for birds observed during Spring 2010 at the Bull Hill Wind Project

	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
No. of position observations (N=62)	11	4	3	14	11	19
Average minimum flight height (m)	57	86	150	74	36	225

Of the 55 raptor observations that occurred within the study area, 72 percent (n=40) were outside the project area. The remaining 15 observations took place in the Project area along ridges where turbines may be sited. Within these positions (flight positions A, B, and C), all (n=15; 100%) of observed flight heights occurred below the proposed maximum turbine height of 145 m for at least of portion of their flight (Figure 4-6; Appendix C Table 4).

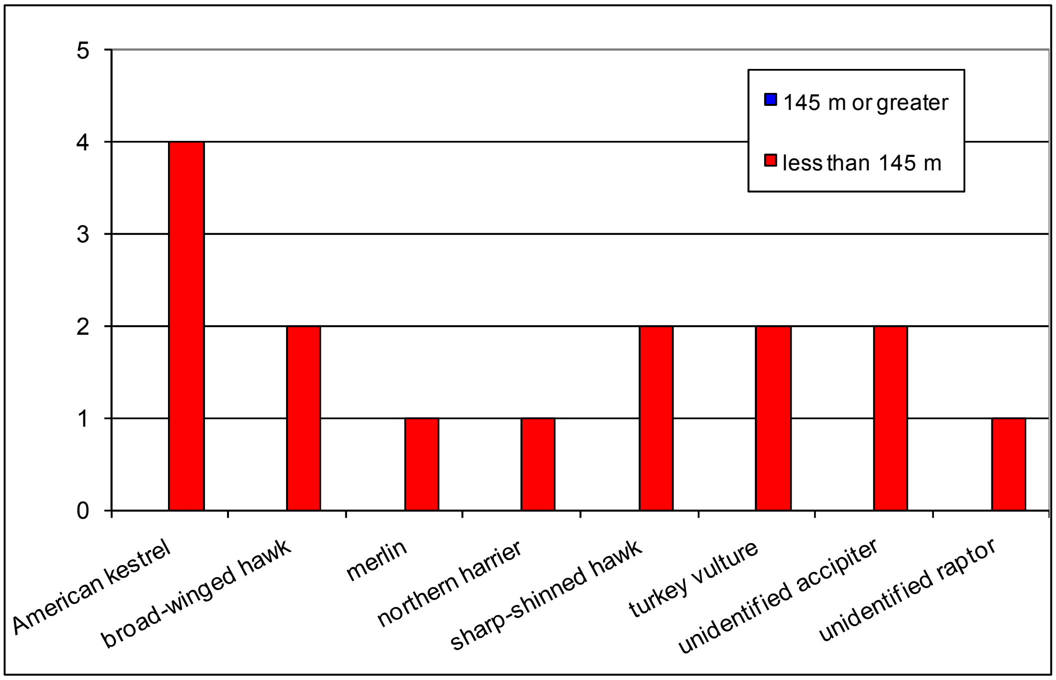


Figure 4-6. Number of observations of raptor species observed within Project area at heights above and below 145 m during Spring 2010 surveys at Bull Hill Wind Project.

4.6 SPECIAL CONCERN SPECIES

No state or federally endangered or threatened raptor species were observed during the surveys. Two raptor species of special concern were observed during both survey seasons: bald eagle and northern harrier. Two other species of interest were observed during the spring 2010 surveys: great blue heron (special concern) and osprey.

Five bald eagle observations were made during winter 2010 survey and one bald eagle observation was made during the spring raptor survey (additionally, one incidental bald eagle observation was made on the same day as the raptor survey, but outside the survey hours and outside the Project area). All eagle observations occurred outside the Project area. Four bald eagle observations occurred on one survey day in early spring (March 19): two adult eagles were observed in the same vicinity on two occasions at locations outside of the Project area, including a known nest location on Crimmins Island on Molasses Pond. On April 6, an adult eagle was seen as it was chased by a red-tailed hawk to the southwest of Sparrow Hill. On May 4, an adult eagle was seen soaring west high over Spectacle Pond.

Five northern harrier observations were made during spring 2010 raptor surveys, one of which occurred over Bull Hill within the Project area. On April 23, an adult female harrier was observed hunting a snake on the ground just outside the Project area on Bull Hill, then flew out over Little Bull Hill toward the Oxbow Heath. A second adult female, possibly the same individual was seen later that day crossing Little Bull Hill and roughly following the lakeshore to the west. On May 4, a harrier was seen flying east over Spectacle Pond. On May 5, a harrier was seen flying in the Oxbow Heath vicinity and a second harrier—the only harrier seen in the Project area—was observed flying just over the treetops on the ridge of Bull Hill, flapping southeast, then back to the northwest.

There were two osprey observed on May 12 from Bull Hill: the birds were seen over valleys outside of the Project area. One great blue heron was observed outside of the Project area on May 5 flying southwest between Bull Hill and Little Bull Hill toward the French's Dam Meadow.

4.7 INCIDENTAL NON-RAPTOR OBSERVATIONS

Forty-five non-raptor avian species were observed incidentally during the winter and spring 2010 raptor surveys in the Project area, specifically within the viewshed shown on Figure 1-1. All non-raptor species identified by the observer were recorded on a separate datasheet. Passerine species were listed at the time they were seen or heard. Data were recorded for any waterbird seen or heard including the time it was observed, flight height, direction of flight, and location in the Project area. Among these species, six species are listed as state special concern: American redstart (*Setophaga ruticilla*), barn swallow (*Hirundo rustica*), black-and-white warbler (*Mniotilta varia*), chestnut-sided warbler (*Dendroica pensylvanica*), great blue heron (*Ardea herodias*), and white-throated sparrow (*Zonotrichia albicollis*) (Table 4-5).

Table 4-5. Non-raptor avian species observed incidentally during Spring 2010 raptor migration surveys at the Bull Hill Wind Project

Common Name	Scientific Name	Special Concern
Acadian flycatcher	*Empidonax virescens*	
American crow	*Corvus brachyrhynchos*	
American goldfinch	*Spinus tristis*	
American redstart	*Setophaga ruticilla*	Y
American robin	*Turdus migratorius*	
American woodcock	*Scolopax minor*	
barn swallow	*Hirundo rustica*	Y
black-and-white warbler	*Mniotilta varia*	Y
black-capped chickadee	*Poecile atricapillus*	
black-throated blue warbler	*Dendroica caerulescens*	
black-throated green warbler	*Dendroica virens*	
blue jay	*Cyanocitta cristata*	
blue-headed vireo	*Vireo solitarius*	
brown creeper	*Certhia americana*	
Canada goose	*Branta canadensis*	
chestnut-sided warbler	*Dendroica pensylvanica*	Y
common loon	*Gavia immer*	
common raven	*Corvus corax*	
common yellowthroat	*Geothlypis trichas*	
dark-eyed junco	*Junco hyemalis*	
downy woodpecker	*Picoides pubescens*	
eastern phoebe	*Sayornis phoebe*	
golden-crowned kinglet	*Regulus satrapa*	
great blue heron	*Ardea herodias*	Y
hairy woodpecker	*Picoides villosus*	
hermit thrush	*Catharus guttatus*	
herring gull	*Larus argentatus*	
house finch	*Carpodacus mexicanus*	
magnolia warbler	*Dendroica magnolia*	
mourning dove	*Zenaida macroura*	
northern flicker	*Colaptes auratus*	
ovenbird	*Seiurus aurocapilla*	
palm warbler	*Dendroica palmarum*	
pileated woodpecker	*Dryocopus pileatus*	
pine warbler	*Dendroica pinus*	
purple finch	*Carpodacus purpureus*	
ruby-crowned kinglet	*Regulus calendula*	
ruby-throated hummingbird	*Archilochus colubris*	
ruffed grouse	*Bonasa umbellus*	
song sparrow	*Melospiza melodia*	
unidentified gull	n/a	
unidentified passerines	n/a	
unidentified waterfowl	n/a	
white-breasted nuthatch	*Sitta carolinensis*	
white-throated sparrow	*Zonotrichia albicollis*	Y
wild turkey	*Meleagris gallopavo*	
winter wren	*Troglodytes troglodytes*	
yellow-rumped warbler	*Dendroica coronata*	

4.8 DISCUSSION

Of the 55 raptor observations made in the study area during the spring 2010 surveys, 27 percent of these observations occurred within the Project area. Of these birds within the Project area, all (100%) occurred over or along Bull Hill (where one of the two observation locations was positioned). It should be noted that the locations where raptors were observed in the study area are subject to observer bias. In general, birds in closer vicinity to the observer would be more visible to the observer than birds that occur at greater distances from the observer; whereas birds that traveled outside of the observer's view shed would have gone undetected. In this case, the fact that more raptor observations were made over Bull Hill than over the Beech Knoll/Heifer Hill area may be due to the fact that the raptor survey location was on Bull Hill, and observers more readily focused on raptors flying over this ridge.

The three winter survey days conducted at Sparrow Hill documented five bald eagle observations in the vicinity of Molasses Pond, none of which occurred within the Project area. The two spring aerial bald eagle nest surveys did not reveal any active nests in the Project area at the time of the surveys.

The survey effort and results of regional spring 2010 HMANA raptor surveys are available in Appendix C Table 5. The passage rate at the Project is lower than the rates reported at regional HMANA locations in Maine, New Hampshire, and Massachusetts. It should be noted that, when comparing the results of the Bull Hill surveys to the HMANA surveys, HMANA surveys typically do not count birds that are not actively migrating. The observations in this report are more inclusive, counting both migrating and non-migrating raptors. The Bull Hill passage rate for migrants only (0.25 raptors/hour) is considerably lower than the results at the other HMANA survey locations.

Raptor migration in the spring is most intense during the approach of a low pressure system and a cold front, and on days with southerly winds and rising air temperatures (Drennan 1981). Accordingly, days with the highest passage rates at the Project during the spring 2010 surveys occurred in early May during approaching and passing low pressure systems.

The flight paths of raptors observed at the Project varied between survey dates and were influenced by varying wind direction and weather. During raptor migration, flight pathways and flight heights along ridges, side slopes, and across valleys may vary seasonally, daily, or hourly. Raptors may shift and use different ridgelines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration paths as well as flight heights. Wind strongly affects the propensity of raptors to congregate along 'leading lines' or topographic features (Richardson 1998). Wind, air temperature, and cloud cover influence the development of updrafts and thermals used by raptors while making long-distance flights.

The behaviors and flight heights of raptors observed in the different topographical positions of the study area were typical of actively migrating raptors as well as non-migrant raptors traveling between locations in the general area. Raptors observed were primarily commuting between resources in the area; few foraging behaviors were seen during the spring 2010 surveys.

Variations in flight heights among sites, and among survey days at a single site, are due to variable weather conditions and the particular flight behaviors of different raptor species. Typically, *accipiters* and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. *Buteos* tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors (*accipiters* in particular) typically fly lower than usual during windy or inclement conditions. Local birds may fly at lower altitudes while making small scale movements between foraging locations (Barrios and Rodriguez 2004). The relatively low average flight heights recorded at the Project may be due to the fact that more raptors at the Project were suspected to be local or commuting between resources rather than migrating.

Pre-construction raptor studies can provide baseline data regarding the species of raptor that occur in the study area and their general flight behaviors. At the Project, the number of raptors observed and the passage rates are comparable with, or below, those results documented at other raptor studies in the region (Appendix C Table 5).

5.0 Literature Cited

Able, K.P. 1973. The role of weather variables and flight direction in determining the magnitude of nocturnal migration. Ecology 54(5):1031–1041.

Alerstam, T. 1990. Bird Migration. Cambridge University Press, Cambridge, United Kingdom.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Takersley Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61-78.

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.

Arnett, E. B., J. P. Hayes, and M. M. P. Huso. 2006. An evaluation of the use of acoustic monitoring to predict bat fatality at a proposed wind facility in south central Pennsylvania. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Barrios, L. and A. Rodriguez. 2004. Behavioral and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81.

Batschelet, E. 1965. Statistical Methods for the Analysis of Problems in Animal Orientation and Certain Biological Rhythms. AIBS Monograph. American Institute of Biological Sciences. Washington, DC.

(BCI) Bat Conservation International. 2001. Bats in Eastern Woodlands. http://www.batcon.org/nabcp/newsite/forrep.pdf. Accessed on November 2007.

Bingman, V.P., K.P. Able, and P. Kerlinger. 1982. Wind drift, compensation, and the use of landmarks by nocturnal bird migrants. Animal Behavior 30:49–53.

Bruderer, B. and A. Boldt. 2001. Flight characterstics of birds: I. Radar measurements of speeds. Ibis. 143:178-204.

Cooper, B.A., R.H. Day, R.J. Ritchie, and C.L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 62:367–377.

Drennan, S. R. 1981. Where to find birds in New York State The Top 500 Sites. Part II: Hawk Migration pp. 459-480. Syracuse University Press, New York.

Gauthreaux, S.A., Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187–204.

Gauthreaux, S.A., Jr., and K.P. Able. 1970. Wind and the direction of nocturnal songbird migration. Nature 228:476–477.

Harmata, A., K. Podruzny, J. Zelenak, and M. Morrison. 1999. Using marine surveillance radar to study bird movements and impact assessment. Wildlife Society Bulletin 27(1):44–52.

Hassler, S.S., R.R. Graber, and F.C. Bellrose. 1963. Fall migration and weather, a radar study. The Wilson Bulletin 75(1):56–77.

Hayes, J. P. 1997. Temporal variation in activity of bats and the design of echolocation-monitoring studies. Journal Of Mammalogy 78:514-524.

(HMANA) Hawk Migration Association of North America [Internet]. c 2007. Available at http://www.hmana.org/index.php

Kerlinger, P. 1995. How Birds Migrate. Stackpole Books. Mechanicsburg, PA.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5:315-324.

Larkin, R.P. 1991. Flight speeds observed with radar, a correction; slow “birds” are insects. Behavioral Ecology and Sociobiology. 29:221-224.

McNab, H. and P. Avers. 1994. Ecological Subregions of the United States. Prepared by the US Department of Agriculture Forest Service. Available at http://www.fs.fed.us/land/pubs/ecoregions. Accessed on Jan 21, 2008.

O’Farrell, M.J., and W.L. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. Journal of Mammalogy 80(1):24–30.

O’Farrell, M.J., B.W. Miller, and W.L. Gannon. 1999. Qualitative identification of free-flying bats using the anabat detector. Journal of Mammalogy 80(1):11–23.

Reynolds, D. S. 2006. Monitoring the potential impacts of a wind development site on bats in the Northeast. Journal of Wildlife Management 70(5):1219 – 1227.

Richardson, W.J. 1972. Autumn migration and weather in eastern Canada: a radar study. American Birds 26(1):10–16.

Richardson, W.J. 1998. Bird migration and wind turbines: migration timing, flight behavior, and collision risk. Proceedings: National Avian-Wind Power Planning Meeting III, sponsored by Avian Workgroup of the National Wind Coordinating Committee, June 2000.

Appendix A

Radar survey results

Appendix A Table 1. Survey dates, results, level of effort, and weather - Spring 2010

Date	Sunset	Sunrise	Passage rate	Flight Direction	Flight Height (m)	% below 145 m
4/20	19:23	5:40	453	62	163	55%
4/21	19:25	5:38	334	24	401	20%
4/22	19:26	5:37	528	32	357	33%
4/29	19:34	5:26	200	51	165	74%
4/30	19:36	5:24	879	38	164	68%
5/3	19:39	5:20	399	54	151	59%
5/4	19:41	5:19	646	35	177	54%
5/5	19:42	5:17	360	12	314	22%
5/6	19:43	5:16	350	57	158	56%
5/10	19:48	5:11	43	349	106	82%
5/11	19:49	5:10	747	50	220	35%
5/12	19:50	5:08	300	74	100	79%
5/13	19:51	5:07	383	63	115	79%
5/14	19:52	5:06	210	22	240	29%
5/18	19:57	5:02	421	68	216	35%
5/20	19:59	5:00	323	66	150	67%
5/21	20:00	4:59	546	49	319	24%
5/22	20:01	4:58	179	59	355	20%
5/23	20:02	4:57	117	53	309	19%
5/24	20:03	4:57	325	54	178	52%
Entire Season			**387**	**48**	**218**	**38%**

Appendix A Table 2. Summary of passage rates by hour, night, and for entire season.

Night of	Passage Rate (targets/km/hr) by hour after sunset										Entire Night			
	1	2	3	4	5	6	7	8	9	10	Mean	Median	Stdev	SE
4/20	289	450	9	900	668	718	525	461	279	229	453	455	264	83
4/21	511	350	207	211	411	407	311	254	271	407	334	330	100	32
4/22	393	575	739	1032	886	686	314	250	175	229	528	484	300	95
4/29	104	171	171	164	229	214	304	189	250	N/A	200	189	58	19
4/30	439	593	796	1057	1029	1050	1045	1018	882	N/A	879	1018	227	76
5/3	43	239	446	668	561	421	418	436	361	N/A	399	421	179	60
5/4	404	1486	971	911	629	657	279	239	239	N/A	646	629	419	140
5/5	200	336	475	279	264	318	464	450	457	N/A	360	336	103	34
5/6	125	357	446	414	479	446	382	336	164	N/A	350	382	125	42
5/10	75	0	29	50	18	25	14	14	161	N/A	43	25	49	16
5/11	107	371	821	739	1429	1104	914	643	596	N/A	747	739	389	130
5/12	146	500	336	311	279	229	282	350	264	N/A	300	282	97	32
5/13	11	393	464	629	789	593	289	204	71	N/A	383	393	263	88
5/14	96	221	257	171	193	143	182	343	479	16	210	188	129	41
5/18	89	343	446	579	489	739	543	357	204	N/A	421	446	198	66
5/20	46	232	475	514	482	375	336	407	43	N/A	323	375	180	60
5/21	136	364	364	696	811	875	725	593	346	N/A	546	593	252	84
5/22	104	300	382	275	268	125	46	79	29	N/A	179	125	128	43
5/23	43	325	157	193	107	89	36	57	50	N/A	117	89	95	32
5/24	118	257	314	375	396	436	354	393	283	N/A	325	354	97	32
Entire Season	**174**	**393**	**415**	**508**	**521**	**483**	**388**	**354**	**280**	**220**	**387**	**339**	**282**	**21**

0 indicates no targets counted for that hour — N/A indicates no data for that hour

Appendix A Table 3. Mean Nightly Flight Direction		
Night of	**Mean Flight Direction**	**Circular Stdev**
4/20	62	39
4/21	24	59
4/22	32	77
4/29	51	42
4/30	38	40
5/3	54	35
5/4	35	43
5/5	12	58
5/6	57	41
5/10	349	113
5/11	50	36
5/12	74	46
5/13	63	30
5/14	22	47
5/18	68	53
5/20	66	47
5/21	49	31
5/22	59	58
5/23	53	53
5/24	54	44
Entire Season	**48**	**49**

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season.														
Night of	Mean Flight Height (m) by hour after sunset													% of targets below 145 meters
	1	2	3	4	5	6	7	8	9	10	Mean	Median	STDV	SE	
4/20	137	187	151	172	161	177	166	166	143	167	163	166	15	5	55%
4/21	203	384	9	408	518	500	451	383	Rain	363	358	384	160	53	20%
4/22	279	441	523	348	389	321	467	334	290	176	357	341	102	32	33%
4/29	552	165	127	134	98	106	94	108	102	N/A	165	108	147	49	74%
4/30	111	256	306	215	191	129	95	92	80	N/A	164	129	81	27	68%
5/3	136	166	175	154	180	132	145	125	150	N/A	151	150	19	6	59%
5/4	209	222	195	163	166	151	179	172	141	N/A	177	172	27	9	54%
5/5	211	261	307	345	334	320	387	353	312	N/A	314	320	52	17	22%
5/6	186	288	203	191	162	128	103	85	75	N/A	158	162	68	23	56%
5/10	63	78	131	179	76	165	--	96	61	N/A	106	87	46	16	82%
5/11	138	287	189	180	184	227	255	277	246	N/A	220	227	50	17	35%
5/12	142	155	101	92	96	77	64	82	89	N/A	100	92	30	10	79%
5/13	101	136	103	125	96	72	113	111	177	N/A	115	111	30	10	79%
5/14	181	269	221	244	263	261	299	215	205	N/A	240	244	37	12	29%
5/18	168	342	260	234	200	136	196	249	160	N/A	216	200	63	21	35%
5/20	148	169	191	126	134	119	144	114	202	N/A	150	144	31	10	67%
5/21	171	290	268	260	308	368	349	387	468	N/A	319	308	86	29	24%
5/22	331	455	424	368	331	362	350	293	280	N/A	355	350	57	19	20%
5/23	263	366	426	352	347	277	281	252	217	N/A	309	281	67	22	19%
5/24	160	218	191	164	154	148	187	165	216	N/A	178	165	26	9	52%
Entire Season	**195**	**257**	**246**	**223**	**219**	**209**	**228**	**203**	**190**	**213**	**217**	**186**	**109**	**8**	**38%**
-- indicates no targets counted for that hour										N/A indicates no data for that hour				

Appendix A Table 5. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Spring 2005									
Ellenberg, Clinton Cty, NY	40	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(125 m) 20%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	422	(120 m) 6%	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Sheffield, Caledonia Cty, VT	20	180	Forested ridge	166	12-440	40	552	(125 m) 6%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Stamford, Delaware Cty, NY	35	301	Forested ridge	210	10-785	46	431	(110 m) 8%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(100 m) 4%	Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
Franklin, Pendleton Cty, NY	21	204	Forested ridge	457	34-1240	53	492	(125 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	460	71-1769	30	443	(150 m) 14%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Dans Mountain, Allegany Cty, MD	23	189	Forested ridge	493	63-1388	38	541	(125 m) 15%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(145 m) 16% [1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
Spring 2006									
Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Kibby, Franklin Cty, ME (Valley)	2	14	Forested ridge	443	45-1242	61	334	(120 m) n/a	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Kibby, Franklin Cty, ME (Mountain)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Spring 2007									
Stetson, Washington Cty, ME	21	138	Forested ridge	147	3-434	55	210	(120 m) 22%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Cape Vincent, Jefferson Cty, NY	50	300	Great Lakes plain	166	n/a	34	441	(125 m) 14%	Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America.
New Grange, Chautauqua Cty, NY	41	n/a	Great Lakes plain	175	n/a	18	450	(125 m) 13%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Laurel Mountain, Barbour Cty, WV	20	197	Forested ridge	277	13-646	27	533	(130 m) 3%	Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Errol, Coos County, NH	30	212	Forested ridge	342	2 to 870	76	332	(125 m) 14%	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Villenova, Chautauqua Cty, NY	40	n/a	Great Lakes plain	419	22-1190	10	493	(120 m) 3%	Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
Roxbury, Oxford Cty, ME	20	n/a	Forested ridge	539	137-1256	52	312	(130) 18%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Lempster, Sullivan Cty, NH	30	277	Forested ridge	542	49-1094	49	358	(125 m) 18%	Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Spring 2008									
Lincoln, Penobscot Cty, ME	20	189	Forested ridge	247	40-766	75	316	(120 m) 13%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Allegany, Cattaraugus Cty, NY	30	275	Forested ridge	268	53-755	18	316	(150 m) 19%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
Oakfield, Penobscot Cty, ME	20	194	Forested ridge	498	132-899	33	276	(120 m) 21%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Hounsfield, Jefferson Cty, NY	42	379	Great Lakes island	624	74-1630	51	319	(125 m) 19%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
New Creek, Grant Cty, WV	20	n/a	Forested ridge	1020	289-2610	30	354	(130 m) 13%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Tenney, Grafton Cty, NH	40	373	Forested ridge	234	35-549	77	321	(125m) 12%	Stantec Consulting Services Inc. 2008. Spring 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Rollins, Penobscot Cty, ME	20	189	Forested ridge	247	40 - 766	75	316	(120 m) 13%	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Spring 2009									
Sisk (Kibby Expansion), Franklin Cty, ME	21	193	Forested ridge	207	50-452	28	293	(125m) 18%	Stantec Consulting Services Inc. 2009. Spring 2009 Nocturnal Migration Survey Report for the Kibby Expansion Wind Project. Prepared for TRC Engineers LLC.
Vermont Community Wind Farm, Orleans Cty, VT	15	90	Forested ridge	435	49-771	48	320	(130m) 22%	Stantec Consulting Services Inc. 2009. Spring and Summer 2009 Bird and Bat Survey Report. Prepared for Vermont Community Wind Farm, LLC.
Moresville, Delaware Cty, NY	30	275	Forested ridge	230	30-575	53	314	(125m)12%	Stantec Consulting Services Inc. 2009. 2009 Spring Nocturnal Radar Survey Report for the Moresville Energy Center. Prepared for Moresville Energy LLC.
Highland, Somerset Cty, ME (location 1)	21	192	Forested ridge	496	10-1262	47	287	(130.5m) 26%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC
Highland, Somerset Cty, ME (location 2)	19	161	Forested ridge	511	8-1735	53	314	(130.5m) 23%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC

Note:
[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix B

Bat survey results

Appendix B Table 1. Summary of acoustic bat data and weather during each survey night at the Bull Hill Met High detector – Spring/Summer, 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
4/15/10	1												0		
4/16/10	1												0		
4/17/10	0												0		
4/18/10	0												0		
4/19/10	0												0		
4/20/10	0												0		
4/21/10	0												0		
4/22/10	0												0		
4/23/10	0												0		
4/24/10	0												0		
4/25/10	0												0		
4/26/10	0												0		
4/27/10	1												0		
4/28/10	1									3			3		
4/29/10	1												0		
4/30/10	1												0		
5/1/10	1												0		
5/2/10	1			1									1		
5/3/10	1												0		
5/4/10	1												0		
5/5/10	1												0		
5/6/10	1												0		
5/7/10	1												0		
5/8/10	1												0		
5/9/10	1												0		
5/10/10	1												0		
5/11/10	1												0		
5/12/10	1												0		
5/13/10	1												0		
5/14/10	1												0		
5/15/10	1												0		
5/16/10	1												0		
5/17/10	1										1		1		
5/18/10	1												0		
5/19/10	1												0		
5/20/10	1												0		
5/21/10	1												0		
5/22/10	1												0		
5/23/10	1												0		
5/24/10	1										1		1		
5/25/10	1												0		
5/26/10	1									1			1		
5/27/10	1												0		
5/28/10	1												0		
5/29/10	1												0		
5/30/10	1												0		
5/31/10	1												0		
6/1/10	1												0		
6/2/10	1												0		
6/3/10	1												0		
6/4/10	1												0		
6/5/10	1												0		
6/6/10	1												0		
6/7/10	1												0		
6/8/10	1												0		
6/9/10	1												0		
6/10/10	1												0		
6/11/10	1												0		
6/12/10	1												0		
6/13/10	1												0		
6/14/10	1												0		
6/15/10	1					1							1		
6/16/10	1												0		
6/17/10	1												0		
6/18/10	1												0		
6/19/10	1												0		
6/20/10	1												0		
6/21/10	1												0		
6/22/10	1												0		
6/23/10	1												0		
6/24/10	1												0		
6/25/10	1												0		
6/26/10	1									1			1		
6/27/10	1												0		
6/28/10	1												0		
6/29/10	1												0		
6/30/10	1												0		
7/1/10	1												0		
7/2/10	1												0		
7/3/10	1												0		
7/4/10	1												0		
7/5/10	1												0		
7/6/10	1												0		
7/7/10	1												0		
7/8/10	1												0		
7/9/10	1												0		
7/10/10	1												0		
7/11/10	1												0		
7/12/10	1												0		
7/13/10	1												0		
7/14/10	1												0		
By Species		**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**5**	**2**	**0**	**9**		
By Guild		**1**			**0**	**1**	**0**			**7**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Stantec

Appendix B Table 2. Summary of acoustic bat data and weather during each survey night at the Bull Hill Met Low detector – Spring/Summer, 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (celsius)**
4/15/10	0												**0**		
4/16/10	0												**0**		
4/17/10	0												**0**		
4/18/10	0												**0**		
4/19/10	0												**0**		
4/20/10	0												**0**		
4/21/10	0												**0**		
4/22/10	0												**0**		
4/23/10	0												**0**		
4/24/10	0												**0**		
4/25/10	0												**0**		
4/26/10	0												**0**		
4/27/10	1												**0**		
4/28/10	1												**0**		
4/29/10	1												**0**		
4/30/10	1												**0**		
5/1/10	1												**0**		
5/2/10	1					1				1	1		**3**		
5/3/10	1												**0**		
5/4/10	1												**0**		
5/5/10	1												**0**		
5/6/10	1										1		**1**		
5/7/10	1												**0**		
5/8/10	1												**0**		
5/9/10	1												**0**		
5/10/10	1												**0**		
5/11/10	1												**0**		
5/12/10	1												**0**		
5/13/10	1					1							**1**		
5/14/10	1												**0**		
5/15/10	1												**0**		
5/16/10	1					1				1			**2**		
5/17/10	1												**0**		
5/18/10	1												**0**		
5/19/10	1												**0**		
5/20/10	1					1							**1**		
5/21/10	1												**0**		
5/22/10	1												**0**		
5/23/10	1												**0**		
5/24/10	1												**0**		
5/25/10	1					2							**2**		
5/26/10	1												**0**		
5/27/10	1									2			**2**		
5/28/10	1												**0**		
5/29/10	1									2			**2**		
5/30/10	1									1			**1**		
5/31/10	1												**0**		
6/1/10	1					1							**1**		
6/2/10	1												**0**		
6/3/10	1												**0**		
6/4/10	1												**0**		
6/5/10	1												**0**		
6/6/10	1												**0**		
6/7/10	1	1											**1**		
6/8/10	1					1							**1**		
6/9/10	1												**0**		
6/10/10	1												**0**		
6/11/10	1												**0**		
6/12/10	1												**0**		
6/13/10	1									1			**1**		
6/14/10	1												**0**		
6/15/10	1					1							**1**		
6/16/10	1												**0**		
6/17/10	1												**0**		
6/18/10	1												**0**		
6/19/10	1												**0**		
6/20/10	1												**0**		
6/21/10	1												**0**		
6/22/10	1												**0**		
6/23/10	1												**0**		
6/24/10	1					1				1			**2**		
6/25/10	1									1			**1**		
6/26/10	1												**0**		
6/27/10	1												**0**		
6/28/10	1									1			**1**		
6/29/10	1												**0**		
6/30/10	1									1			**1**		
7/1/10	1									1			**1**		
7/2/10	1												**0**		
7/3/10	1									1			**1**		
7/4/10	1												**0**		
7/5/10	1									2			**2**		
7/6/10	1				2	2				2			**6**		
7/7/10	1									1			**1**		
7/8/10	1									3			**3**		
7/9/10	1												**0**		
7/10/10	1									4	1		**5**		
7/11/10	1									2			**2**		
7/12/10	1					1				1			**2**		
7/13/10	1												**0**		
7/14/10	1									7	1		**8**		
By Species		**1**	**0**	**0**	**2**	**13**	**0**	**0**	**0**	**36**	**4**	**0**	**56**		
By Guild		**1**			**2**	**13**	**0**			**40**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 3. Summary of acoustic bat data and weather during each survey night at the Bull Hill NE Tree detector – Spring/Summer, 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
4/15/10	1					1							1		
4/16/10	1												0		
4/17/10	1												0		
4/18/10	1												0		
4/19/10	1												0		
4/20/10	1												0		
4/21/10	1					3							3		
4/22/10	1					1							1		
4/23/10	1					3							3		
4/24/10	1					2							2		
4/25/10	1					2							2		
4/26/10	1									2			2		
4/27/10	1					1							1		
4/28/10	1												0		
4/29/10	1												0		
4/30/10	1									1			1		
5/1/10	1					1							1		
5/2/10	1					11							11		
5/3/10	1									1			1		
5/4/10	1					1							1		
5/5/10	1									1			1		
5/6/10	1												0		
5/7/10	1												0		
5/8/10	1												0		
5/9/10	1												0		
5/10/10	1												0		
5/11/10	1												0		
5/12/10	1					1							1		
5/13/10	1	1				2				1			4		
5/14/10	1					2							2		
5/15/10	1					4							4		
5/16/10	1												0		
5/17/10	1												0		
5/18/10	1					2				1			3		
5/19/10	1												0		
5/20/10	1	1				11				1			13		
5/21/10	1					4				1			5		
5/22/10	1					2							2		
5/23/10	1					1							1		
5/24/10	1	4				9				2			15		
5/25/10	1		1			2							3		
5/26/10	1									3			3		
5/27/10	1					2							2		
5/28/10	1					1							1		
5/29/10	1					6				3			9		
5/30/10	1					5				3			8		
5/31/10	1					2				3			5		
6/1/10	1					2							2		
6/2/10	1					2				1			3		
6/3/10	1												0		
6/4/10	1					9				7			16		
6/5/10	1					3				1			4		
6/6/10	1												0		
6/7/10	1					2				2			4		
6/8/10	1					2				2			4		
6/9/10	1					14				5			19		
6/10/10	1					2				2			4		
6/11/10	1					6				6			12		
6/12/10	1					10				7			17		
6/13/10	1					5				7			12		
6/14/10	1												0		
6/15/10	1					3				3	1		7		
6/16/10	1					1				1			2		
6/17/10	1					5				5			10		
6/18/10	1					3				6			9		
6/19/10	1					1				1			2		
6/20/10	1				1	4				1			6		
6/21/10	1					1				1			2		
6/22/10	1					2				3			5		
6/23/10	1									17			17		
6/24/10	1					3				1	1	1	6		
6/25/10	1	4				6				13	2		25		
6/26/10	1					1				6			7		
6/27/10	1					10				14			24		
6/28/10	1	1			1	2				2			6		
6/29/10	1									4	2		6		
6/30/10	1					28				16			44		
7/1/10	1					1				1			2		
7/2/10	1	1				14				11			26		
7/3/10	1					24				97			121		
7/4/10	1					13				13			26		
7/5/10	1	1				12				13			26		
7/6/10	1					7				26			33		
7/7/10	1					6				13			19		
7/8/10	1					4				3			7		
7/9/10	1					1				1			2		
7/10/10	1	3				11				14			28		
7/11/10	1					9				4			13		
7/12/10	1	1				3				3			7		
7/13/10	1									1			1		
7/14/10	1					7				5	1		13		
By Species		17	1	0	2	321	0	0	0	362	7	1	711		
By Guild		18			2	321	0			370					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Stantec

Appendix B Table 4. Summary of acoustic bat data and weather during each survey night at the Bull Hill Radar Tree detector – Spring/Summer, 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
4/15/10	1												**0**		
4/16/10	1												**0**		
4/17/10	1												**0**		
4/18/10	1												**0**		
4/19/10	1												**0**		
4/20/10	1					1							**1**		
4/21/10	1					2							**2**		
4/22/10	1					1			1	1			**3**		
4/23/10	1					1							**1**		
4/24/10	1												**0**		
4/25/10	1					5							**5**		
4/26/10	1					4							**4**		
4/27/10	1												**0**		
4/28/10	1												**0**		
4/29/10	1												**0**		
4/30/10	1												**0**		
5/1/10	1					3							**3**		
5/2/10	1			1		4							**5**		
5/3/10	1												**0**		
5/4/10	1					4							**4**		
5/5/10	1					1							**1**		
5/6/10	1												**0**		
5/7/10	1									1			**1**		
5/8/10	1												**0**		
5/9/10	1									1			**1**		
5/10/10	1												**0**		
5/11/10	1					1				1	1		**3**		
5/12/10	1					5				1			**6**		
5/13/10	1					2							**2**		
5/14/10	1												**0**		
5/15/10	1					2				1			**3**		
5/16/10	1					2				1			**3**		
5/17/10	1									1			**1**		
5/18/10	1												**0**		
5/19/10	1												**0**		
5/20/10	1	1				17				1			**19**		
5/21/10	1					2				1			**3**		
5/22/10	1												**0**		
5/23/10	1					2							**2**		
5/24/10	1					1				2			**3**		
5/25/10	1				1	4				4			**9**		
5/26/10	1					2				1			**3**		
5/27/10	1												**0**		
5/28/10	1					1							**1**		
5/29/10	1					3				1			**4**		
5/30/10	1					4				1			**5**		
5/31/10	1					1							**1**		
6/1/10	1				1	9							**10**		
6/2/10	1												**0**		
6/3/10	1					3				2	1		**6**		
6/4/10	1					2				1			**3**		
6/5/10	1					2							**2**		
6/6/10	1				1								**1**		
6/7/10	1					2							**2**		
6/8/10	1					6				1			**7**		
6/9/10	1												**0**		
6/10/10	1				1	4				2			**7**		
6/11/10	1	1									2		**3**		
6/12/10	1					2				2			**4**		
6/13/10	1					6				3			**9**		
6/14/10	1					4							**4**		
6/15/10	1				2	2				7			**11**		
6/16/10	1									1			**1**		
6/17/10	1					9				1	2		**12**		
6/18/10	1					1							**1**		
6/19/10	1									1			**1**		
6/20/10	1					3			1	2			**6**		
6/21/10	1					10				5			**15**		
6/22/10	1												**0**		
6/23/10	1					1			2	2			**5**		
6/24/10	1					1				4			**5**		
6/25/10	1				1	55				46			**102**		
6/26/10	1					35				8			**43**		
6/27/10	1	2				21				7			**30**		
6/28/10	1					6			1	3			**10**		
6/29/10	1	1				17				5			**23**		
6/30/10	1					41			1	6			**48**		
7/1/10	1	1				3				2			**6**		
7/2/10	1	1				8				5			**14**		
7/3/10	1					7				2			**9**		
7/4/10	1	1				157				23			**181**		
7/5/10	1					1							**1**		
7/6/10	1	1				5				2			**8**		
7/7/10	1					1				2			**3**		
7/8/10	1					3				2			**5**		
7/9/10	1									1			**1**		
7/10/10	1	40				36				12			**88**		
7/11/10	1	58				13				9	1		**81**		
7/12/10	1	3				5			1	6			**15**		
7/13/10	1	24				4							**28**		
7/14/10	1	50	5			39				19			**113**		
By Species		**184**	**5**	**1**	**7**	**599**	**0**	**0**	**7**	**213**	**7**	**0**	**1023**		
By Guild		**190**			**7**	**599**	**7**			**220**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Stantec

Appendix B Table 5. Summary of acoustic bat data and weather during each survey night at the Bull Hill SE Tree detector – Spring/Summer, 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
4/15/10	0												0		
4/16/10	0												0		
4/17/10	0												0		
4/18/10	0												0		
4/19/10	0												0		
4/20/10	0												0		
4/21/10	0												0		
4/22/10	0												0		
4/23/10	0												0		
4/24/10	0												0		
4/25/10	0												0		
4/26/10	0												0		
4/27/10	1												0		
4/28/10	0												0		
4/29/10	0												0		
4/30/10	0												0		
5/1/10	0												0		
5/2/10	0												0		
5/3/10	0												0		
5/4/10	0												0		
5/5/10	0												0		
5/6/10	0												0		
5/7/10	0												0		
5/8/10	0												0		
5/9/10	0												0		
5/10/10	1												0		
5/11/10	1									1			1		
5/12/10	1					5							5		
5/13/10	1					2				1			3		
5/14/10	1					3							3		
5/15/10	1					1				1			2		
5/16/10	1					1				2			3		
5/17/10	1					2							2		
5/18/10	1					1							1		
5/19/10	1												0		
5/20/10	1	1				1				1			3		
5/21/10	0												0		
5/22/10	0												0		
5/23/10	0												0		
5/24/10	0												0		
5/25/10	0												0		
5/26/10	0												0		
5/27/10	0												0		
5/28/10	0												0		
5/29/10	0												0		
5/30/10	0												0		
5/31/10	0												0		
6/1/10	0												0		
6/2/10	0												0		
6/3/10	0												0		
6/4/10	0												0		
6/5/10	0												0		
6/6/10	0												0		
6/7/10	0												0		
6/8/10	0												0		
6/9/10	0					2			1	3			6		
6/10/10	1					2				3			5		
6/11/10	1	2				1				3	1		7		
6/12/10	1				1	4				3			8		
6/13/10	1					4				12			16		
6/14/10	1	1				1				1			3		
6/15/10	1				1	1				1			3		
6/16/10	1					16				41			57		
6/17/10	1	1				3				6			10		
6/18/10	1					1				10			11		
6/19/10	1												0		
6/20/10	1												0		
6/21/10	1												0		
6/22/10	1												0		
6/23/10	1												0		
6/24/10	1	1			1	2				2			6		
6/25/10	1					1				5			6		
6/26/10	1	1				1				3			5		
6/27/10	1	1				4				6			11		
6/28/10	1					2							2		
6/29/10	1									1			1		
6/30/10	1	1											1		
7/1/10	1												0		
7/2/10	1	1								1	1		3		
7/3/10	1									3			3		
7/4/10	1		1							3			4		
7/5/10	1									3			3		
7/6/10	1					3				4			7		
7/7/10	1					1				1			2		
7/8/10	1									2			2		
7/9/10	1												0		
7/10/10	1					2				3			5		
7/11/10	1	3								6	1		10		
7/12/10	1		1			5				3			9		
7/13/10	1	2				2				3			7		
7/14/10	1	1				3				10			14		
By Species		16	2	0	3	77	0	0	1	148	3	0	250		
By Guild		18			3	77	1			151					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 6. Summary of acoustic bat data and weather during each survey night at the Bull Hill SW Tree detector – Spring/Summer, 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
4/15/10	0												0		
4/16/10	0												0		
4/17/10	0												0		
4/18/10	0												0		
4/19/10	0												0		
4/20/10	0												0		
4/21/10	0												0		
4/22/10	0												0		
4/23/10	0												0		
4/24/10	0												0		
4/25/10	0												0		
4/26/10	0												0		
4/27/10	0					3				1			4		
4/28/10	1												0		
4/29/10	1												0		
4/30/10	1					5				2			7		
5/1/10	1					2				3			5		
5/2/10	1					1							1		
5/3/10	1												0		
5/4/10	1					1				1			2		
5/5/10	1					1				1			2		
5/6/10	1					2							2		
5/7/10	1					1							1		
5/8/10	1												0		
5/9/10	1												0		
5/10/10	1												0		
5/11/10	1									1			1		
5/12/10	1					3							3		
5/13/10	1					4				2			6		
5/14/10	1					5				3			8		
5/15/10	1					2				2			4		
5/16/10	1					1				1	1		3		
5/17/10	1	1			1	2							4		
5/18/10	1					3				2			5		
5/19/10	1												0		
5/20/10	1	1			1	20				7			29		
5/21/10	1					3				1			4		
5/22/10	1			1		4				2			7		
5/23/10	1					2							2		
5/24/10	1					8				5			13		
5/25/10	1	1				11				9			21		
5/26/10	1					7				2			9		
5/27/10	1				2	2				1			5		
5/28/10	1					2							2		
5/29/10	1					2				13			15		
5/30/10	1				1	4				6	1		12		
5/31/10	1					8				6			14		
6/1/10	1					5				4			9		
6/2/10	1					6							6		
6/3/10	1					2				5			7		
6/4/10	1					2				4			6		
6/5/10	1					5				3			8		
6/6/10	1									1			1		
6/7/10	1					6				7	1		14		
6/8/10	1					2				6			8		
6/9/10	1	1				5				2			8		
6/10/10	1					2							2		
6/11/10	1				1	4							5		
6/12/10	1				1	7			2	12			22		
6/13/10	1					4			1	7			12		
6/14/10	1				4	1				1	1		7		
6/15/10	1					3				3			6		
6/16/10	1				2	1			1	3			7		
6/17/10	1	1				9				4			14		
6/18/10	1					10				2			12		
6/19/10	1					5				1			6		
6/20/10	1					3				3			6		
6/21/10	1				3	4				4			11		
6/22/10	1	2			6	18			1	6			33		
6/23/10	1				1	1				1			3		
6/24/10	1					5				1			6		
6/25/10	1				2	16							18		
6/26/10	1				1	9				1			11		
6/27/10	1	1			3	12				7			23		
6/28/10	1					10				1			11		
6/29/10	1	1				4							5		
6/30/10	1	2				2			1	3			8		
7/1/10	1					2				3			5		
7/2/10	1	1				5				5			11		
7/3/10	1	3				5				3			11		
7/4/10	1	3			1	10				1	1		16		
7/5/10	1	2				13				7			22		
7/6/10	1	1				11			1	8			21		
7/7/10	1	3				1				3			7		
7/8/10	1									2			2		
7/9/10	1									1			1		
7/10/10	1					14			1	8			23		
7/11/10	1	1				5			1	2			9		
7/12/10	1	7				6				4	2		19		
7/13/10	1					2				5			7		
7/14/10	1					7			1	6			14		
By Species		32	0	1	30	353	0	0	10	221	7	0	654		
By Guild		33			30	353	10			228					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix C

Raptor Data Results

Appendix C Table 1. Daily total observations of raptor species and daily passage rates during Spring 2010 at the Bull Hill Wind Project

Species	3/19/2010	3/25/2010	4/6/2010	4/21/2010	4/22/2010	4/23/2010	4/29/2010	4/30/2010	5/4/2010	5/5/2010	5/12/2010	5/20/2010	5/21/2010	5/22/2010	5/23/2010	Entire Season
American kestrel									2							**2**
bald eagle	4		1						1							**6**
broad-winged hawk									2	9	1					**12**
merlin										1						**1**
northern harrier						2			1	2						**5**
osprey											2					**2**
red-tailed hawk	2	1	1				1				1					**6**
sharp-shinned hawk									1	2	1	1				**5**
turkey ulture v	1	1	2	1					2	1	3					**11**
unidentified accipiter											2					**2**
unidentified falcon									1							**1**
unidentified raptor								1						1		**2**
Daily Totals:	**7**	**2**	**4**	**1**	**0**	**2**	**1**	**1**	**10**	**15**	**10**	**1**	**0**	**1**	**0**	**55**

Appendix C Table 2. Hourly summary of raptor observations during Spring 2010 at the Bull Hill Wind Project

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	Grand Total
American kestrel	2							**2**
bald eagle		1	1		2	2		**6**
broad-winged hawk	8				3	1		**12**
merlin			1					**1**
northern harrier		2			1	1	1	**5**
osprey					2			**2**
red-tailed hawk		3	2				1	**6**
sharp-shinned hawk			4	1				**5**
turkey vulture	2	2	2	3	1	1		**11**
unidentified accipiter	2							**2**
unidentified falcon				1				**1**
unidentified raptor	1					1		**2**
Hourly totals	**15**	**8**	**10**	**5**	**9**	**6**	**2**	**55**

Appendix C Table 3. Total observations of raptor species at locations in the study area at the Bull Hill Wind Project, Spring 2010

Species	Inside Project area: Bull Hill	Inside Project area: Beech Knoll - Heifer Hill	Outside of Project area: Ridges	Outside of Project area: Valleys	TOTAL
American kestrel	2	0	0	0	2
bald eagle	0	0	3	3	6
broad-winged hawk	4	0	3	5	12
merlin	1	0	0	0	1
northern harrier	1	0	2	2	5
osprey	0	0	0	2	2
red-tailed hawk	0	0	4	2	6
sharp-shinned hawk	2	0	0	3	5
turkey vulture	2	0	7	2	11
unidentified accipiter	2	0	0	0	2
unidentified falcon	0	0	0	1	1
unidentified raptor	1	0	1	0	2
Season Totals:	**15**	**0**	**20**	**20**	**55**

Appendix C Table 4. Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A, B, and C) above or below 145 m at the Bull Hill Wind Project, Spring 2010

Species	145 m or greater	less than 145 m	Total
American kestrel	0	4	4
broad-winged hawk	0	2	2
merlin	0	1	1
northern harrier	0	1	1
sharp-shinned hawk	0	2	2
turkey vulture	0	2	2
unidentified accipiter	0	2	2
unidentified raptor	0	1	1
Season Totals:	**0**	**15**	**15**

Summary of spring raptor data at proposed wind sites on forested ridges in the East (2005-present)

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Spring 2005									
Moresville, Delaware County, NY	Forested ridge	March 28 to May 10	8	45	170	6	3.8	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Sheffield, Caledonia Cty, VT	Forested ridge	April to May	10	60	98	10	1.63	(125 m) 69%[1]	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing facility)	Forested ridge	April 9 to April 29	7	42	44	11 (for both sites combined)	1.05	(125 m) 83% (at both sites combined)[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
Deerfield, Bennington Cty, VT (Western expansion)	Forested ridge	April 9 to April 29	7	42	38	11 (for both sites combined)	0.9	(125 m) 83% (at both sites combined)[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
Spring 2006									
Mars Hill, Aroostook Cty, ME	Forested ridge	April 12 to May 18	10	60.25	64	9	1.06	(120 m) 48%[1]	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Lempster, Sullivan County, NH	Forested ridge	Spring 2006	10	78	102	n/a	1.3	(165 m) 56%[1]	The Louis Berger Group. 2006. Pre and Post-construction Avian Survey, Monitoring, and Mitigation at the Lempster, New Hampshire Wind Power Project. Prepared for Lempster Wind, LLC.
Spring 2007									
Stetson, Penobscot Cty, ME	Forested ridge	April 26 to May 4	9	59	34	10	0.6	(125 m) 65%[1]	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	March 30 to May 17	10	63.75	266	12	4.17	(125 m) 55%[5]	Stantec Consulting. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia – November 2007. Prepared for AES Laurel Mountain, LLC.
Spring 2008									
Oakfield, Aroostook Cty, ME	Forested ridge	April 25-May 30	12	79	58	9	0.7	(120 m) 80%[5]	Stantec Consulting. 2008. Spring and Summer 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for First Wind Management, LLC.
Record Hill, Oxford Cty, ME	Forested ridge	March 11 to May 27	15	97	118	12	1.2	n/a	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project Roxbury, Maine. Prepared for Record Hill Wind, LLC.
Greenland, Grant Cty, WV	Forested ridge	March 21 to May 14	10	68	212	9	3.12	(125 m) 68%[5]	Stantec Consulting. 2008. Spring, Summer, and Fall 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the New Creek Mountain Project West Virginia. Prepared for AES New Creek, LLC.
Allegany, Cattaraugus Cty, NY	Forested ridge	March 23 to May 8	10	75	134	10	1.8	(150 m) 87%[5]	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project. Prepared for EverPower Renewables
Rollins Mountain, Penobscot Cty, ME	Forested ridge	Apr 3 to Jun 3	15	108	122	12	1.1	(125 m) 76%[5]	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Spring 2009									
Stetson, Penobscot Cty, ME	Forested ridge	April 27 to May 5	4	20	34	11	1.7	(119 m) 67%[3,5]	Stantec Consulting. 2009. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC
Groton Wind, Grafton Cty, NH	Forested ridge	March 26 to May 23	11[6]	125[6]	175[6]	11	1.4[6]	(121 m) 25%[5]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC.
Highland, Somerset Cty, ME	Forested ridge	March 25 to May 19	20	139	260	10	1.87	(130.5 m) Whitham 80% Briggs 86%[5]	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys. Prepared for Highland Wind LLC.
Kingdom Community, Orleans Cty, VT	Forested ridge	April 15 to June 1	10	74	134	10	1.81	(125 m) 67%[1]	Stantec Consulting. 2009. Spring and Summer 2009 Raptor Surveys for the Kingdom Community Wind Project. Prepared for Vermont Environmental Research Associates
Spring 2010									
Granite Reliable Power, Coos County, NH (Dixville peak)	Forested ridge	April 1 to May 11	10	67.52	14	8	0.21	(125 m) 64%[1]	Stantec Consulting. 2010. Fall 2009 and Spring 2010 Raptor Migration Surveys For the Granite Reliable Power Project. Prepared for Granite Reliable Power, LLC
Granite Reliable Power, Coos County, NH (Owl head mtn)	Forested ridge	April 1 to May 11	10	62.45	29	8	0.46	(125 m) 76%[1]	Stantec Consulting. 2010. Fall 2009 and Spring 2010 Raptor Migration Surveys For the Granite Reliable Power Project. Prepared for Granite Reliable Power, LLC
Bingham, Somerset Cty, ME (Kingsbury Ridge)	Forested ridge	March 19 to May 21	10	70	19	9	0.27	(152 m) 77%[5]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Bingham, Somerset Cty, ME (Johnson Ridge)	Forested ridge	March 19 to May 21	5	35	37	9	1.06	(152 m) 95%[5]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Bowers, Washington Cty, ME	Forested ridge	April 21 to May 26	12	84	131	9	1.56	(131 m) 75%[5]	Stantec Consulting. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC
Bull Hill, Hancock Cty, ME	Forested ridge	March 19 to May 23	15	104.25	55	9	0.53	(145 m) 100%[5]	*This Report*

[1] Percent below turbine height calculated for all observations within study area.

[2] Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

[3] Calculated for spring and fall combined.

[4] Calculated for spring and fall 2006 and 2007 combined.

[5] Percent below turbine height calculated for those observations within project area (locations within study area where turbines could possibly be located).

[6] 5 of the 11 survey days were conducted simultaneously by 2 observers at 2 survey locations; however, results are combined for both sites which inflates the number of raptors observed for this site.

Appendix C Table 5. Summary of Regional Spring 2010 (March to May) Migration Surveys*

Site Number**	Location	Observation Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	ML	PG	UA	UB	UF	UE	UR	MK	TOTAL	BIRDS/ HOUR
1	Bull Hill Wind Project; Washington County, Maine	104.25	0	11	2	6	5	5	0	0	0	12	6	0	0	2	1	0	2	0	1	0	2	0	**55**	0.5
2	Bradbury Mountain; Pownal, Maine	432.75	1	354	500	52	106	724	97	7	67	1746	292	0	0	450	44	3	10	5	3	0	13	0	**4474**	10.3
3	Barre Falls, Barre, MA	150.50	0	104	80	18	10	118	20	0	11	1101	66	0	0	31	1	0	0	0	0	0	13	0	**1573**	10.5
4	Pitcher Mountain; Stoddard, NH	23.25	0	28	3	1	2	5	1	2	2	50	8	0	2	4	0	0	0	1	0	0	8	0	**117**	5.0
5	Pilgrim Heights; North Truro, MA	280.00	10	794	174	19	13	527	39	2	15	331	155	0	0	119	72	26	1	3	3	0	2	7	**2312**	8.3
6	Plum Island; Newburyport, MA	121.33	0	18	27	0	39	133	9	0	0	0	0	0	0	305	88	5	5	1	6	0	4	0	**640**	5.3

* Data obtained from HMANA 2010.

** See map to right for site location.

Abbreviation Key:

BV - Black Vulture	RT - Red-tailed Hawk
TV - Turkey Vulture	RL - Rough-legged Hawk
UV - unidentified vulture	SW - Swainson's Hawk
MK - Mississippi Kite	GE - Golden Eagle
OS - Osprey	AK - American Kestrel
BE - Bald Eagle	ML - Merlin
NH - Northern Harrier	PG - Peregrine Falcon
SS - Sharp-shinned Hawk	UA - unidentified Accipiter
CH - Cooper's Hawk	UB - unidentified Buteo
NG - Northern Goshawk	UF - unidentified Falcon
RS - Red-shouldered Hawk	UE - unidentified Eagle
BW - Broad-winged Hawk	UR - unidentified Raptor

Exhibit 7-7-6

Fall 2016 Nocturnal Radar Survey Report for Weaver Wind Project

Weaver Wind Project Pre-Construction Nocturnal Radar Migration Surveys, Fall 2016

Hancock County, Maine

Prepared for:

Weaver Wind LLC

Prepared by:
Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

September 4, 2018

Table of Contents

EXECUTIVE SUMMARY i

1.0 INTRODUCTION 1.1
1.1 PROJECT BACKGROUND 1.1
1.2 PROJECT AREA DESCRIPTION 1.1
1.3 OBJECTIVES 1.3

2.0 METHODS 2.3
2.1 DEPLOYMENT 2.3
2.2 DATA COLLECTION 2.4
2.3 DATA SUMMARY AND ANALYSIS 2.5

3.0 RESULTS 3.5
3.1 PASSAGE RATES 3.6
3.2 FLIGHT DIRECTION 3.7
3.3 FLIGHT HEIGHT 3.8
3.4 WEATHER AND ACTIVITY 3.11

4.0 DISCUSSION 4.12
4.1 PASSAGE RATES 4.12
4.2 FLIGHT HEIGHTS 4.12
4.3 DATA UTILITY 4.12

5.0 REFERENCES 5.1

LIST OF FIGURES

Figure 1.1. Nocturnal Radar Survey Location, Weaver Wind Project, 2016....................... 1.2
Figure 2.1. Screenshots from actual radar files in horizontal mode (left) and vertical mode (right), Weaver Wind Project, fall 2016... 2.5
Figure 3.1. Nightly passage rates (error bars ± 1 SE) during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.6
Figure 3.2. Hourly passage rates for the season during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.7
Figure 3.3. Mean flight direction (the bracket along the margin of the histogram is the 95% confidence interval) during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.8
Figure 3.4. Seasonal mean (green line) and nightly mean (blue squares) flight height of targets (error bars ± 1 SE) during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.9
Figure 3.5. Percent of targets observed flying below proposed turbine height (180 m) during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.9
Figure 3.6. Hourly target flight height distribution during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.10
Figure 3.7. Flight height whisker plot depicting the vertical distribution of targets for each survey night during nocturnal radar surveys, Weaver Wind Project, fall 2016. .... 3.11

LIST OF APPENDICES

APPENDIX A NOCTURNAL RADAR SURVEY TABLES A.1

EXECUTIVE SUMMARY

Stantec Consulting Services Inc. (Stantec) conducted pre-construction nocturnal radar migration surveys in fall 2016 at the proposed Weaver Wind Project (Project) in Hancock County, Maine. Radar surveys followed protocols outlined in the Maine Department of Inland Fisheries and Wildlife's *Curtailment Policy and Wind Power Preconstruction Study Recommendations* dated June 2015, as these guidelines were the most current at the time of the survey.

The objective of the radar surveys was to document the abundance, flight patterns, and flight altitudes of nocturnal migrants at the Project.

Stantec conducted radar surveys on 20 nights from 22 August to 26 October 2016. The overall mean passage rate was 543 targets per kilometer per hour (t/km/hr). The night with the highest passage rate was 22 September (1,126 t/km/hr). The seasonal mean flight height was 479 meters (m) above the radar site, and the average percentage of targets flying below the proposed turbine height of 180 m was 12%.

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

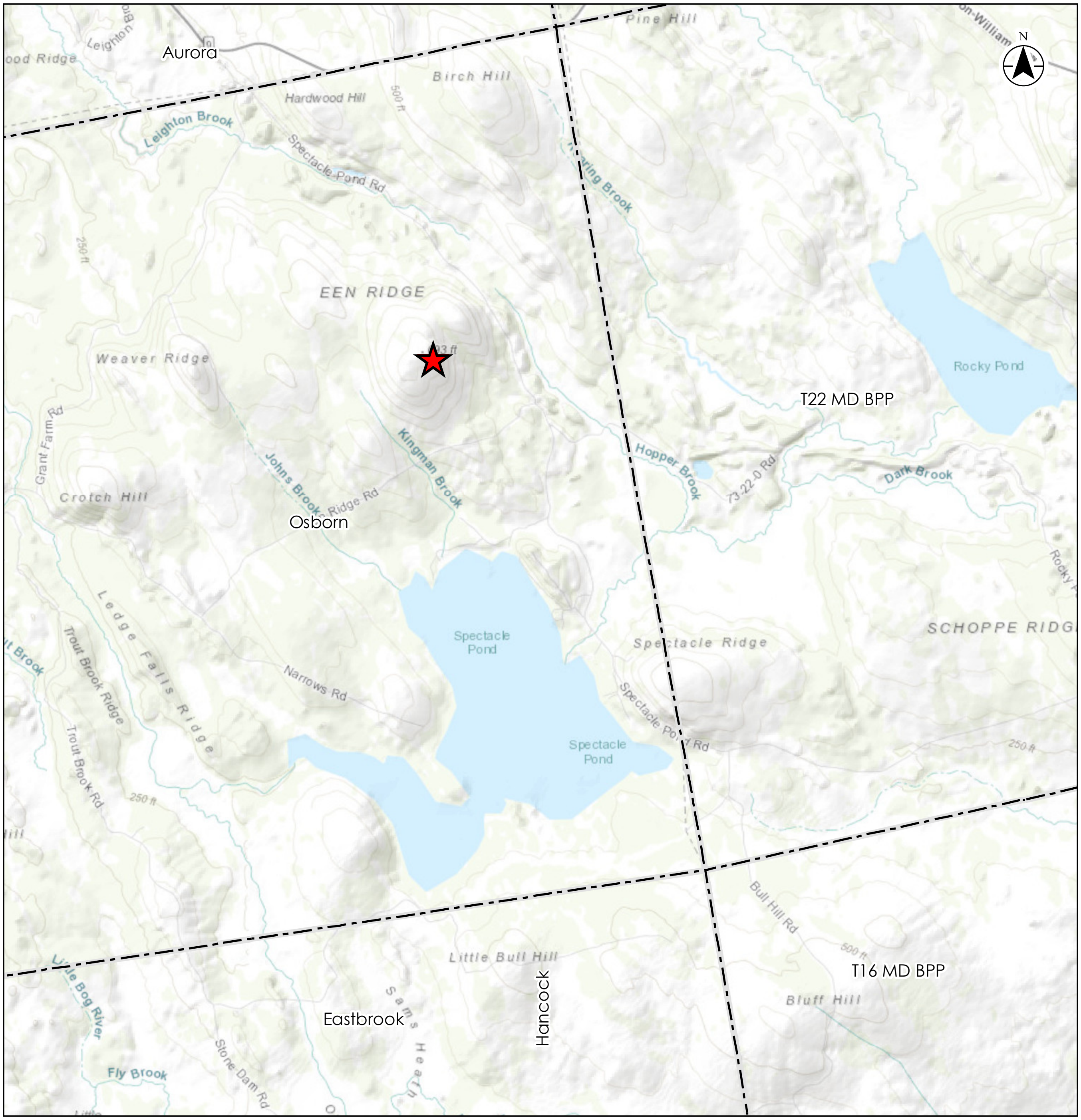
Stantec Consulting Services Inc. (Stantec) conducted pre-construction nocturnal radar migration surveys during fall 2016 at Weaver Wind LLC's proposed Weaver Wind Project (Project) located in Hancock County, Maine (Figure 1.1). The Project will include 22 V126 3.45 MW wind turbines and associated infrastructure (i.e., access roads, transmission lines, and electrical substation). The proposed turbines are expected to have a maximum height of 180 meters (m; 591 feet [ft]). Surveys were conducted based on the Maine Department of Inland Fisheries and Wildlife's (MDIFW) *Curtailment Policy and Wind Power Preconstruction Study Recommendations* dated June 2015 (MDIFW 2015) as these guidelines were the most current at the time of the study. Stantec also completed nocturnal radar surveys at the Project in spring and fall 2014. Results of the 2014 surveys can be found in the public document titled *2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project*, prepared for First Wind, LLC (Stantec 2014).

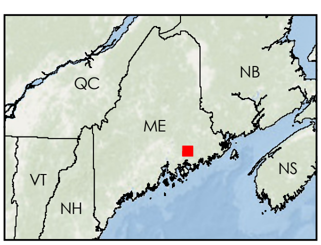
1.2 PROJECT AREA DESCRIPTION

The Project area is located within the Downeast Maine Ecoregion as defined in Maine's Comprehensive Wildlife Conservation Strategy (Griffith et al. 2009). The Downeast Maine Ecoregion extends from coastal areas from Ellsworth to Eastport and inland to north of Route 9. This ecoregion is characterized by low acidic summits, blueberry barrens, coastal spruce-fir forests, and industrial timberlands.

The Project area includes the ridgelines on Hardwood Hill, Birch Hill, Een Ridge, Little Bull Hill, and other unnamed hills nearby (Figure 1.1). Peak elevations in the Project area range from approximately 152 m (500 ft) to 213 m (700 ft). The Project area is dominated by mixed forest including paper birch (*Betula papyrifera*), American beech (*Fagus grandifolia*), balsam fir (*Abies balsamea*), and red spruce (*Picea rubens*). The Project area also includes multiple spruce and fir plantations. Forest management activities and logging in the area are ongoing. Evidence of these activities, including active logging roads, skidder trails and managed plantations, is present throughout the Project area.

V:\1956\active\195601223\03_data\gis_cad\GIS\mxd\AvianBat\01223_1-1_Radar.mxd Revised: 2018-08-15 By: gcarpentier





Legend

Radar Survey Location

Town Boundary

0 6,000 Feet

1:72,000 (at original document size of 8.5x11)

Stantec

Project Location 195601223
Hancock County, Maine
Prepared by GAC on 2018-08-15
Reviewed by KJW on 2018-08-15

Client/Project
Weaver Wind Project
Longroad Energy Partners LLC

Figure No.
1.1

Title
Nocturnal Radar Survey Location

Notes
1. Coordinate System: NAD 1983 UTM Zone 19N FT
2. Base map: ESRI Wowrld Topographic Map

1.3 OBJECTIVES

The objective of the radar surveys was to document the abundance, flight patterns, and flight altitudes of nocturnal migrants at the Project.

2.0 METHODS

2.1 DEPLOYMENT

X-band marine surveillance radar, similar to that described by Cooper et al. (1991), was used during field data collection. The radar unit was deployed at the same location used in 2014, on Een ridge, which is centrally located in the Project area at an elevation of approximately 200 m (656 ft) (Photo 2.1). To maximize the airspace sampled and reduce ground clutter interference, the radar antenna was elevated approximately 4 m (12 ft) above ground level. The radar had a horizontal range of 1.4 km (0.75 nautical miles, 0.9 miles) and a vertical range of 20° (10° above and below horizontal).

Photo 2.1. Radar on Een Ridge in the Weaver Wind Project area, fall 2016.

2.2 DATA COLLECTION

Survey nights were selected based on weather forecast predictions. Nights expected to be optimal for migration, i.e., nights with no precipitation were targeted for survey. Suboptimal nights, i.e., nights with intermittent precipitation, strong winds, and/or unusually high or low temperatures, were sampled at a lower frequency than optimal nights.

The radar operated continuously during nighttime hours (sunset to sunrise) on survey nights. The radar operated in 2 modes (surveillance [horizontal] and vertical mode) during each survey hour, resulting in 30 minutes each of horizontal and vertical data collection. Videos produced by the radar were recorded and archived for subsequent analysis. Below are examples of the radar's view of the surrounding airspace and targets as depicted on the video files (Figure 2.1). Ground clutter interference was less than 30% of the view.

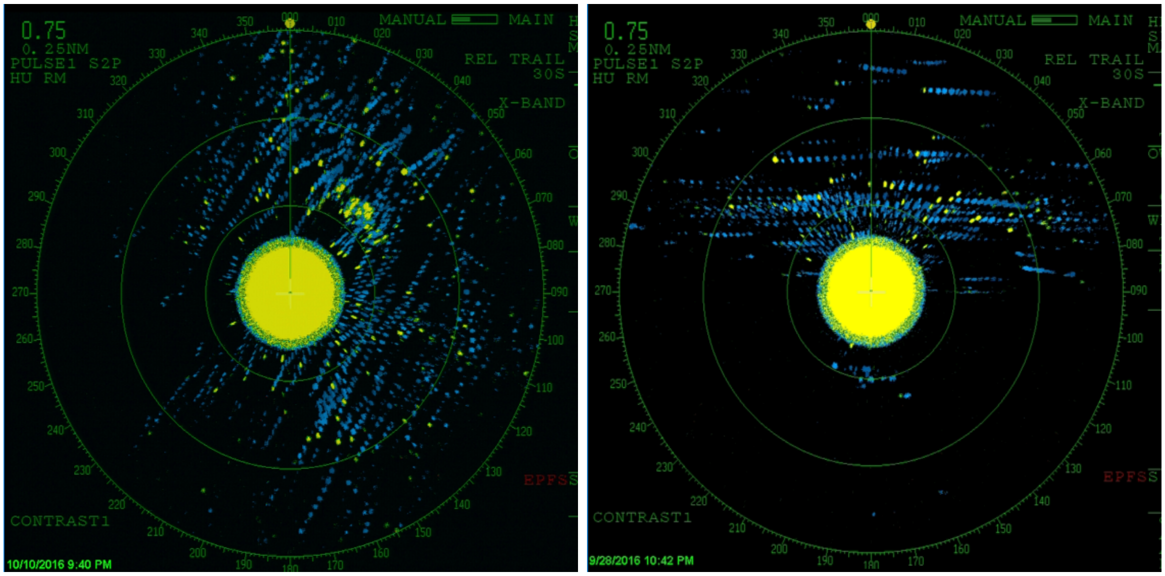


Figure 2.1. Screenshots from actual radar files in horizontal mode (left) and vertical mode (right), Weaver Wind Project, fall 2016.

2.3 DATA SUMMARY AND ANALYSIS

From each hour of operation, 6 1-minute horizontal video samples and 6 1-minute vertical video samples were randomly selected for visual analysis. For those hours with less than 60 minutes sampled, proportionally less and no fewer than 3 samples were selected. The videos were visually reviewed to identify and select targets (migrants) and their flight paths, resulting in location, flight height, and flight direction data for each target. Data were summarized using programs and macros designed by Stantec. Horizontal video samples were used to calculate mean hourly, nightly, and seasonal passage rates, as well as nightly and seasonal mean flight direction. Vertical video samples were used to calculate mean hourly, nightly, and seasonal flight heights, as well as nightly and seasonal percent of targets below turbine height.

Weather data including nightly temperature, wind speed, wind direction, visibility and fog occurrence data were collected from the KBGR weather station located at the Bangor International Airport approximately 30 miles west of the radar site, via weatherunderground.com. Weather data were used for analysis and interpretation of radar results.

3.0 RESULTS

Fall radar surveys were conducted on 20 nights between 22 August and 26 October 2016, resulting in 225 total survey hours (Appendix A Table 1).

3.1 PASSAGE RATES

Nightly mean passage rate ranged from 61 ± 20 t/km/hr on 18 October to 1,126 ± 93 t/km/h on 22 September. The overall mean passage rate for the survey period was 543 ± 28 t/km/hr (Figure 3.1; Appendix A Table 2). Individual hourly passage rates varied within and among nights and throughout the season, ranging from 0 t/km/hr during hour 2, 3, and 4 after sunset on 18 October to 2,154 t/km/hr during hour 4 on 10 October (Appendix A Table 2). For the entire season, passage rates increased after sunset, peaked 3 hours after sunset, and generally declined until sunrise (Figure 3.2).

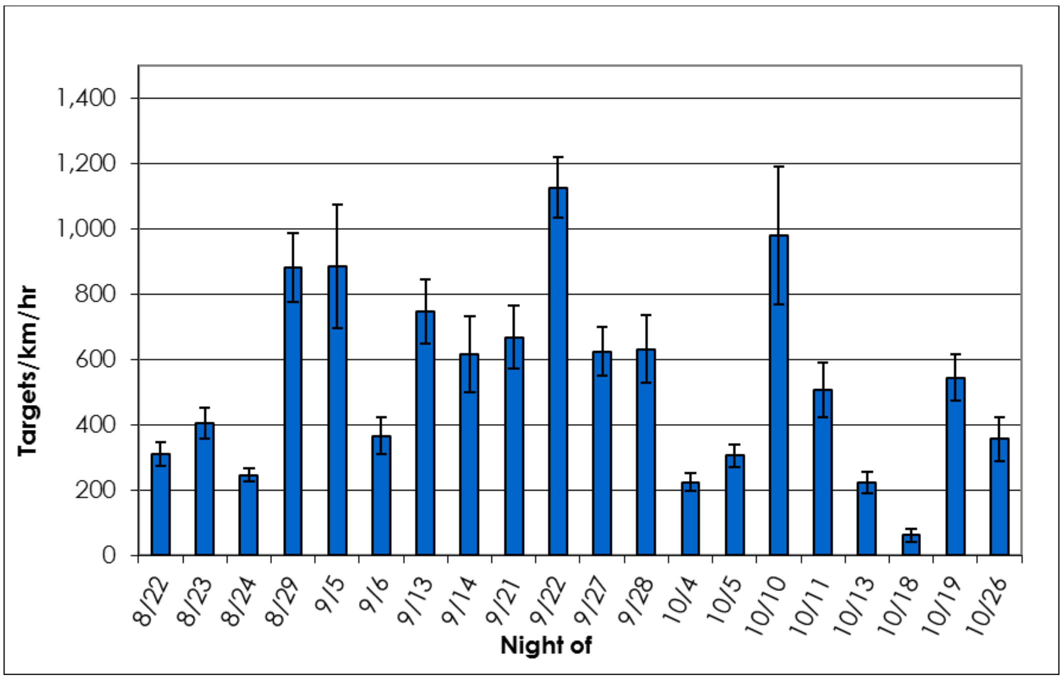


Figure 3.1. Nightly passage rates (error bars ± 1 SE) during nocturnal radar surveys, Weaver Wind Project, fall 2016.

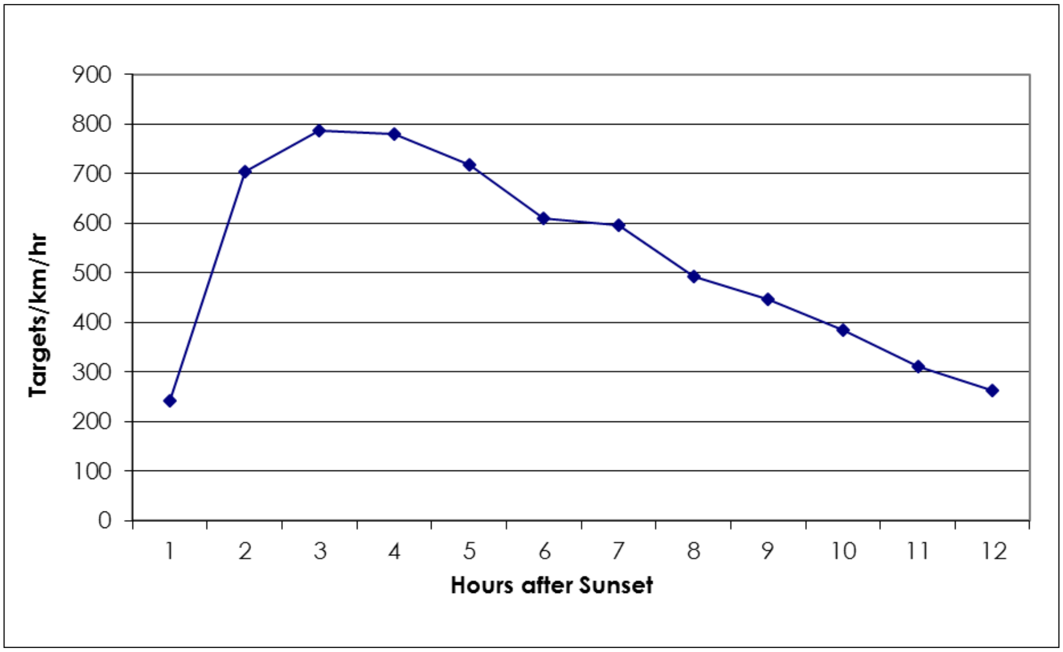


Figure 3.2. Hourly passage rates for the season during nocturnal radar surveys, Weaver Wind Project, fall 2016.

3.2 FLIGHT DIRECTION

Mean flight direction of nocturnal migrants was 207° ± 94°, south-southwest and varied among nights (Figure 3.3; Appendix A Table 3).

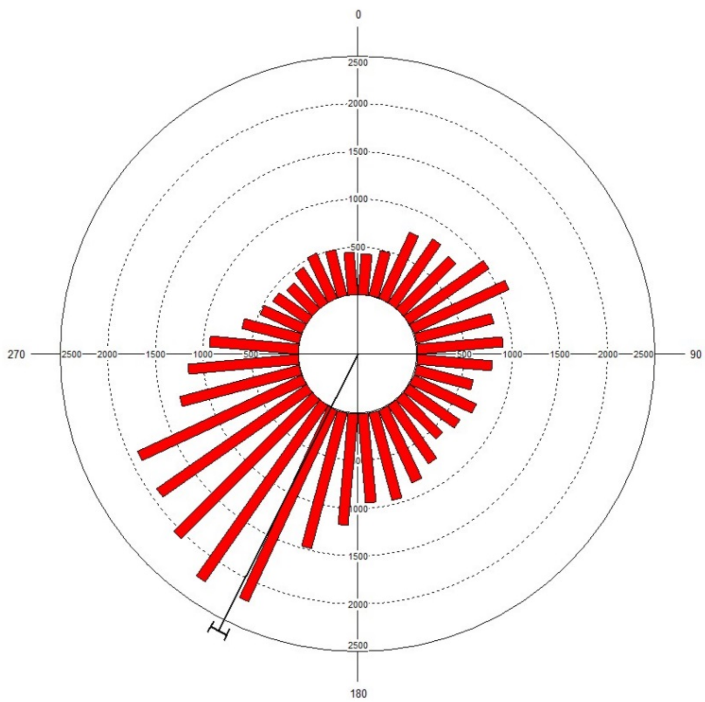


Figure 3.3. Mean flight direction (the bracket along the margin of the histogram is the 95% confidence interval) during nocturnal radar surveys, Weaver Wind Project, fall 2016.

3.3 FLIGHT HEIGHT

The seasonal mean flight height of targets was 479 ± 1 m above the radar site. The mean nightly flight height ranged from 298 ± 10 m on 23 August to 768 ± 8 m on 11 October (Figure 3.4; Appendix A Table 4). Standard error bars in Figure 3.4 are not visible beyond nightly mean flight heights; Appendix A Table 4 shows all flight height SE data. The percent of targets flying below turbine height (180 m) was 12% for the season. Percent of targets observed flying below turbine height varied nightly from 4% on 26 October (n = 100 targets) to 31% on 23 August (n = 133 targets) (Figure 3.5; Appendix A Table 4). For the season, mean hourly flight heights were lowest during hour 1 and highest during hour 7 (Figure 3.6).

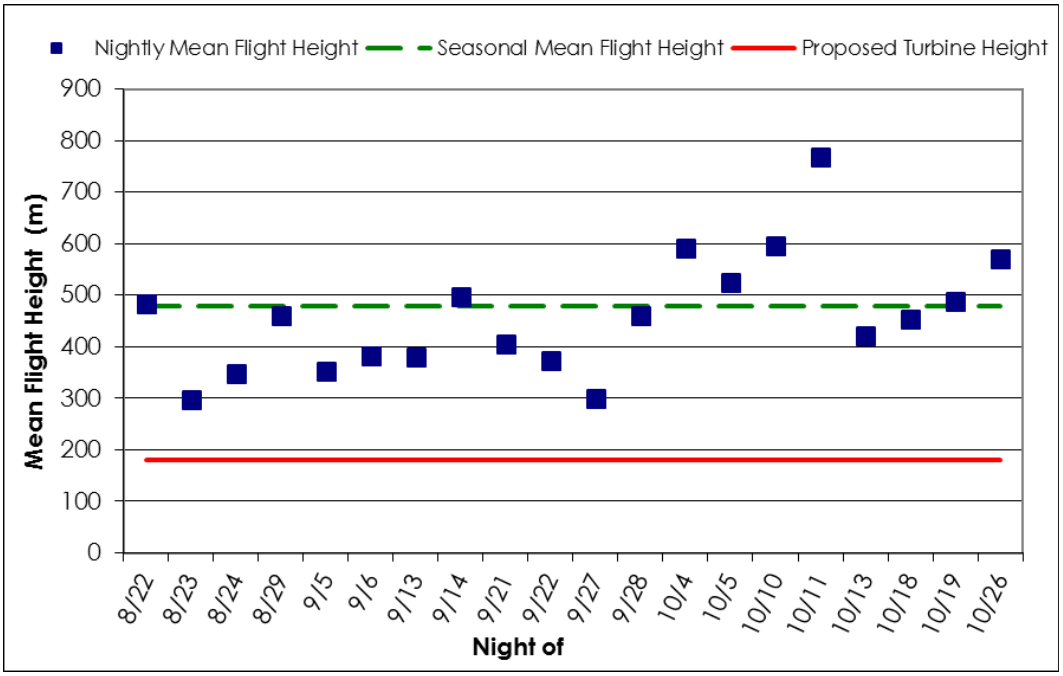


Figure 3.4. Seasonal mean (green line) and nightly mean (blue squares) flight height of targets (error bars ± 1 SE) during nocturnal radar surveys, Weaver Wind Project, fall 2016.

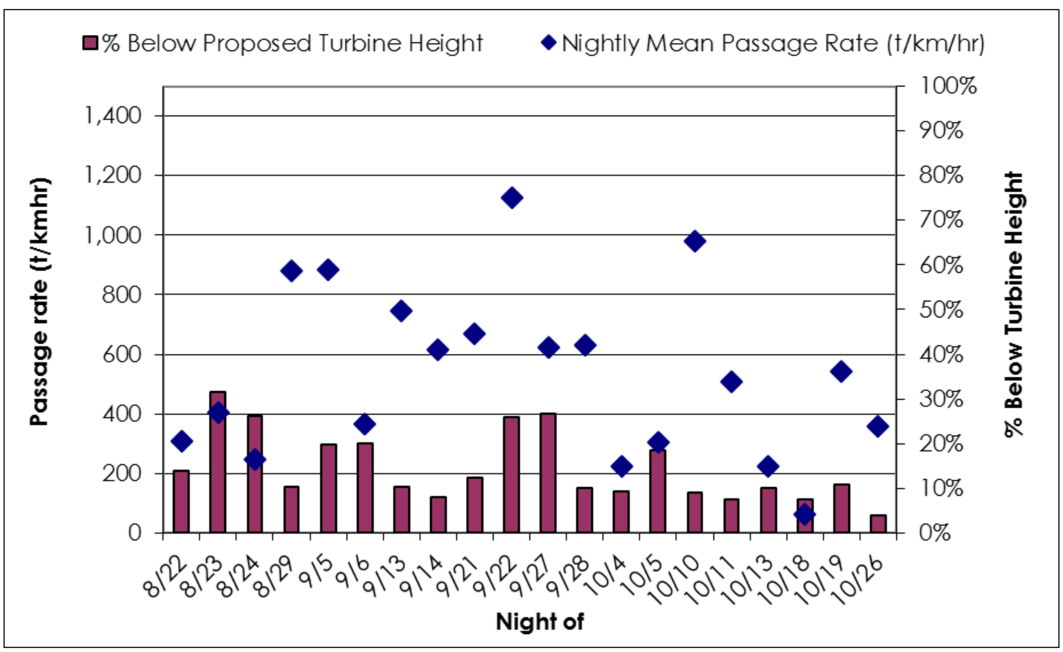


Figure 3.5. Percent of targets observed flying below proposed turbine height (180 m) during nocturnal radar surveys, Weaver Wind Project, fall 2016.

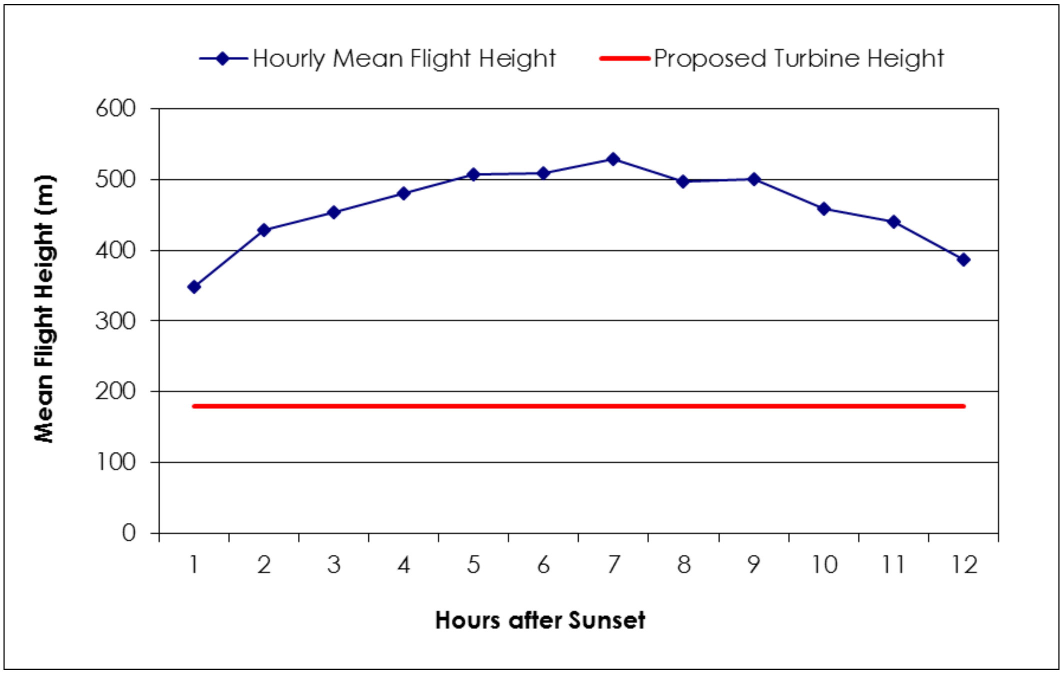


Figure 3.6. Hourly target flight height distribution during nocturnal radar surveys, Weaver Wind Project, fall 2016.

Figure 3.7 shows the distribution of individual nightly flight heights of all targets relative to proposed turbine height. The yellow boxes depict the middle 50% of targets. The error bars depict the statistical outliers, or 25% of targets above and below the middle 50% of targets. The horizontal line within each box represents the nightly median flight height value. No nights in fall had nightly mean flight heights below 180 m.

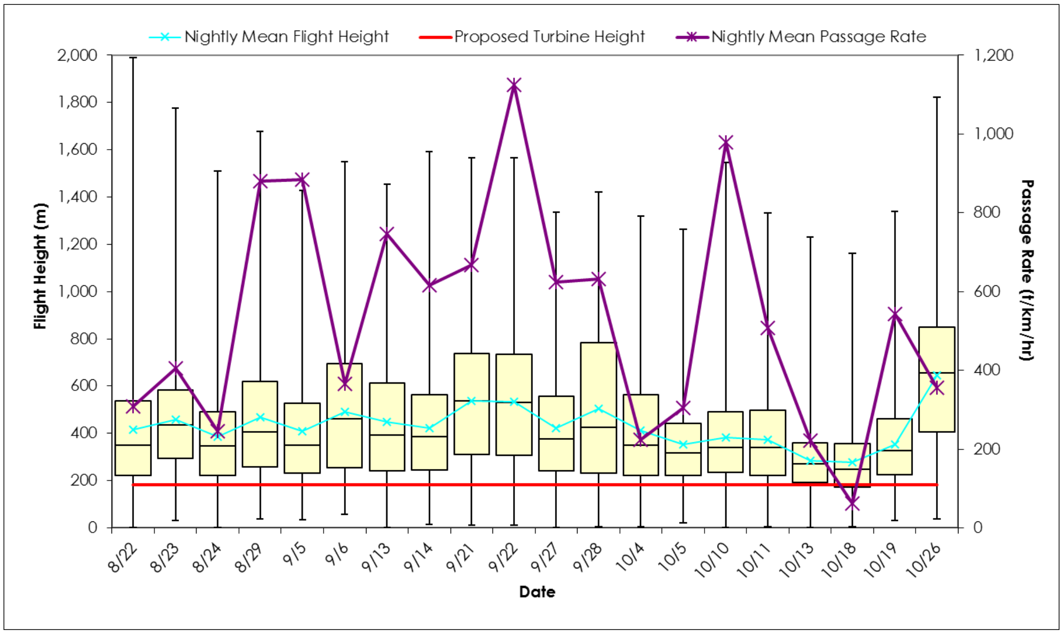


Figure 3.7. Flight height whisker plot depicting the vertical distribution of targets for each survey night during nocturnal radar surveys, Weaver Wind Project, fall 2016.

3.4 WEATHER AND ACTIVITY

Survey nights consisted of clear to overcast skies (Appendix A Table 1). Short periods of light rain, mist, or fog occurred on 7 of 20 (35%) nights surveyed.

The night with the highest mean passage rate for the season (22 September) consisted of mostly cloudy to overcast skies with light rain in the morning, a warm average nightly temperature among nights surveyed (17°C), and low to moderate wind speeds from the southeast. The night with the lowest passage rate (18 October) consisted of overcast skies with a short period of light rain in the morning, a moderate to warm average nightly temperature among nights surveyed (15°C), and high wind speeds from the south-southwest.

The night with the highest flight height (11 October) consisted of clear skies with partly cloudy skies in late morning, a low average nightly temperature (7°C), and low wind speeds from the south. The night with the lowest flight height and the highest percent of targets flying below turbine height (23 August) consisted of partly cloudy to clear skies, a warm average nightly temperature of 17°C, and low wind speeds from the south-southwest.

4.0 DISCUSSION

4.1 PASSAGE RATES

Peak migrant activity occurred in late-September. This timing is consistent with other radar studies in Maine.

The seasonal average passage rate at the Project (543 ± 28 t/km/hr) was within the range of fall results at proposed wind projects in Maine (201–952 t/km/hr) (Appendix A Table 5).

Nightly mean passage rates were highly variable, indicating that nocturnal migration was pulsed, presumably due to seasonal timing and regional weather conditions. The nights with the highest passage rate (22 September) and lowest passage rate (18 October) had similar conditions in terms of cloud cover, temperature, and wind direction, though wind speeds were relatively low on 22 September and relatively high on 18 October.

4.2 FLIGHT HEIGHTS

The increasing number of publicly available radar studies at proposed wind projects shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of 200 m or more above the ground, regardless of local topography (Appendix A Table 5). Mean flight height (479 ± 1 m) at the Project was well above the proposed 180 m turbine height and above the range of average flight heights in fall at proposed wind projects in Maine (279–424 m). None of the nightly mean flight heights were below the proposed turbine height of 180 m. Nightly mean flight heights were variable likely due to changing weather conditions throughout the season.

4.3 DATA UTILITY

These radar surveys effectively characterized the levels and timing of nocturnal migratory activity over the Project during the fall 2016 survey period. When considered with data from other sites, collectively these data may reveal patterns in migration that are specific to a particular region (e.g., timing of peak activity, flight direction patterns, and flight height patterns relative to topography).

Radar surveys are not capable of quantifying the level of collision risk involving nocturnal migrants at a particular project. Statistical analysis of publicly available pre-construction radar survey passage rates with post-construction bird mortality for wind projects in Maine has shown no relationship between passage rate and level of mortality (the correlation is very low, with no significant trend [Stantec 2018]). Fatality data collected at operational wind projects have shown that the cause of fatality events involving multiple passerine individuals has occurred during the migratory season and either a) when weather conditions have caused migratory fall-out behavior (i.e., when birds dramatically reduce migratory flight heights in response to sudden, inclement weather); or b) when lighting at facility structures proximal to turbines disoriented or attracted migratory birds, resulting in them colliding with the nearby turbines. It is possible that radar surveys, with modification to the sampling regime, could document such fall-out events. However, while this is a hypothesis for research, radar surveys as described in this report cannot predict such random events or address risk of mortality.

5.0 REFERENCES

Cooper, B.A., R.H. Day, R.J. Ritchie, and C.L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 62:367–377.

Griffith, G.E., J.M. Omernik, S.A. Bryce, J. Royte, W.D. Hoar, J.W. Homer, D. Keirstead, K.J. Metzler, and G. Hellyer. 2009. Ecoregions of New England (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,325,000).

MDIFW (Maine Department of Inland Fisheries and Wildlife). 2015. Curtailment Policy and Wind Power Preconstruction Study Recommendations. Augusta, Maine.

Stantec (Stantec Consulting Services Inc.). 2014. 2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project. Prepared for First Wind, LLC. November 21, 2014.

Stantec. 2018. Comparison of Pre-construction Bird/Bat Activity and Post-construction Mortality at Commercial Wind Projects in Maine. Prepared for Maine Renewable Energy Association. March 2017.

Appendix A Nocturnal Radar Survey Tables

September 4, 2018

Appendix A Table 1. Survey dates, results, level of effort, and weather during nocturnal radar surveys, Weaver Wind Project, fall 2016.

Date	Sunset	Sunrise	# of Hours Analyzed	Passage rate	Flight Direction	Flight Height (m)	% below 180 m	Average Nightly Temperature (°C)	Average Nightly Wind Speed (m/s)	Average Nightly Wind Direction (degrees)	Overall Nightly Visibility
8/22	19:29	5:45	10	309	143	483	14%	14	4	282	Clear with partly cloudy skies early in the night
8/23	19:27	5:46	10	405	52	298	31%	17	2	198	Partly cloudy to clear skies
8/24	19:25	5:47	10	246	42	348	26%	20	3	188	Partly cloudy to overcast skies in early morning
8/29	19:17	5:53	11	880	162	462	10%	16	3	296	Skies ranging from clear to mostly cloudy
9/5	19:04	6:02	11	884	252	352	20%	16	2	21	Overcast with periods of light rain in morning
9/6	19:02	6:03	11	366	344	382	20%	19	3	181	Overcast with a short period of mist near midnight
9/13	18:49	6:11	11	746	17	380	10%	17	3	184	Skies ranging from clear to partly cloudy
9/14	18:47	6:12	12	615	213	497	8%	12	3	353	Skies ranging from clear to overcast with patches of fog in late morning
9/21	18:34	6:21	12	668	89	405	12%	15	2	270	Partly cloudy to clear skies
9/22	18:32	6:22	12	1,126	133	373	26%	17	2	141	Mostly cloudy to overcast with light rain in morning
9/27	18:22	6:28	12	624	242	299	27%	11	4	29	Skies ranging from partly cloudy to overcast
9/28	18:20	6:29	12	631	229	460	10%	9	4	26	Skies ranging from clear to overcast
10/4	18:09	6:36	12	224	49	591	9%	5	1	351	Clear skies with patches of fog in late morning
10/5	18:07	6:38	10	305	63	524	18%	8	1	318	Clear skies
10/10	17:58	6:44	12	980	212	595	9%	5	3	331	Clear with partly cloudy skies early in night
10/11	17:56	6:45	11	507	342	768	8%	7	2	192	Clear skies with partly cloudy skies in late morning
10/13	17:53	6:48	11	222	189	422	10%	10	5	281	Overcast with a period of light rain in late evening and partly cloudy in morning
10/18	17:44	6:54	11	61	32	453	8%	15	4	200	Overcast with a short period of light rain in morning
10/19	17:43	6:56	12	544	189	489	11%	8	1	342	Clear to partly cloudy skies
10/26	17:31	7:05	12	357	219	571	4%	3	3	339	Overcast skies
Entire Season			**225**	**543**	**207**	**479**	**12%**				

* Weather data derived from weatherunderground.com data – Bangor International Airport KBGR weather station.

Appendix A Table 2. Summary of passage rates by hour, night, and for the entire season during nocturnal radar surveys, Weaver Wind Project, fall 2016.

Night of	Passage Rate (targets/km/hr) by hour after sunset												Entire Night			
	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Median	Stdev	SE
8/22	114	293	268	543	368	379	354	314	211	243	N/A	N/A	309	304	115	36
8/23	71	371	461	407	596	575	475	393	357	339	N/A	N/A	405	400	146	46
8/24	150	339	304	314	293	246	193	179	196	243	N/A	N/A	246	245	65	21
8/29	625	1,479	1,236	1,132	782	732	1,114	918	782	696	188	N/A	880	782	350	105
9/5	436	1,471	1,907	1,668	1,411	850	804	386	129	425	236	N/A	884	804	628	189
9/6	425	693	643	114	339	307	475	357	346	196	132	N/A	366	346	187	56
9/13	407	1,157	1,289	1,089	904	743	707	668	561	407	279	N/A	746	707	331	100
9/14	164	1,086	1,336	971	800	757	696	621	414	282	236	21	615	659	402	116
9/21	229	443	371	1,075	1,011	1,029	767	525	575	1,143	632	219	668	604	332	96
9/22	543	1,482	1,314	1,118	1,096	1,061	1,471	1,636	1,229	796	836	926	1,126	1,107	320	93
9/27	189	846	1,129	1,036	586	511	507	582	607	532	454	507	624	557	260	75
9/28	182	1,014	1,161	989	871	821	818	554	371	371	261	161	631	686	355	102
10/4	89	207	379	361	307	236	289	243	150	161	111	157	224	221	95	27
10/5	221	521	468	371	232	264	236	246	279	214	N/A[1]	N/A[1]	305	255	110	35
10/10	271	1,129	1,471	2,154	1,929	1,746	1,343	661	368	279	204	204	980	895	735	212
10/11	39	318	671	954	911	721	500	329	411	393	332	N/A[1]	507	411	278	84
10/13	175	214	168	75	Rain	107	179	332	336	407	318	129	222	179	109	33
10/18	4	0	0	0	14	29	57	143	150	164	Rain	114	61	29	68	20
10/19	314	539	568	586	571	518	546	532	1,268	329	396	361	544	536	249	72
10/26	218	486	614	664	629	582	418	243	196	79	61	89	357	330	234	67
Entire Season	**243**	**704**	**788**	**781**	**718**	**611**	**597**	**493**	**447**	**385**	**312**	**262**	**543**	**407**	**418**	**28**

0 indicates no targets counted for that hour N/A indicates no or only partial data for that hour

N/A[1] indicates equipment failure during that hour

Appendix A Table 3. Mean nightly flight direction during nocturnal radar surveys, Weaver Wind Project, fall 2016.

Night of	Mean Flight Direction (°)	Circular Stdev (°)
8/22	143	45
8/23	52	47
8/24	42	35
8/29	162	45
9/5	252	36
9/6	344	90
9/13	17	42
9/14	213	40
9/21	89	112
9/22	133	77
9/27	242	39
9/28	229	40
10/4	49	97
10/5	63	52
10/10	212	25
10/11	342	47
10/13	189	71
10/18	32	19
10/19	189	43
10/26	219	31
Entire Season	**207**	**94**

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season during nocturnal radar surveys, Weaver Wind Project, fall 2016.

Night of	Mean Flight Height (m) by hour after sunset												Entire Night				# of targets below 180 meters	% of targets below 180 meters
	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Median	STDV	SE		
8/22	410	435	445	477	476	515	511	524	508	432	N/A	N/A	483	448	278	8	158	14%
8/23	399	353	308	289	272	291	231	310	296	272	N/A	N/A	298	266	201	10	133	31%
8/24	334	294	346	310	400	357	404	337	376	285	N/A	N/A	348	303	244	11	132	26%
8/29	359	452	446	503	494	474	475	461	458	416	403	N/A	462	404	255	5	316	10%
9/5	301	405	380	309	299	293	309	356	444	478	350	N/A	352	322	210	5	305	20%
9/6	326	395	407	422	361	331	296	392	481	329	352	N/A	382	349	220	6	248	20%
9/13	322	384	374	387	404	380	406	393	365	333	305	N/A	380	338	200	5	205	10%
9/14	517	507	467	502	515	506	550	502	436	395	375	328	497	483	229	4	288	8%
9/21	322	390	427	434	403	401	385	371	447	403	377	323	405	388	203	4	312	12%
9/22	251	410	400	378	414	403	406	343	421	351	330	197	373	339	255	7	375	26%
9/27	280	318	295	311	350	318	282	292	223	270	253	216	299	284	182	4	468	27%
9/28	311	393	436	458	512	484	481	437	504	493	422	367	460	418	244	4	445	10%
10/4	278	388	546	576	562	571	677	666	594	641	589	514	591	597	293	10	86	9%
10/5	270	286	412	546	577	615	599	541	521	424	N/A[1]	N/A[1]	524	535	309	13	109	18%
10/10	376	460	533	578	594	637	692	651	609	587	585	657	595	574	304	5	345	9%
10/11	280	558	641	698	786	825	829	825	787	791	862	N/A[1]	768	818	341	8	155	8%
10/13	318	420	416	436	Rain	436	416	459	414	451	366	417	422	395	204	10	43	10%
10/18	--	--	447	540	580	552	511	514	414	424	Rain	442	453	464	169	9	29	8%
10/19	384	388	405	374	468	515	564	533	573	535	430	326	489	420	287	6	224	11%
10/26	574	585	605	604	599	494	476	552	601	542	551	506	571	564	241	5	100	4%
Entire Season	**348**	**429**	**454**	**481**	**508**	**509**	**528**	**497**	**501**	**459**	**440**	**387**	**479**	**426**	**275**	**1**	**4,476**	**12%**

-- indicates no targets counted for that hour
N/A indicates no or only partial data for that hour
N/A[1] indicates equipment failure during that hour

Appendix A Table 5. Summary of publicly available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-2016).

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Fall 2004									
Maple Ridge, Lewis Cty, NY	57	n/a	Agricultural plateau	158	n/a	181	415	(125 m) 8%	Mabee, T. J., J. H. Plissner, and B. A. Cooper. 2005. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Flat Rock Wind Power Project, New York, Fall 2004. Prepared by ABR, Inc. for Atlantic Renewable Energy Corporation
Sheffield, Caledonia Cty, VT	18	176	Forested ridge	91	19–320	200	566	(125 m) 1%	Woodlot Alternatives, Inc. 2005. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Hardscrabble Mountain Wind Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Dans Mountain, Allegany Cty, MD	34	318	Forested ridge	188	2–633	193	542	(125 m) 11%	Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Prattsburgh, Steuben Cty, NY	30	315	Agricultural plateau	193	12–474	188	516	(125 m) 3%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Franklin, Pendleton Cty, WV	34	349	Forested ridge	229	7–926	175	583	(125 m) 8%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Fall 2005									
Dairy Hills, Wyoming Cty, NY	57	n/a	Agricultural plateau	64	n/a	180	466	(125 m) 10%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns, and L. Pavalonis. 2006. Avian and Bat Studies for the Proposed Dairy Hills Wind Project, Wyoming County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Alabama, Genesee Cty, NY	59	n/a	Agricultural plateau	67	n/a	219	489	(125 m) 11%	Young, D. P., C. S. Nations, V. K. Poulton, and J. Kerns. 2007. Avian and Bat Studies for the Proposed Alabama Ledge Wind Project, Genesee County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Churubusco, Clinton Cty, NY	38	414	Great Lakes plain/ADK foothills	152	9–429	193	438	(120 m) 5%	Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Sheldon, Wyoming Cty, NY	36	347	Agricultural plateau	197	43–529	213	422	(120 m) 3%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
Noble C/E/A, Clinton Cty, NY	57	n/a	Great Lakes plain/ADK foothills	197	n/a	162	333	(125 m) 12%	Mabee, T. J., J. H. Plissner, B. A. Cooper, and J. B. Barna. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Clinton County Windparks, New York, Spring and Fall 2005. Final Report prepared by ABR, Inc. for Ecology and Environment, Inc. and Noble Environmental Power, LLC.
Prattsburgh, Steuben Cty (Ecogen), NY	45	n/a	Agricultural plateau	200	n/a	177	365	(125 m) 9%	Mabee, T. J., J. H. Plissner, and B. A. Cooper. 2004. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Plattsburgh-Italy Wind Power Project, New York, Fall 2004. Final Report prepared by ABR, Inc. for Ecogen, LLC.
Kibby, Franklin Cty, ME (Range 1)	12	101	Forested ridge	201	12–783	196	352	(125 m) 12%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Stamford, Delaware Cty, NY	48	418	Forested ridge	315	22–784	251	494	(110 m) 3%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Preston Cty, WV	26	n/a	Forested ridge	379	n/a	n/a	420	(125 m) 10%	Plissner, J. H., T. J. Mabee, and B. A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Jordanville, Herkimer Cty, NY	38	404	Agricultural plateau	380	26–1,019	208	440	(125 m) 6%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Stark and Warren, NY. Fall 2005 Final Report prepared for Community Energy, Inc.
Highland, Highland Cty, VA	58	n/a	Forested ridge	385	n/a	n/a	442	(125 m) 12%	Plissner, J. H., T. J. Mabee, and B. A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Clayton, Jefferson Cty, NY	37	385	Agricultural plateau	418	83–877	168	475	(150 m) 10%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Bliss, Wyoming Cty, NY	8	n/a	Agricultural plateau	444	n/a	n/a	411	(125 m) 13%	Ecology and Environment, Inc. 2006. Avian and Bat Risk Assessment Bliss Windpark Town of Eagle, Wyoming County, New York. Prepared for Noble Environmental Power, LLC.
Kibby, Franklin Cty, ME (Valley)	5	13	Forested ridge	452	52–995	193	391	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Mars Hill, Aroostook Cty, ME	18	117	Forested ridge	512	60–1,092	228	424	(120 m) 8%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Howard, Steuben Cty, NY	39	405	Agricultural plateau	481	18–1,434	185	491	(125 m) 5%	Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Deerfield, Bennington Cty, VT	32	324	Forested ridge	559	3–1,736	221	395	(100 m) 13%	Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Kibby, Franklin Cty, ME (Mountain)	12	115	Forested ridge	565	109–1,107	167	370	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Fairfield, Herkimer Cty, NY	38	423	Agricultural plateau	691	116–1,351	198	516	(145 m) 6%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
Munnsville, Madison Cty, NY	31	292	Agricultural plateau	732	15–1,671	223	644	(118 m) 2%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Fall 2006									
Villenova, Chautauqua Cty, NY	36	n/a	Great Lakes plain	189	16–604	216	353	(120 m) 9%	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
Wethersfield, Wyoming Cty, NY	56	n/a	Agricultural plateau	256	31–701	203	344	(125 m) 11%	Mabee, T. J., J. H. Plissner, J. B. Barna, and B. A. Cooper. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield windparks, New York, Fall 2006. Final Report prepared by ABR, Inc. for Ecology and Environment and Noble Environmental Power, LLC
Centerville, Allegany Cty, NY	57	n/a	Agricultural plateau	259	12–877	208	305	(125 m) 12%	Mabee, T. J., J. H. Plissner, J. B. Barna, and B. A. Cooper. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield windparks, New York, Fall 2006. Final Report prepared by ABR, Inc. for Ecology and Environment and Noble Environmental Power, LLC

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Cape Vincent, Jefferson Cty, NY	60	n/a	Great Lakes plain	346	n/a	209	490	(125 m) 8%	Young, D. P., J. J. Kerns, C. S. Nations, and V. K. Poulton. 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Project Jefferson County, New York. Final Report prepared by WEST, Inc. for BP Alternative Energy.
Stetson, Washington Cty, ME	12	77	Forested ridge	476	131–1,192	227	378	(125 m) 13%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Dutch Hill, Steuben Cty, NY	21	n/a	Agricultural plateau	535	n/a	215	358	(125 m) 11%	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Dutch Hill Wind Project Cohocton, New York. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan Cty, NH	32	290	Forested ridge	620	133–1,609	206	387	(125 m) 8%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Chateaugay, Franklin Cty, NY	35	327	Agricultural plateau	643	38–1,373	212	431	(120 m) 8%	Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
Granite Reliable Power, Coos Cty, NH	30	328	Forested ridge	469	22–1,098	223	455	(125 m) 1%	Stantec Consulting Services Inc. 2007. Fall 2006 Radar Surveys of Nighttime Migration Activity at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Fall 2007									
Arkwright, Chautauqua Cty, NY	57	n/a	Great Lakes plain	112	n/a	208	458	(125 m) 10%	Kerns, J., D. P. Young, C. S. Nations, and V. K. Poulton. 2008. Avian and Bat Studies for the Proposed New Grange Wind Project, Chautauqua County, New York. Final Report prepared by WEST, Inc. for New Grange Wind Farm LLC.
Laurel Mountain, Barbour Cty, WV	20	212	Forested ridge	321	76–513	209	533	(130 m) 6%	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Granite Reliable Power, Coos Cty, NH	29	232	Forested ridge	366	54–1,234	223	343	(125 m) 15%	Stantec Consulting Services Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Rollins, Lincoln, Penobscot Cty, ME	22	231	Forested ridge	368	82–953	284	343	(120 m) 13%	Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Record Hill, Oxford Cty, ME	20	220	Forested ridge	420	88–1,006	227	365	(130 m) 14%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Allegany, Cattaraugus Cty, NY	46	n/a	Forested ridge	451	n/a	230	382	(150 m) 10%	Stantec Consulting Services Inc. 2008. Fall Bird and Bat Migration Survey Report, Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project in Allegany, New York. Prepared for Allegany Wind, LLC. March 2008 (updated January 2010).
New Creek, Grant Cty, WV	20	n/a	Forested ridge	811	263–1,683	231	360	(130 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Fall 2008									
Hounsfield, Jefferson Cty, NY	60	674	Great Lakes island	281	64–835	207	298	(125 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
Georgia Mountain, Franklin and Chittenden Ctys, VT	21	n/a	Forested ridge	326	56–700	230	371	(120 m) 7%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind.

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Oakfield, Penobscot Cty, ME	20	n/a	Forested ridge	501	116–945	200	309	(125 m) 18%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Groton Wind, Grafton Cty, NH	45	509	Forested ridge	470	94–1,174	260	342	(125 m) 13%	Stantec Consulting Services Inc. 2008. Fall 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Highland, Somerset Cty, ME	20	216	Forested ridge	549	68–1,201	227	348	(130.5 m) 17%	Stantec Consulting. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC
Kingdom Community, Orleans Cty, VT	20	230	Forested ridge	356	12–1,372	n/a	350	(125 m) 15%	Stantec Consulting. 2008. Fall 2008 Bird and Bat Migration Survey Report: Radar Surveys for the Kingdom Community Wind Project in Lowell, Vermont. Prepared for Vermont Environmental Research Associates.
Fall 2009									
Sisk (Kibby Expansion) Franklin Cty, ME	20	210	Forested ridge	458	44–1,067	206	287	(125 m) 23%	Stantec Consulting Services Inc. 2009. Fall 2009 Nocturnal Migration Survey Report. Prepared for TRC Engineers LLC.
Bull Hill, Hancock Cty, ME	20	232	Forested ridge	614	188–1,500	260	357	(145 m) 20%	Stantec Consulting Services Inc. 2010. Summer and Fall 2009 Avian and Bat Survey Report for the Bull Hill Project. Prepared for Blue Sky East Wind, LLC.
Hancock, Hancock Cty, ME	n/a	n/a	Forested ridge	n/a	n/a	n/a	n/a	(175 m) 20%	Stantec Consulting Services Inc. 2014. Hancock Wind Project avian and bat migration data – reanalyzed for a turbine height of 175 m. Prepared for First Wind. *Used the Bull Hill Wind Project fall 2009 radar data and reanalyzed for % targets below 175 m turbine height*
Bowers, Washington Cty, ME	22	249	Forested ridge	344	95–844	231	315	(119 m) 14%	Stantec Consulting Services Inc. 2010. Fall 2009 Avian and Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Wild Meadows, Grafton and Merrimack Ctys, NH	35	380	Forested ridge	980	384–2,442	225	362	(150 m) 19%	Stantec Consulting Services Inc. 2013. Fall 2009 Radar and Acoustic Surveys, Wild Meadows Wind Project in Grafton and Merrimack Counties, New Hampshire. Prepared for Atlantic Wind LLC.
Fall 2010									
Bingham, Somerset Cty, ME	20	232	Forested ridge	803	194–2,463	234	378	(152 m) 20%	Stantec Consulting Services Inc. 2012. Fall 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind, LLC.
Fall 2011									
Antrim, Hillsborough Cty, NH	30	327	Forested ridge	138	4–538	217	203	(150 m) 40%	Stantec Consulting Services Inc. 2011. Summer and Fall 2011 Radar and Acoustic Bat Survey Report for the Antrim Wind Energy Project in Antrim, New Hampshire. Prepared for Antrim Wind Energy, LLC.
Bingham, Somerset Cty, ME	12	139	Forested ridge	952	341–2,234	244	397	(152 m) 16%	Stantec Consulting Services Inc. 2012. Fall 2011 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind, LLC.
Passadumkeag, Penobscot Cty, ME	20	222	Forested ridge	394	65–1,281	251	325	(140 m) 22%	Stantec Consulting Services. 2011. Summer and Fall 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Bull Hill, Hancock Cty, ME	10	112	Forested ridge	431	111–747	282	279	(145 m) 26%	Stantec Consulting Services Inc. 2011. Fall 2011 Radar Survey Results and Comparison to Fall 2009 Radar Results: Memo for the Bull Hill Wind Project. Prepared for Blue Sky East Wind, LLC.
Hancock, Hancock Cty, ME	n/a	n/a	Forested ridge	n/a	n/a	n/a	n/a	(175 m) 35%	Stantec Consulting Services Inc. 2014. Hancock Wind Project avian and bat migration data – reanalyzed for a turbine height of 175 m. Prepared for First Wind. *Used the Bull Hill Wind Project fall 2011 radar data and reanalyzed for % targets below 175 m turbine height*
Fall 2014									

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Weaver, Hancock Cty, ME	20	211	Forested ridge	657	239–1,122	259	412	(180 m) 23%	Stantec Consulting Services Inc. 2014. 2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project. Prepared for First Wind, LLC.
Number Nine, Aroostock Cty, ME	20	227	Forested ridge	247	47-806	218	354	(150 m) 21%	Stantec Consulting Services Inc. 2014. Fall 2014 Nocturnal Radar Survey Report. Prepared for Number Nine Wind Farm, LLC.
Fall 2016									
Weaver, Hancock Cty, ME	**20**	**225**	**Forested ridge**	**543**	**61 - 1,126**	**207**	**479**	**(180 m) 12%**	**This Report**

[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Exhibit 7-8

Hancock Post-Construction Monitoring Report

Hancock Wind Project

Post-Construction Bird and Bat Fatality Monitoring Report
Year 1 (2017)

Prepared For:

Novatus Energy, LLC
767 Third Avenue
17th Floor
New York, NY 10017

Prepared By:

TRC
6 Ashley Drive
Scarborough, ME 04074

December 2017

EXECUTIVE SUMMARY

The Hancock Wind Project (Project) is a 17-turbine wind energy facility generating a nameplate capacity of 51 megawatts of renewable energy. The Project, which went in-service in December of 2016, is located in Townships 16 and 22 in Hancock County, Maine. TRC conducted post-construction monitoring during the first full year of operation in 2017 to evaluate bird and bat fatalities as a result of the Project.

Fatality monitoring involved searching all 17 turbines and the permanent meteorological (met) tower for bird and bat fatalities between April 15 and October 15. A trained technician systematically searched the turbines and met tower at a rate of one search every 3.5 days (2 times per week). During the fatality monitoring period, 702 turbine searches were conducted. The turbines were programmed to curtail during low wind speed conditions (below 6 meters per second [m/s]) every night from 30 minutes before sunset to 30 minutes after sunrise between April 20 and October 15.

During 2017 fatality monitoring, nine birds and three bats were found. Eight birds were found during searches, and one bird, a golden-crowned kinglet (*Regulus satrapa*), was found incidentally. Bird fatalities by taxonomic order included six passerines identified to species, two birds that could not be identified to species, and one owl. Of the eight birds found during searches, six were identified to species: black-and-white warbler (*Mniotilta varia*), blackpoll warbler (*Setophaga striata*), palm warbler (*Setophaga palmarum*), northern parula (*Setophaga americana*), yellow-bellied flycatcher (*Empidonax flaviventris*), and barred owl (*Strix varia*). None of the bird fatalities found are listed as federally- or state-threatened or endangered, though one species (black-and-white warbler) is considered a species of Special Concern in Maine. Bats found during searches included two silver-haired bats (*Lasionycteris noctivagans*) and one eastern red bat (*Lasiurus borealis*). Neither of these bat species are listed as federally- or state-threatened or endangered, though both are considered species of Special Concern in Maine.

The Huso, Shoenfeld, and Smallwood Estimators were used to estimate bird and bat fatality rates. Fatality estimates were calculated with area corrections and were calculated separately for birds and bats. Fatality estimates for each estimator were:

- Huso:
    - 4.56 birds/turbine/study period
    - 0.89 bats/turbine/study period
- Shoenfeld:
    - 6.99 birds/turbine/study period
    - 1.14 bats/turbine/study period
- Smallwood:
    - 2.76 birds/turbine/study period
    - 1.03 bats/turbine/study period

TABLE OF CONTENTS

1.0 INTRODUCTION..1-1

2.0 BIRD AND BAT FATALITY SURVEY 2-1

2.1 Methods 2-1

2.1.1 Data Collection 2-1

2.1.1.1 Searcher Efficiency Trials 2-2

2.1.1.2 Carcass Persistence Trials 2-3

2.1.2 Data Analysis 2-3

2.1.2.1 Temporal and Spatial Analyses 2-3

2.1.2.2 Bird and Bat Fatality Estimates 2-4

2.2 Results 2-4

2.2.1 Fatality Search Effort and Search Plot Visibility 2-4

2.2.2 Bird and Bat Fatalities 2-4

2.2.3 Seasonal Timing of Fatalities 2-5

2.2.4 Fatality, Nighttime Weather Conditions, and Turbine Operation 2-7

2.2.5 Spatial Distribution of Fatalities 2-8

2.2.6 Incidental Wildlife Observations 2-10

2.2.7 Covariate Distribution Analyses 2-10

2.2.8 Searcher Efficiency Results 2-11

2.2.9 Carcass Persistence Results 2-11

2.2.10 Estimates of Fatality 2-12

2.2.11 Huso Fatality Estimator 2-13

2.2.12 Shoenfeld Fatality Estimator 2-13

2.2.13 Smallwood Fatality Estimator 2-14

2.3 Discussion 2-14

2.3.1 Species Composition and Temporal and Spatial Distribution of Fatalities 2-14

2.3.2 Carcass Persistence Bias Trials 2-15

2.3.3 Covariate Distribution Analyses 2-15

2.3.4 Fatality Estimators 2-15

2.3.5 Regional Comparison of Fatality Estimates 2-16

3.0 CONCLUSIONS AND RECOMMENDATIONS 3-1

4.0 REFERENCES...4-1

Estimator Calculations 4-3

Huso Fatality Estimate 4-3

Shoenfeld Fatality Estimate 4-4
Smallwood Fatality Estimate 4-4

LIST OF TABLES

Table 1. Bird and Bat Fatalities 2-5
Table 2. Turbine and Weather Information for Fresh Bat Carcass 2-8
Table 3. Search Efficiency Tests for Birds and Bats 2-11
Table 4. Carcass Persistence and Carcass Persistence Rates for Birds and Bats 2-11
Table 5. Density Weighted Proportion (DWP) Calculations 2-13
Table 6. Huso Estimates of Bird and Bat Fatality (with Area Corrections) 2-13
Table 7. Shoenfeld Estimates of Bird and Bat Fatality (with Area Corrections) 2-14
Table 8. Smallwood Estimates of Bird and Bat Fatality (with Area Corrections) 2-14
Table 9. Bird and Bat Fatality Rates at Operational Wind Projects in New England 2-17

LIST OF FIGURES

Figure 1. Hancock Wind Project Overview 1-2
Figure 2. Timing of Bird Fatalities by Season 2-6
Figure 3. Timing of Bird Fatalities by Month 2-6
Figure 4. Timing of Bat Fatalities by Season 2-7
Figure 5. Timing of Bat Fatalities by Month 2-7
Figure 6. Number of Birds and Bats Found at Individual Search Turbines 2-8
Figure 7. Distribution of Bird and Bat Carcasses 2-9
Figure 8. Distribution of Bird and Bat Carcasses in 10-meter Distance Increments from Towers 2-10
Figure 9. Bird Fatality Rates Reported from Wind Projects in New England 2-21
Figure 10. Bat Fatality Rates Reported from Wind Projects in New England 2-21

APPENDICES

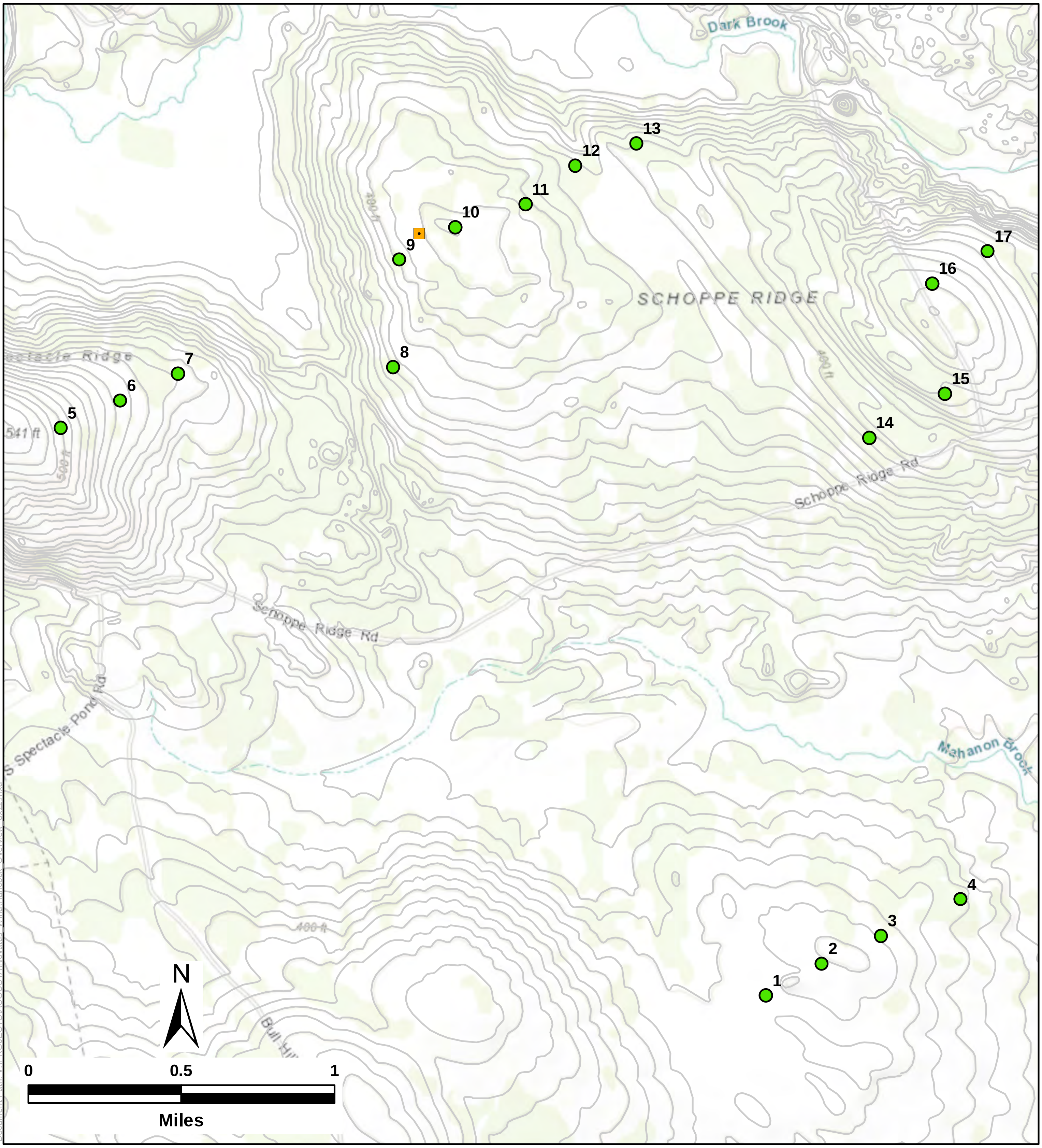
Appendix A Hancock Wind Post-Construction Bird and Bat Fatality Monitoring Plan, Years 1 and 2
Appendix B Fatality Model Descriptions and Inputs
Appendix C Visibility Class Figures

1.0 Introduction

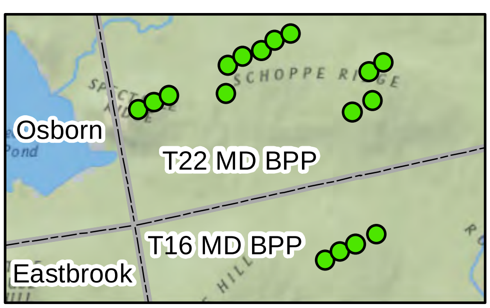
The Hancock Wind Project (Project) is a 17-turbine wind energy facility generating a nameplate capacity of 51 megawatts (MW) of renewable energy that went in service in December of 2016. The Project, which consists of 3.0-MW Vestas V-117 turbines, is located in Townships 16 and 22 in Hancock County, Maine (see Figure 1). Project turbines have a maximum height from tower base to blade tip of 175 meters (m) (574 feet), and the manufacturer's cut-in speed is 3.5 m per second (m/s). As of the date of this report, 13 of the 17 turbines are lit with Federal Aviation Administration (FAA) radar-activated lighting.

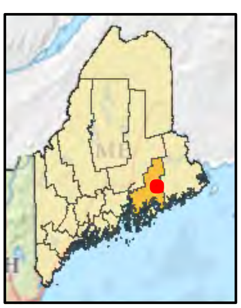
In compliance with conditional requirements of the Project permits issued by the Maine Department of Environmental Protection (MDEP) (#L-25875-24-A-N issued July 2013 and amended March 2015), TRC conducted post-construction bird and bat fatality monitoring during the first full year of operation in 2017. Methods employed during 2017 monitoring are described in the *Hancock Wind Project Post-Construction Bird and Bat Fatality Monitoring Plan, Years 1 and 2* (PCMP), dated December 2016 (see Appendix A). The PCMP was developed in consultation with the Maine Department of Inland Fisheries and Wildlife (MDIFW) and submitted to the MDEP prior to implementation.

This report presents the results of bird and bat fatality monitoring in 2017. Bird and bat fatality monitoring will also occur in Year 2 as outlined in the PCMP. The objectives of bird and bat fatality monitoring were to assess the species involved in fatal collisions and the amount of bird and bat fatalities at the Project. In accordance with the MDEP permit, turbines operated under a seasonal curtailment regime of 6 m/s 30 minutes before sunset to 30 minutes after sunset from April 20 to October 15.



Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Hancock_Overview_8x11.mxd





Turbine Sites

Permanent Met Tower

Town

Source: Novatus, TRC, MEGIS and ESRI.
Map Projection: NAD 1983 UTM ZONE 19N

Figure 1

Hancock Wind Project Location Map

TRC

12/29/2017

2.0 Bird and Bat Fatality Survey

2.1 Methods

2.1.1 Data Collection

Bird and bat fatality monitoring involved searching beneath all 17 of the turbines and the permanent meteorological (met) tower at a frequency of approximately every 3.5 days (twice per week) between April 15 and October 15. The efficacy of the 3.5-day search interval was assessed by conducting carcass persistence trials[1] (as described in Section 2.1.1.2 below).

Standardized search plots were established prior to the beginning of the monitoring period. The search areas included all cleared and leveled lay-down areas, gravel roads, and other easy to moderately searchable ground cover areas within 80 m of the turbine towers. Where feasible, search areas also included gravel road surfaces within 140 m of the turbine towers. Steep slopes, unsafe walking terrain (e.g. boulder fields), forest, and other areas where searcher efficiency is expected to be very low was not included in the established search plots. Schematics of each search area were provided to the MDIFW prior to the start of searches.

The boundary of each search plot, along with the start and end points of the survey transects, were mapped using a Global Positioning System (GPS). Additionally, during the growing season, the boundaries of different visibility classes within each search plot were also mapped using a GPS.

During searches, vegetation conditions (vegetation type, height, and percent cover) were monitored within the search plots. Ground cover within the plots was categorized into four visibility classes defined as follows:

- Easy - > 90% bare ground; ground cover sparse and height < 12 inches (in);
- Moderate - > 25% bare ground; all ground cover < 12 in and mostly sparse;
- Difficult - < 25% bare ground; < 25% of ground cover > 12 in; and
- Very Difficult / Unsearchable – little or no bare ground; > 75% of ground cover > 12 in.

A trained technician walked along marked, parallel transects at 4-m intervals across the search plots. The technician walked along each transect at a rate of approximately 45-60 m per minute, searching both sides of each transect for fatalities. During the next search of the same plot, the technician walked between the marked transects to increase the chances of finding carcasses that may occur between transects.

The technician documented all observed fatalities on a standardized field form, photographed the fatalities, and collected bat carcasses in accordance with the Wildlife Scientific Collection Permit issued by the MDIFW (# 2017-513). The Project applied for a federal collection permit from the United States Fish and Wildlife Service, but a permit was not issued; therefore, bird fatalities were left in place where they were found. Bat carcasses were individually bagged and retained in a freezer, and photos of all bat fatalities were submitted to the MDIFW within two business days of discovery.

---

[1] The threshold for potential adjustment to the 3.5 day search interval was set at less than 67% of persistence trial carcasses remaining after Day 3.

The following information was recorded for each observed fatality:

- Date and time;
- Turbine number;
- Whether the carcass was found during a regular search or incidentally;
- Physical condition of carcass (e.g., intact or partial carcass, scavenged, feather spot);
- Estimated carcass age (based on carcass characteristics);
- Distance of the carcass from the turbine tower (determined via tape measure);
- Direction of the carcass from the turbine tower (determined via compass);
- Ground conditions under carcass;
- Carcass species (if known);
- Carcass age, sex, and reproductive condition (if possible);
- Carcass state (e.g., fresh, early or late decomposition, desiccated, dead, live/injured); and
- Evidence of scavenger activity (e.g., tracks, scat).

At the onset of each search day, weather conditions including cloud cover, precipitation, temperature, wind speed, and wind direction were recorded. Additionally, local weather summaries were also acquired from a commercial weather service (Weather Underground).

2.1.1.1 Searcher Efficiency Trials

Searcher efficiency trials were conducted at all turbines to estimate the percentage of bird and bat fatalities that were found by searchers. Three searcher efficiency trials were performed in 2017, one in each seasonal period: April 15 – June 1; June 2 – August 31; and September 1 – October 15. During each individual efficiency trial, a total of 30 carcasses were placed within the search plots. Carcasses consisted of 20 birds (10 of small size class and 10 of medium size class) and 10 brown mice or bats. Bird carcasses used during the trials consisted of domestic quail chicks, rock pigeons, house sparrows, and European starlings.

For the first trial of the year, 35 carcasses were placed early in the morning within plots to be searched that day and plots to be searched the following day. Carcasses placed were increased from 30 to 35 to account for some scavenging of carcasses in plots to be searched the following day. After discovering a high rate of scavenging during the first trial, the remaining two trials were conducted such that carcasses were placed early in the morning only within plots to be searched that day.

For all trials, the trial coordinator attempted to limit the evidence of trial set-up to the extent possible. Searchers were unaware of the timing of efficiency trials. Carcasses were marked with a small piece of string or a rubber band placed around a leg or tail (in the case of mice carcasses). Carcasses were then placed in search plots at random distances and bearings from the turbine towers. To avoid carcass swamping at any one location, no more than two carcasses were placed at an individual turbine. Carcasses were placed within various ground cover types and visibility classes (easy, moderate, or difficult) to the extent possible given site conditions.

For each carcass placed, the trial coordinator recorded the following: date and set up time; name of searcher; turbine number; carcass species; carcass distance and direction from tower; and ground conditions under the carcass. At the end of the search day, the trial coordinator documented the results (carcasses found and not found) on standardized data forms. Once the trial was completed, the trial carcasses not found by the searcher or not removed by scavengers were collected. Carcasses that were removed by scavengers were not included in search efficiency results, as it was not known whether the carcasses were scavenged before or after the search event.

2.1.1.2 Carcass Persistence Trials

Carcass persistence trials were performed to determine the percentage of carcasses that remained detectable (i.e., not removed by scavengers) between search intervals. Three carcass persistence trials were conducted during the 2017 monitoring period. One trial was conducted in each seasonal period: April 15 – June 1; June 2 – August 31; and September 1 – October 15. During each individual persistence trial, a total of 30 carcasses were placed within the search plots. Carcasses consisted of 20 birds (10 of small size class and 10 of medium size class) and 10 brown mice or bats. Carcasses used for persistence trials were fresh carcasses that had been frozen. Bird carcasses used during the trials consisted of domestic quail chicks and rock pigeons.

Carcasses were placed in search plots at random distances and bearings from the turbine towers. Carcasses were marked with a small piece of string or a rubber band placed around a leg or tail (in the case of mice carcasses). To avoid carcass swamping at any one location, no more than two carcasses were placed at an individual turbine. Carcasses were placed within various ground cover types and visibility classes (easy, moderate, or difficult) to the extent possible given site conditions.

For each carcass placed, the trial coordinator recorded the following: date and set up time; name of investigator; turbine number; carcass species; carcass distance and direction from tower; ground conditions and cover type percent under the carcass; and visibility class under the carcass. The status of trial carcasses was monitored for 30 days on the following schedule: daily for the first seven days, then on Day 10, Day 14, Day 21, and Day 30. All evidence of insect, mammalian, or avian scavenging was documented on standardized data forms. Each time a trial carcass was checked, technicians noted whether the carcass was present (intact or partially scavenged but readily detectable) or absent (completely removed or with so few feathers or tissue remaining that it would not be readily detectable during a regular fatality monitoring search). All carcasses remaining after 30 days were removed.

In addition to the three carcass persistence trials described above, an additional carcass persistence test was conducted that incorporated the use of game cameras. As with the other trials, 30 carcasses were placed, in addition to three game cameras that were setup at three different turbines. Each camera was oriented to face the direction of the carcass that was placed at that particular turbine. After carcasses at the three camera locations were scavenged, the trial was ended.

2.1.2 Data Analysis

2.1.2.1 Temporal and Spatial Analyses

The following data summaries and analyses were based on the temporal and spatial distribution of bird and bat fatalities found in 2017.

<u>Species Composition of Fatalities</u>

The species composition of fatalities included a summary of the number of bird and bat fatalities found by species.

Timing of Fatalities

For timing of fatalities, the seasonal timing of fatalities and the nighttime weather conditions for nights prior to the discovery of a fresh fatality was analyzed.

Spatial Distribution of Fatalities

The spatial distribution of fatalities analyses included: the range of distances that birds and bats were found from the towers; the average distances birds and bats were found from the towers; and the distances and bearings of carcasses from the towers, plotted on a scatterplot diagram within 10-m concentric distance increments.

Covariate Distribution Analyses

The number of incidents of night migrating bird and bat fatalities at FAA-lit turbines versus unlit turbines was examined, and the effect of turbine lighting on the number of bird and bat fatalities found per searched turbine was evaluated using chi-square tests.

2.1.2.2 Bird and Bat Fatality Estimates

Estimates of bird and bat fatality rates were calculated using three estimators: the Huso Estimator (Huso et al. 2012), a method that was developed in 2010 based on Thompson (1992); the Shoenfeld Estimator (2004), which is largely based on methods proposed by Erickson et al. (2003), as modified by Young et al. (2009); and the Smallwood Estimator, as described in Smallwood et al. (2013), based on modified methods developed by Horovitz and Thompson (1952). For a description of these models and the inputs for data from this Project, refer to Appendix B.

2.2 Results

2.2.1 Fatality Search Effort and Search Plot Visibility

A total of 702 searches were conducted at 17 turbines and the met tower at a search interval of every 3.5 days between April 17 and October 13, 2017.

Within all search plots, the dominant cover type during the spring surveys was gravel. During the summer and fall surveys, the dominant cover type was either gravel or short grass (0-6 inches). Other cover types in the search plots included clover, mulch, dirt, and cobble. All search plots included gravel pads and segments of road, and all search plots were classified as easy visibility class. A summary of visibility class, searchable area, and cover types is provided in Appendix C, Table 1. Figures showing the visibility classes and ground cover type and representative photos are also included in Appendix C.

2.2.2 Bird and Bat Fatalities

During the fatality monitoring period, eight birds were found during searches and one was found incidentally (see Table 1). Passerines represented the bulk of the carcasses found during searches (n = 5, 62.5%), with unidentified birds representing 25% (n = 2). A barred owl (*Strix varia*) was also detected during searches. Incidentally, one golden-crowned kinglet (*Regulus satrapa*) was found. Seven species of birds were found, not including the unidentified specimens. No single bird species was represented more than once. No federally or state-listed threatened or endangered bird species were found during the course of these searches. The black-and-white warbler (*Mniotilta varia;* n = 1) is listed as a Species of Special Concern by the MDIFW (MDIFW, 2011).

During the course of searches, three bat carcasses were found. Two of the carcasses were silver-haired bats (*Lasiurus noctivagans*), and one was an eastern red bat (*Lasiurus borealis*). No federally or state-listed threatened or endangered bats were found during the course of fatality searches or incidentally. Both bat species found are listed by the MDIFW as Species of Special Concern (MDIFW, 2011).

Table 1. Bird and Bat Fatalities

Date	Turbine	Detection Method	Species	Estimated Time of Collision
Birds				
4/17/2017	05	Incidental	Golden-crowned Kinglet	2-3 days
5/4/2017	16	Search	Palm Warbler	2-3 days
5/10/2017	03	Search	Black-and-white Warbler	2-3 days
5/22/2017	16	Search	Unidentified Bird	> 1 month
5/24/2017	03	Search	Unidentified Bird	2-3 days
6/5/2017	11	Search	Northern Parula	7-14 days
7/20/2017	06	Search	Barred Owl	Unknown
8/21/2017	02	Search	Yellow-bellied Flycatcher	4-7 days
9/15/2017	14	Search	Blackpoll Warbler	2-3 days
Bats				
8/31/2017	04	Search	Silver-haired Bat	< 48 hrs
9/1/2017	11	Search	Eastern Red Bat	Last night (<12 hrs)
9/4/2017	09	Search	Silver-haired Bat	4-7 days

2.2.3 Seasonal Timing of Fatalities

Birds were found during searches in all three survey periods as defined by the PCMP. The majority (50.0%, n = 4) were found within the spring migration period, prior to June 1 (see Figure 2). Two birds (25%) were found within the summer period, and the remaining two birds (25%) were found within the fall migration period. By month, May had the highest number of fatalities (50%, n = 4) (see Figure 3).

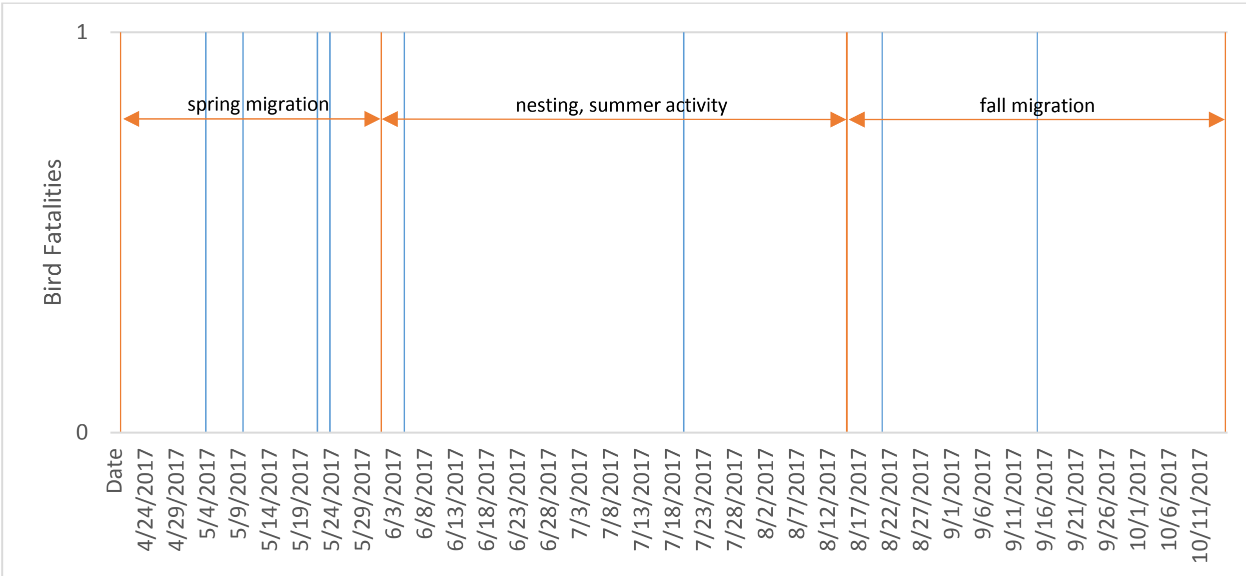


Figure 2. Timing of Bird Fatalities by Season

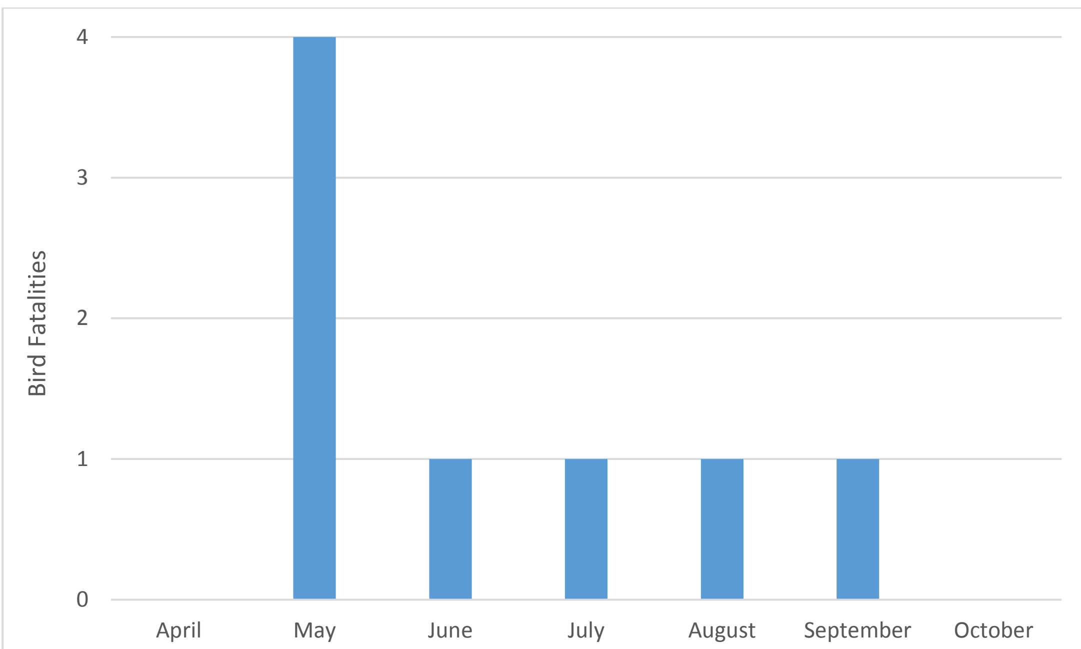


Figure 3. Timing of Bird Fatalities by Month

Bats were found in only one of the survey periods as defined in the PCMP: fall migration (August 15 – October 15) (see Figure 4). All three of the bat fatalities fall into the category of migratory bats. By month, September had the most bat fatalities (n = 2) (see Figure 5).

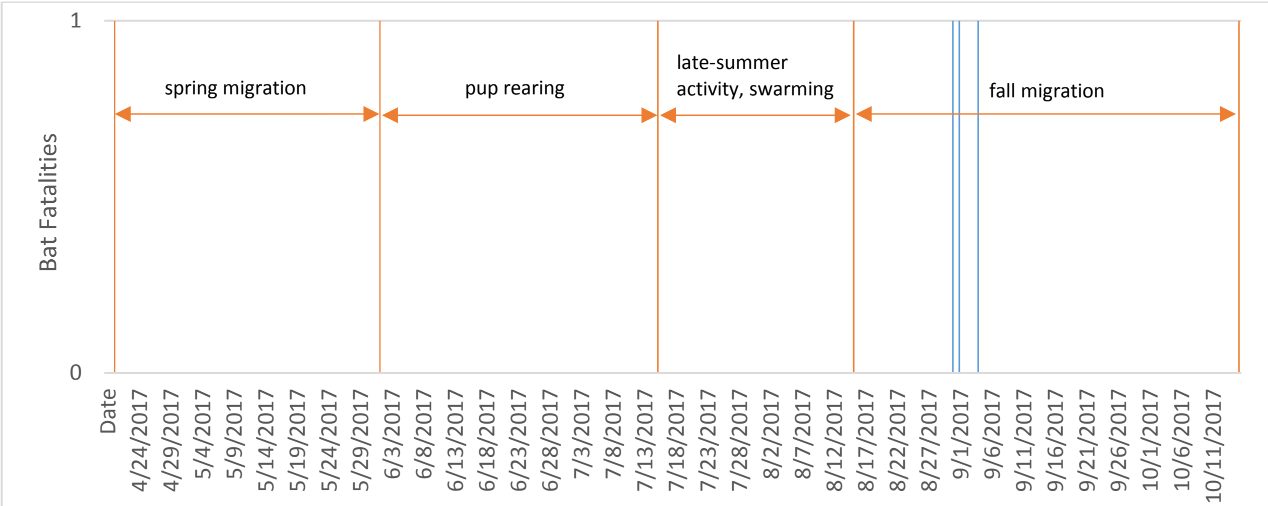


Figure 4. Timing of Bat Fatalities by Season

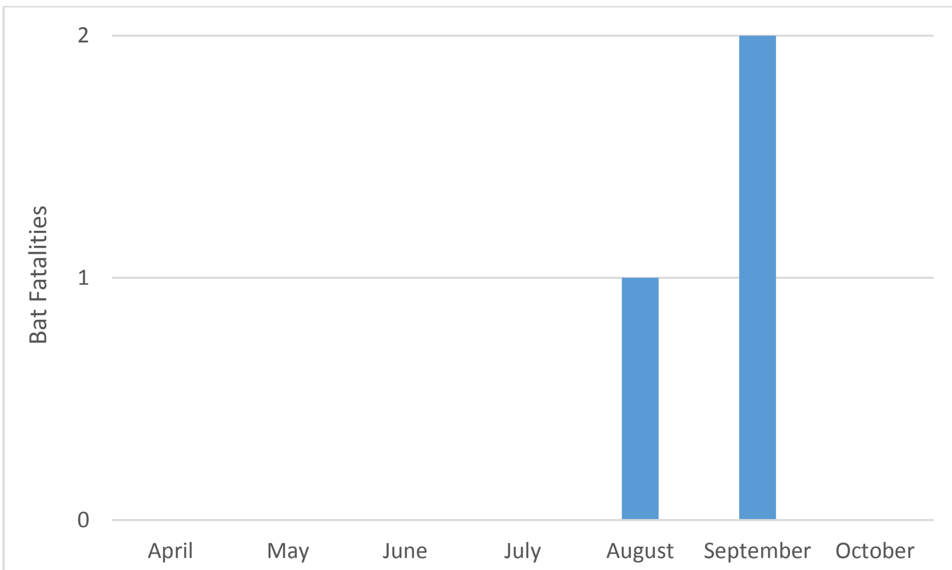


Figure 5. Timing of Bat Fatalities by Month

2.2.4 Fatality, Nighttime Weather Conditions, and Turbine Operation

Only fresh carcasses for which collision time was assumed to be less than 24 hours (< 24 hrs) were examined with respect to weather and operational data. Factors such as predation/scavenging and decomposition can negatively affect a searchers' ability to accurately determine time of collision. One fresh bat carcass was found during a discrete search. For the fresh bat carcass, weather and turbine data were compiled only for the night prior to the find, as it can reasonably be assumed that a bat collision happened at night. Due to the small sample size, it is impossible to determine probability of finding a bat carcass based on weather or operational parameters.

The turbine and weather information presented in Table 2 below is for the single fresh bat carcass (< 24 hrs) found, which was that of an eastern red bat documented at Turbine 11 on September 1, 2017.

Table 2. Turbine and Weather Information for Fresh Bat Carcass	
Average Wind Speed [a/]	8.16
Average Rotor Rotations Per Minute [a/]	11.47
Average Temperature (°F) [a/]	54.5
Number of 10-Minute Periods Curtailed [a/]	5
Precipitation (amount [inches]) [b/]	Rain (0.08)
Dew Point (°F), Average Humidity [b/]	43 (74%)
Moon Phase (% Visible)	74

[a/] Data from corresponding turbine nacelle.
[b/] Data obtained from www.wunderground, Bar Harbor, KBHB weather station.

2.2.5 Spatial Distribution of Fatalities

The number of birds found at individual turbines ranged from 0 – 2, and the number of bats found at individual turbines ranged from 0 – 1 (see Figure 6). No multiple fatality events were observed.

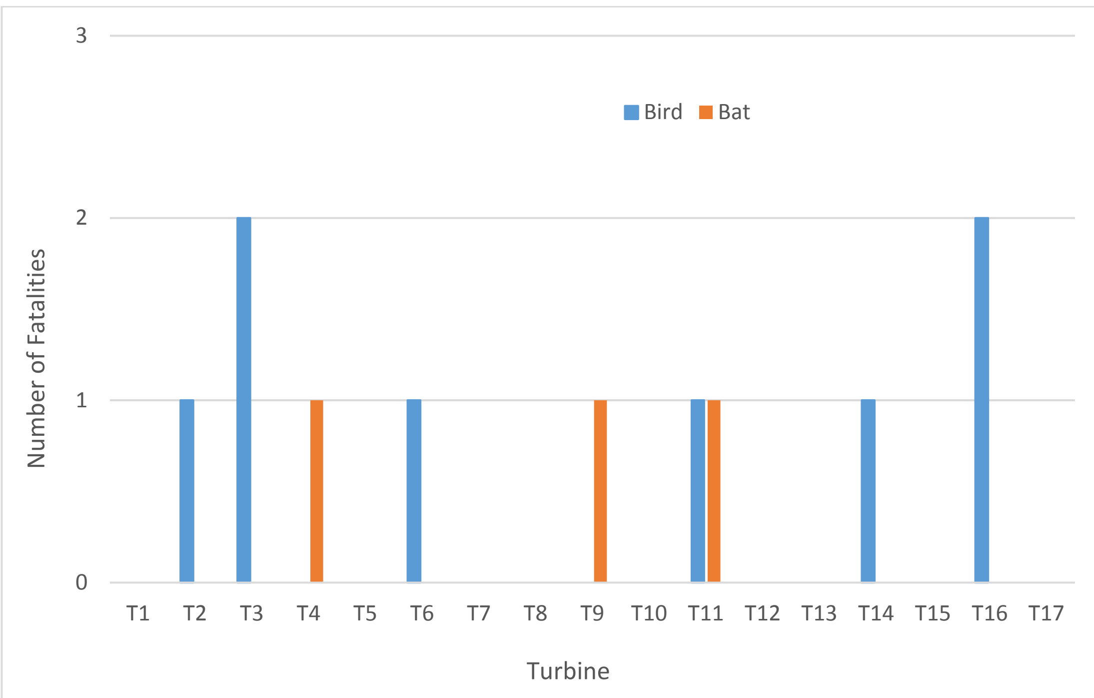
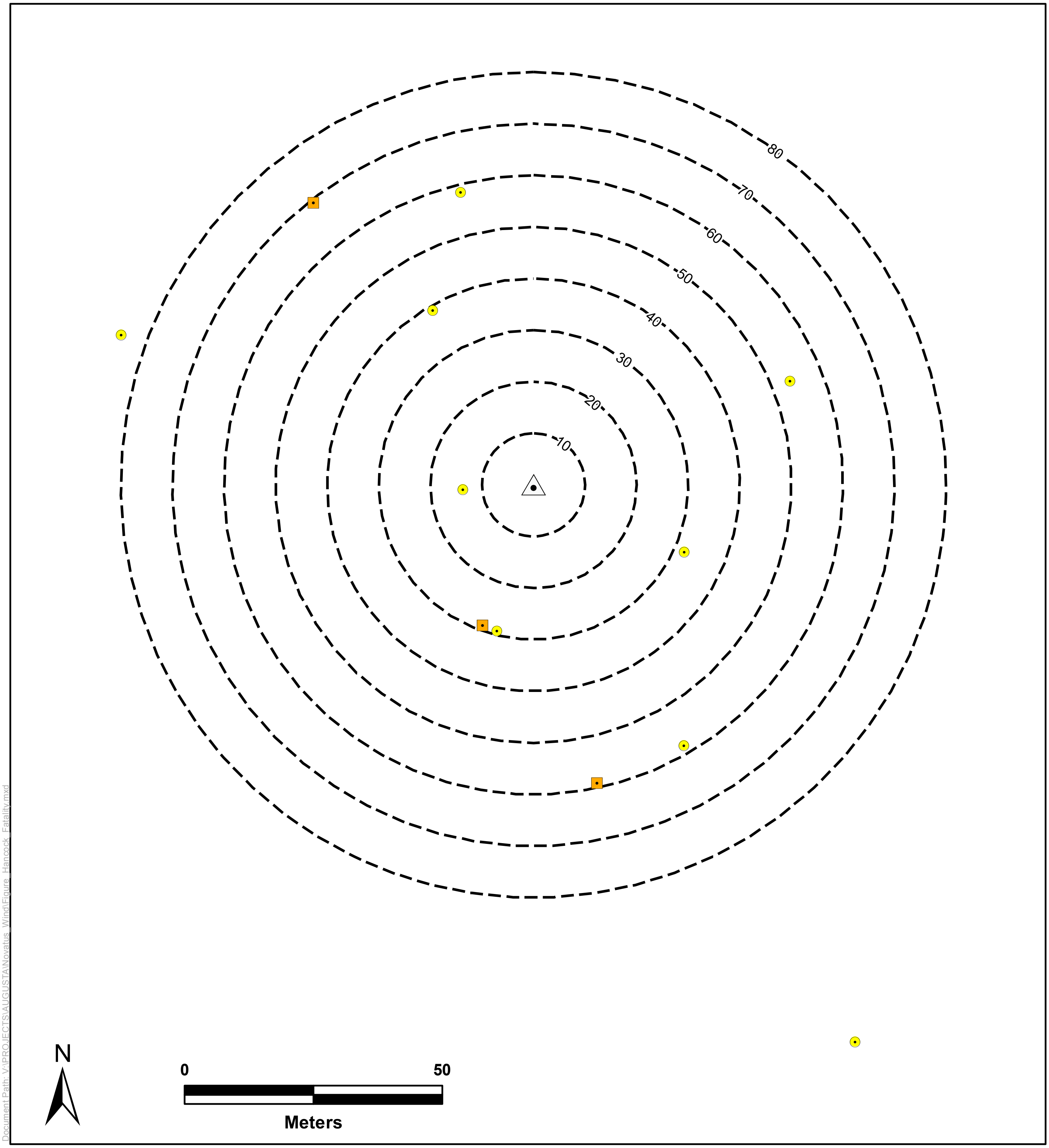


Figure 6. Number of Birds and Bats Found at Individual Search Turbines

The locations of bird and bat carcasses found within search plots were plotted at 10-m increments from the tower base of all search turbines (see Figure 7). Bird fatalities were randomly distributed around the towers, while two of the three bat fatalities were found to the south of towers.



Legend

- Turbine
- Bat
- Bird
- Turbine 10-meter Buffer

Fatalities found beyond 80 meters were on access roads and do not represent a uniform search area. These are provided for reference only and should not be considered when determining fatality fall patterns.

Source: Novatus and TRC

Figure 7

Hancock Wind Project
Bird and Bat Carcass Distribution

TRC

Map Created on: 12/13/2017

Distances that bird carcasses were found from towers ranged from 14 to 125 m (see Figure 8) (average = 57 m). The bird found at 125 m is not represented in the graph as it was a rare event within a small strip of access road and thus not representative of general bird and bat fall patterns surrounding turbines. The total number of bat carcasses was low; thus, patterns are difficult to describe. However, bats were found at distances ranging from 29 to 69 m (see Figure 8) (average = 52 m).

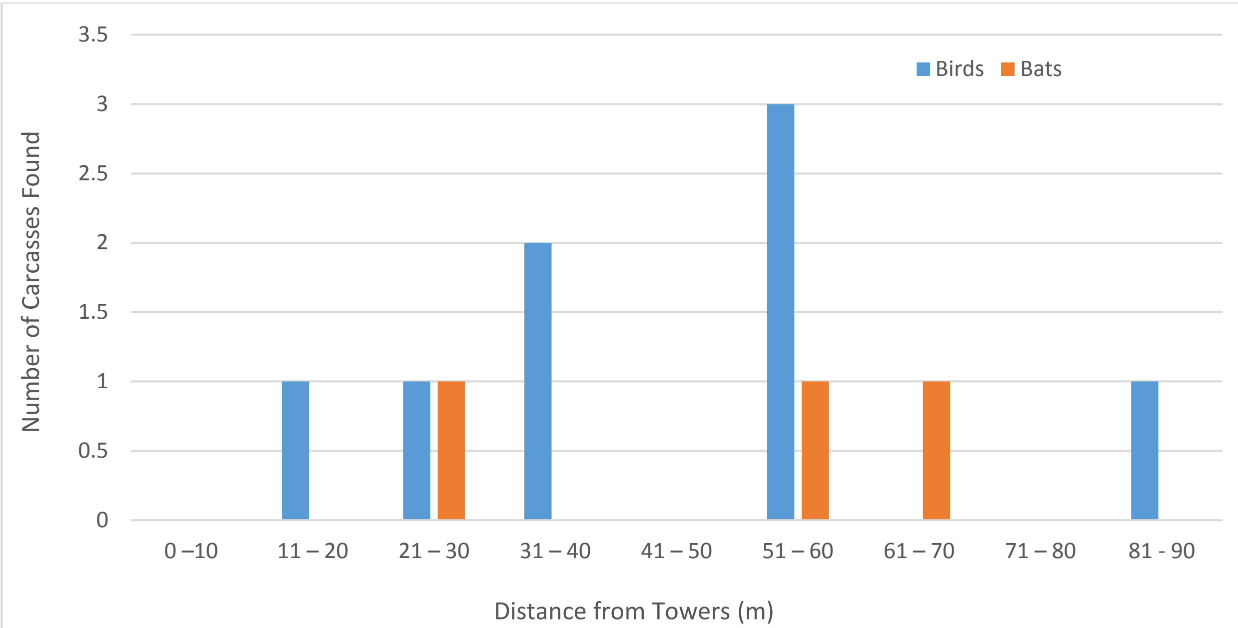


Figure 8. Distribution of Bird and Bat Carcasses in 10-meter Distance Increments from Towers

2.2.6 Incidental Wildlife Observations

The most notable and frequent occurrence of incidental wildlife in the Project area was the presence of common raven (*Corvus corax*). Other prevalent bird species observed included wild turkey (*Meleagris gallopavo*), turkey vulture (*Cathartes aura*), American crow (*Corvus brachyrhynchos*), blue jay (*Cyanocitta cristata*), downy woodpecker (*Picoides pubescens*), pileated woodpecker (*Hylatomus pileatus*), mourning dove (*Zenaida macroura*), white-throated sparrow (*Zonotrichia albiocollis*), and black-throated green warbler (*Setophaga virens*).

Mammals observed in the Project area included moose (*Alces alces*), white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), North American porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), eastern gray squirrel (*Sciurus carolinensis*), American red squirrel (*Tamiasciurus hudsonicus*), and eastern chipmunk (*Tamias striatus*).

2.2.7 Covariate Distribution Analyses

We tested whether the actual proportion of incidents at lit versus unlit towers differed significantly from expected proportion using chi-squared analyses (Preacher, 2001), but no significant difference was seen.

There was no significant deviation from the expected number of bird incidents at lit turbines as opposed to unlit searched turbines (Yate's Chi-Squared Test, $\chi 2 = 0.18$, df = 1, P = 0.67, ns). Additionally, there was no significant deviation from the expected number of bat incidents at lit turbines as opposed to unlit searched turbines (Yate's Chi-Squared Test, χ 2 = 0.03, df = 1, P = 0.87, ns). A probability value for the significance level of 0.05 was chosen prior to analysis.

2.2.8 Searcher Efficiency Results

During the monitoring period, a total of 93 test carcasses were placed at searched turbines. Of these carcasses, 28 (30.1%) were medium-sized quail species, 20 (21.5%) were small-sized quail species, 7 (7.5%) were house sparrows, 4 (4.3%) were European starlings, 1 (1.1%) was a rock pigeon, and 33 (35.4%) of the carcasses placed were mice (surrogates for bat carcasses). Sixty-seven of these test carcasses (44 birds, 23 mice) may have been scavenged prior to searches, as their presence could not be verified at the end of the search period. As a result, 26 carcasses were included in the analysis (16 birds and 10 mice). Carcasses were placed in a range of visibility classes. Search efficiency estimates for bird and mice (bat surrogates) carcasses are provided in Table 3 below.

Table 3. Search Efficiency Tests for Birds and Bats

Bird/Bat	Quantity Found	Quantity Placed	Search Efficiency	95% Lower Confidence Interval (CI)	95% Upper CI
Bird	9	16	**0.56**	0.31	0.81
Bat	8	10	**0.80**	0.50	1.00

2.2.9 Carcass Persistence Results

A total of 76 carcasses were placed for carcass persistence trials, 83 birds and 40 bats/mice (see Table 4). Of the 80 bird carcasses placed, 17.5% (n = 14) remained un-scavenged in search plots between the 3.5-day search interval. The mean number of days that bird carcasses persisted was 4.8 days (range: 2 – 31 days; median: 2 days). Of the 40 bat/mice carcasses placed, 25% (n = 10) remained un-scavenged in search plots between the 3.5-day search interval. The mean number of days that bat/mouse trial carcasses persisted was 5.9 days (range: 2 – 31 days; median: 2 days).

Table 4. Carcass Persistence and Carcass Persistence Rates for Birds and Bats

Bird/Bat	Quantity Placed	Carcass Persistence	95% Lower CI	95% Upper CI	Carcass Persistence Rate	95% Lower CI	95% Upper CI
Bird	83	1.49	1.00	2.04	0.48	0.40	0.56
Bat	40	2.17	1.33	3.42	0.57	0.45	0.69

Results of the additional carcass persistence test that was conducted using game cameras identified ravens at all three of the camera locations. One of the cameras captured an image of a raven with a trial carcass in its beak (see Photo 1 below). This particular carcass was placed on June 22 at 10:33 AM and the camera captured the raven scavenging the carcass on June 23 at 7:22 AM (less than 24 hours after the carcass was placed on site). At the other two turbines with camera monitoring, ravens were captured by the cameras between 6-8 hours after the carcasses were placed.

Photo 1. Raven with a Trial Carcass

2.2.10 Estimates of Fatality

Due to the small sample size of fatalities within individual seasons, fatality estimates would be more reliable if pooled across seasons. Similarly, pooling searcher efficiency and carcass persistence metrics across seasons would result in more robust estimations of fatality. Thus, seasonal fatality estimates were not calculated.

We used the area adjustment methodology in Jain *et al.* 2009. After dividing the area searched under the 33 turbines into eight concentric buffers or bins (see Table 5) of 10 m increments in size (i.e. 0-10 m, 11-20 m, etc.), we examined the fall distribution of the bird and bat incidents in these bins (carcasses that were found on access roads further than 80 m from the turbine base were not included in this calculation. The number of incidents (separately for birds and bats) in each 10 m increment bin and the percent area searched in that bin are reported below for all searched sites combined. Whereas density weighted proportion (DWP) is generally calculated separately for birds and bats, due to the low sample size for bats (n = 3) we pooled our data. The number of carcasses were summed over all bins to yield the total unadjusted carcasses within 80 m (*Total_Unadj.).* The ratio of the area surveyed in each bin (summed over all 17 turbines) to the maximum searchable area in each bin (had there been no search obstructions) was calculated to yield the *DWP per Bin*. The number of carcasses per bin was multiplied by *DWP per Bin* to yield a DWP adjusted bird and bat value for each bin. These values were summed (*Total_Adj.*) over all bins. The ratio of *Total_UnAdj*:*Total_Adj* yielded an average DWP value for all turbines in the study. We used this average DWP value for all three estimators below.

Table 5. Density Weighted Proportion (DWP) Calculations							
10-m Increment	**Number of Birds Found**	**Number of Bats Found**	**Number of Carcasses Found**	**Area Surveyed (square meters)**	**Maximum Surveyable Area (square meters)**	**DWP per Bin [a/]**	**Adjusted Carcasses Found**
0 – 10	0	0	0	5,341	5,343	99.96%	0.00
11 – 20	1	0	1	15,839	16,029	98.82%	1.01
21 – 30	1	1	2	24,399	26,714	91.33%	2.19
31 – 40	2	0	2	28,214	37,400	75.44%	2.65
41 – 50	0	0	0	25,606	48,086	53.25%	0.00
51 – 60	3	1	4	21,353	58,771	36.33%	11.01
61 – 70	0	1	1	14,449	69,457	20.80%	4.81
71 – 80	0	0	0	8,928	80,143	11.14%	0.00
		Total_Unadj.	10			*Total_Adj.*	**21.67**
						Average DWP	10/21.67 = **0.46**

[a/] DWP per Bin = Area Surveyed / Maximum Surveyable Area

2.2.11 Huso Fatality Estimator

Estimates for bird and bat fatality were generated with correction factors of searcher efficiency and carcass persistence (see Tables 3 and 4) and the DWP area correction (0.46). The corrected estimates are shown in Table 6.

Table 6. Huso Estimates of Bird and Bat Fatality (with Area Corrections)							
Level	**Number Found**	**Per Turbine**	**Per Turbine 95% Lower CI**	**Per Turbine 95% Upper CI**	**Site Total Estimate**	**Site Total 95% Lower CI**	**Site Total 95% Upper CI**
Bird	8	4.56	2.06	9.69	78	35	165
Bat	3	0.89	0.26	2.01	16	4	35

2.2.12 Shoenfeld Fatality Estimator

Estimates for bird and bat fatality were generated with correction factors of searcher efficiency and carcass persistence (see Tables 3 and 4) and the DWP area correction (0.46). The corrected estimates are shown in Table 7.

Table 7. Shoenfeld Estimates of Bird and Bat Fatality (with Area Corrections)							
Level	**Number Found**	**Per Turbine**	**Per Turbine 95% Lower CI**	**Per Turbine 95% Upper CI**	**Site Total Estimate**	**Site Total 95% Lower CI**	**Site Total 95% Upper CI**
Bird	8	6.99	2.93	16.04	119	49	273
Bat	3	1.14	0.31	2.75	20	5	47

2.2.13 Smallwood Fatality Estimator

Estimates for bird and bat fatality were generated with correction factors of searcher efficiency and carcass persistence (see Tables 3 and 4) and the DWP area correction (0.46). The corrected estimates are shown in Table 8.

Table 8. Smallwood Estimates of Bird and Bat Fatality (with Area Corrections)							
Level	**Number Found**	**Per Turbine**	**Per Turbine 95% Lower CI**	**Per Turbine 95% Upper CI**	**Site Total Estimate**	**Site Total 95% Lower CI**	**Site Total 95% Upper CI**
Bird	8	2.76	1.38	4.14	47	23	71
Bat	25	1.03	0.34	2.07	18	5	36

2.3 Discussion

2.3.1 Species Composition and Temporal and Spatial Distribution of Fatalities

The majority of bird fatalities detected were passerines, which is consistent with the findings at other North American wind developments where passerines have been found to account for approximately 75% of avian fatalities (NWCC, 2010).

Both of the bat species found (eastern red bat and silver-haired bat) are tree-roosting bats. Studies in North America indicate that 78% of bat fatalities consist of tree-roosting bats, with hoary bats representing the species most commonly found (Arnett and Baerwald, 2013). The three bat fatalities were documented over a span of just five days between August 31 and September 4. These results are consistent with the timing of bat fatalities at other study sites in North America (Arnett et al., 2008; Arnett and Baerwald, 2013). There were no species of *Myotis* found. It is assumed that curtailment reduced the risk of collision of *Myotis* and other species of bats. In addition, the effect of white-nosed syndrome on population numbers of cave-roosting bats is undeniable. Pre-white-nosed syndrome fatality numbers observed approximately 25% cave dwelling bats at wind projects in the northeast from studies published prior to 2006 (Arnett et al., 2008), contrasted with no cave dwelling bat fatalities at the Project.

The timing of bird fatalities spanned five months of the study period, with no bird fatalities observed in April or October. The month with the largest proportion of bird fatalities was May, which corresponds with the peak of spring songbird migration. Studies at other wind developments in New England, including Record Hill and Sheffield in 2012, have documented higher bird fatality in the spring than in the fall. Across North America, bird fatalities primarily occur during the spring and fall migration, but are also known to occur outside of migration periods (NWCC, 2010; NRC, 2007).

Fatalities occurred across the Project, with fatalities at individual turbines ranging from 0 – 2 for birds and 0 – 1 for bats. Birds were relatively evenly distributed throughout the search plots, with the farthest bird found 125 m from the turbine base along an access road. However, the majority of birds (78%) were found within 60 m of the towers. Three birds were found within the 51 – 60 m distance range. All bats were found within 70 m of towers, though overall numbers were low, making patterns difficult to discern. These data are consistent with other studies in the region where search plots have been smaller (i.e., out to a maximum distance of 60 m) than at the Project.

The Project covariate, FAA-lighting, was not found to be a significant predictor of the presence of bird or bat fatalities.

2.3.2 Carcass Persistence Bias Trials

Carcass persistence trials resulted in 17.5% of bird carcasses and 25% of bat/mice carcasses persisting for the 3.5-day search interval. These results indicate that the search interval was adequate to extrapolate fatality. Also, it is unlikely that increasing the search interval would improve the likelihood of detecting fatalities because of the high rate of scavenging at this site. Carcass persistence in terms of mean number of days at the Project was 4.8 days for birds and 5.9 days for bats, which was slightly greater than the search interval. However, the coincidence of the average days of carcass persistence to search interval means that few missed during an initial search would be available to find during subsequent searches; thus, making the search efficiency tests more true to life and reducing the likelihood of overestimating the number of fatalities.

2.3.3 Covariate Distribution Analyses

Chi-square analyses found a lack of significance between bird or bat fatalities at lit versus unlit towers, lending more evidence to the theory that red flashing FAA lights do not affect fatality levels.

2.3.4 Fatality Estimators

Carcass removal rates were consistent with the search interval, but a significant portion of carcasses would be scavenged prior to search. The 3.5-day search interval meant that, theoretically, some carcasses falling within an inter-search period would still be available to be found when the searcher arrived on site. As all estimators allow for and adjust for scavenging, this is not a fatal flaw for any of the estimators.

The Huso Estimator is a two-step estimator which first examines the prevalent search efficiency and carcass persistence trends observed on-site and then is adjusted to best account for the patterns observed at that site. Thus, we recommend the results from this model as most appropriate for this dataset. The Shoenfeld and Huso Estimators are explicitly stochastic methods (Stantec, 2016). Both are developed and thoroughly tested with simulated data by leading statisticians, formal statistical models, and strongly recommended by the Unites States Fish and Wildlife Service.

2.3.5 Regional Comparison of Fatality Estimates

Bird and bat fatality estimates at other wind projects in New England are shown in Table 9. These results must be interpreted with caution due to variability among the field methods, such as search interval, survey timeframe, search plot size, and curtailment, along with variation in data analyses. Fatality estimates with area corrections should also be interpreted with caution. When a small density of carcasses is found, which is often the case in New England, a robust estimate of DWP cannot be calculated.

Bird fatality as estimated by the Huso Estimator was 11.43 birds/turbine/study period, which is above the regional average of 5.92 birds/turbine/study period and the median of 5.14 birds/turbine/study period (see Table 9 and Figure 7). Bat fatality as estimated by the Huso Estimator was 0.74 bats/turbine/study period, which is below the regional average of 2.81 bats/turbine/study period and the median of 1.77 bats/turbine/study period (see Table 9 and Figure 8).

Table 9. Bird and Bat Fatality Rates at Operational Wind Projects in New England				
Project	**Survey Period**	**Birds/Turbine/ Study Period**	**Bats/Turbine/ Study Period**	**Reference**
Kibby Mountain, Maine [a/]	May 2 - June 20; July 11 - Oct 14, 2011	1.01	0.37	Stantec Consulting. 2011. Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
Kibby Mountain, Maine [a/]	May 1 - June 15; Aug 1 - Oct 15, 2014	4.71	0.47	TRC. 2015. Post-Construction Avian and Bat Mortality Survey Report for Kibby Wind Power Project. Prepared for TransCanada Energy Ltd.
Mars Hill, Maine	April 23 - June 3; July 15 - Sept 23, 2007	2.50	4.40	Stantec Consulting. 2008. Spring, Summer, and Fall Post-Construction Bird and Bat Mortality Study at the Marsh Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management LLC.
Mars Hill, Maine	April 19 - June 6; July 15 - Oct 8, 2008	2.65	0.68	Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.
Record Hill, Maine	April 15 - June 7; July 7 - Oct 15; 2012	8.46	6.78	Stantec Consulting. 2012. Record Hill Wind Project Post-Construction Wildlife Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.
Record Hill, Maine	May 1 - June 7, July 7 - Oct 15, 2014	4.20	1.24	Stantec Consulting. 2015. Record Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Prepared for Record Hill Wind, LLC.
Rollins, Maine	April 15 - Oct 15, 2012	2.94	0.18	Stantec Consulting. 2012. Rollins Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Rollins, Maine	April 15 - Oct 15, 2014	5.14	0.49	Stantec Consulting. 2015. Rollins Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Prepared for First Wind, LLC.
Stetson Mountain I, Maine	April 20 - Oct 21, 2009	4.03	2.11	Stantec Consulting. 2010. Stetson I Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.

Table 9. Bird and Bat Fatality Rates at Operational Wind Projects in New England				
Project	**Survey Period**	**Birds/Turbine/ Study Period**	**Bats/Turbine/ Study Period**	**Reference**
Stetson Mountain I, Maine	April 18 - Oct 21, 2011	1.77	0.43	Normandeau Associates. 2011. Year 3 Post-construction avian and bat casualty monitoring at the Stetson I Wind Farm. Prepared for First Wind, LLC.
Stetson Mountain I, Maine [b/]	April 15 - Oct 25, 2013	10.42	0.26	Stantec Consulting. 2014. Stetson I Wind Project, 2013 Post-Construction Monitoring Report, Year 5. Prepared for First Wind Management, LLC.
Stetson Mountain II, Maine	April 19 - Oct 15, 2010	2.14	2.48	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
Stetson Mountain II, Maine	April 15 - Oct 15, 2012	2.83	2.06	Stantec Consulting. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Stetson Mountain II, Maine	April 15 - Oct 15, 2014	4.87	1.25	Stantec Consulting. 2015. Stetson II Wind Project Year 3 Post-Construction Monitoring Report, 2014. Prepared for First Wind, LLC.
Bull Hill, Maine [c/, d/]	April 15 - Oct 15, 2013	7.72	0.94	Stantec Consulting. 2014. Bull Hill Year 1 Post-Construction Wildlife Monitoring Report, 2013. Prepared for First Wind, LLC.
Bull Hill, Maine [c/, d/]	April 15 - Oct 15, 2014	6.28	0.44	Stantec Consulting. 2015. Bull Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Prepared for First Wind, LLC.
Spruce Mountain, Maine	April 11 - Nov 1, 2012	1.49	2.43	TetraTech. 2013. Spruce Mountain Wind Project Post-construction Bird and Bat Fatality and Raptor Monitoring Year 1 Annual Report. Prepared for Patriot Renewables.
Spruce Mountain, Maine	April 15 - Oct 31, 2014	10.06	0.61	TetraTech. 2015. Post-construction Monitoring Report 2014 Spruce Mountain Wind Project Woodstock, Maine. Prepared for Patriot Renewables.

Table 9. Bird and Bat Fatality Rates at Operational Wind Projects in New England				
Project	**Survey Period**	**Birds/Turbine/ Study Period**	**Bats/Turbine/ Study Period**	**Reference**
Oakfield, Maine	April 20 - Oct 15, 2016	7.60	1.77	Stantec Consulting. 2016. Oakfield Wind Project Year 1 Post-Construction Bird and Bat Fatality Monitoring Report, 2016.
Oakfield, Maine	April 20 - Oct 15, 2017	12.70	1.54	TRC. 2017. Oakfield Wind Project Post-Construction Bird and Bat Fatality Monitoring Report Year 2 (2017). Prepared for Novatus Energy, LLC.
Bingham, Maine	April 15 - Oct 15, 2017	11.43	0.74	TRC. 2017. Bingham Wind Project Post-Construction Bird and Bat Fatality Monitoring Report Year 1 (2017). Prepared for Novatus Energy, LLC.
Hancock, Maine	April 15 - Oct 15, 2017	4.56	0.89	TRC. 2017. Hancock Wind Project Post-Construction Bird and Bat Fatality Monitoring Report Year 1 (2017). Prepared for Novatus Energy, LLC.
Granite Reliable, New Hampshire	April 22 - Oct 27, 2012	2.80	3.00	Curry and Kerlinger. 2013. Post-Construction Mortality Study Granite Reliable Power Wind Park, Coos County, New Hampshire, Annual Report January 2013. Prepared for Granite Relaible Power, LLC.
Lempster, New Hampshire [a/, d/]	April 15 - June 1; July 15 - Oct 31, 2009	6.75	6.09	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Lempster, New Hampshire [a/, d/]	April 15 - June 1; July 15 - Oct 31, 2010	5.28	7.13	Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Sheffield, Vermont [c/, d/]	April 1 - Oct 31, 2012	13.17	14.65	Martin, C., E. Amett, M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont 2012 Annual Report. Prepared for Bat Conservation International.
Sheffield, Vermont [c/, d/]	April 23 - Oct 31, 2013	8.01	2.80	TetraTech. 2013. Spruce Mountain Wind Project Post-construction Bird and Bat Fatality and Raptor Monitoring Year 1 Annual Report. Prepared for Patriot Renewables.

Table 9. Bird and Bat Fatality Rates at Operational Wind Projects in New England				
Project	**Survey Period**	**Birds/Turbine/ Study Period**	**Bats/Turbine/ Study Period**	**Reference**
Kingdom Community, Vermont	April 15 - Oct 15, 2013	10.76	1.94	Stantec Consulting. 2014. Kingdom Community Wind 2013 Post-Construction Monitoring Report - Year 1. Prepared for Green Mountain Power.
Kingdom Community, Vermont	April 15 - Oct 15, 2014	9.11	4.96	Stantec Consulting. 2015. Kingdom Community Wind 2014 Post-Construction Monitoring Report - Year 2. Prepared for Green Mountain Power.
Georgia Mountain, Vermont	April 16 - Oct 16, 2013	6.00	11.70	Stantec Consulting. 2014. Georgia Mountain Community Wind 2013 Post- Construction Monitoring Report - Year 1. Prepared for Georgia Mountain Community Wind, LLC.
Georgia Mountain, Vermont	April 15 - Oct 15, 2014	2.13	2.29	Stantec Consulting. 2015. Georgia Mountain Community Wind 2014 Post-Construction Monitoring Report – Year 2. Prepared for Georgia Mountain Community.
Average		**5.92**	**2.81**	
Median		**5.14**	**1.77**	
Minimum		**1.01**	**0.18**	
Maximum		**13.17**	**11.70**	

a/ Sum of spring and fall estimates.
b/ Estimate provided includes area corrections.
c/ Study included curtailment treatments.
d/ A different estimate was calculated for different seasons in the study year, and seasonal estimates were summed for an annual estimate of fatality.

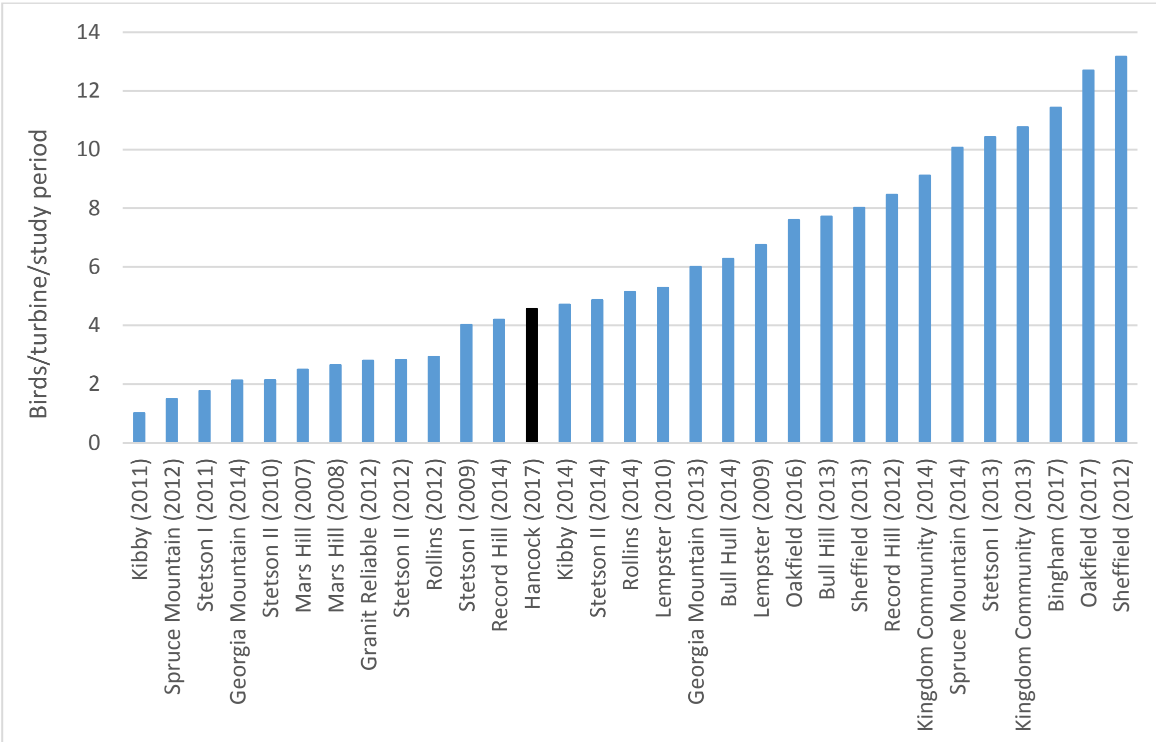


Figure 9. Bird Fatality Rates Reported from Wind Projects in New England

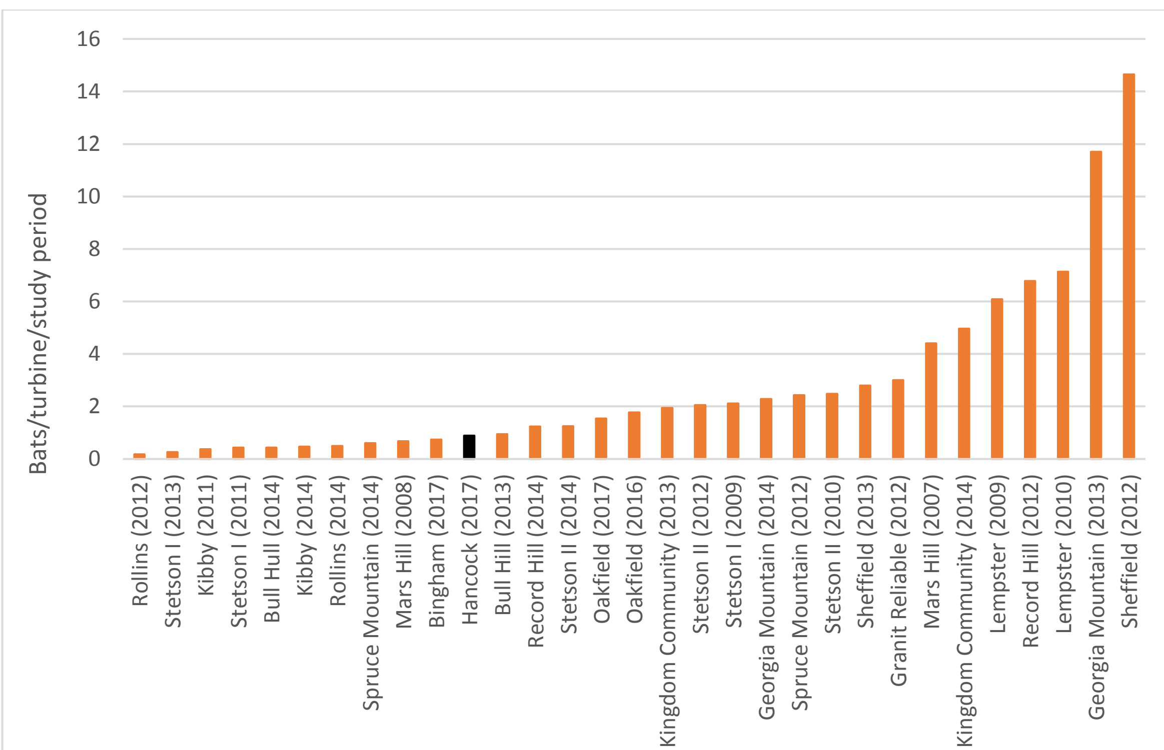


Figure 10. Bat Fatality Rates Reported from Wind Projects in New England

3.0 Conclusions and Recommendations

The results of the first year of post-construction bird and bat fatality monitoring at the Hancock Wind Project identified potential areas of improvement to the PCMP. With regard to schedule and search effort, we recommend removing the requirement that the search frequency will be increased to every two days if less than 67% of carcasses remain after Day 3 of carcass persistence trials. As we discovered during the 2017 fatality monitoring, scavengers (in this case, ravens) generally remove carcasses from the site very rapidly (less than 24 hours); therefore, an increased search frequency would provide little to no value.

Another modification to the PCMP that we recommend is a reduction in the number of carcasses that are required for both searcher efficiency trials and carcass persistence trials. Currently, the PCMP requires 30 carcasses be placed for each of these trials, which translates to 180 carcasses per year at the site. Given that the Project is relatively small (17 turbines), 30 carcasses per trial is an excessive number that results in placing two carcasses at 15 of the 17 turbines during every trial. This number of trial carcasses swamps the site with carcasses and is likely increasing the scavenging rate. As a comparison, the Bingham Wind Project is much larger than the Hancock Wind Project, consisting of 56 turbines (33 searched turbines); however the Bingham Wind Project is only required to place 25 carcasses for searcher efficiency and carcass persistence trials. At the Hancock Wind Project, we suggest reducing the number of carcasses for searcher efficiency and carcass persistence trials from 30 to 15 (10 birds and 5 bats/mice).

Due to low numbers of fatalities found and high scavenging rates, estimates of fatality are not likely to provide any additional insight into actual fatalities from the operation of the Project. Therefore, we recommend additional consultation with the MDIFW and the MDEP to discuss the possibility of eliminating the post-construction bird and bat fatality monitoring requirement at the Hancock Wind Project.

4.0 References

Arnett, E. B. and E. F. Bearwald. 2013. Impacts of Wind Energy Development on Bats: Implications for Conservation, Chapter 21. R. A. Adams and S. C. Pedersen (eds). Bat Evolution, Ecology, and Conservation. DOI 10.1007/978-1-4614-7397-8_21. Spring Science+Business Media New York 2013.

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, and R. D. Tankersley. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. The Journal of Wildlife Management, 72: 61-78. DOI: 10.2193/2007-221.

Erickson, W. P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to Energy Northwest and the Nine Canyon Technical Advisorty Committee.

Horvitz, D. G. and D. J. Thompson. 1952. A generalization of sampling without replacement from a finite Universe. Journal of the American Statistical Association, Vol. 47, No. 260, pp. 663-685.

Huso, M., N. Som, and L. Ladd. 2012. Fatality estimator user's guide: U.S. Geological Survey Data Series 729, 22 pp.

Maine Department of Inland Fisheries and Wildlife (MDIFW). 2011. Species of Special Concern. Available from http://www.maine.gov/ifw/fish-wildlife/wildlife/endangered-threatened-species/special-concern.html.

National Research Council (NRC). 2007. Ecological impacts of wind-energy projects. National Academies Press, Washington, DC.

National Wind Coordination Collaborative (NWCC). 2010. Wind Turbine Interactions with Birds, Bats, and their Habitats. A summary of research results and priority questions. Available at: http://www1.eere.energy.gov/wind/pdfs/birds_and_bats_fact_sheet.pdf

Preacher, K. J. 2001. Calculation for the chi-square test: An interactive calculation tool for chi-square tests of goodness of fit and independence [Computer software]. Available from http://quantpsy.org.

Shoenfeld, P. 2004. Suggestions regarding avian mortality extrapolation. Technical memo provided to FPL Energy. West Virginia Highlands Conservancy, HC70, Box 553, Davis, West Virginia, 26260.

Smallwood, K. S. 2013. Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin 37(1). Wiley Online Library: 19-33.

Stantec. 2016. *Oakfield Wind Project Year 1 Post-Contruction Bird and Bat Fatality Monitoring Report.* Topsham, ME: Stantec Consulting Services, Inc.

Thompson, S. K. 1992. Sampling. John Wiley & Sons, Inc.: New York.

Young, D. P., W. P. Erickson, K. Bay, S. Nomani, and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring, July-October 2008. Prepared for NedPower Mount Storm, LLC, by Western EcoSystems Technology, Inc. 40 pp.

Appendix A

Hancock Wind Project Post-Construction Bird and Bat Fatality Monitoring Plan, Years 1 and 2

Hancock Wind Project
Post-Construction Bird and Bat Fatality Monitoring Plan
Years 1 and 2

Hancock County, Maine

December 2016 REV 3

Table of Contents

1.0 BACKGROUND 1

2.0 BIRD AND BAT FATALITY MONITORING PROTOCOL 1
2.1 SCHEDULE AND SEARCH EFFORT 2
2.2 SEARCH PLOT SIZES 3
2.3 SEARCH TIMING AND FREQUENCY 3
2.4 SCIENTIFIC COLLECTION PERMITS 3
2.5 SEARCH PROTOCOL 4
2.6 SEARCHER EFFICIENCY TRIALS 5
2.7 CARCASS PERSISTENCE TRIALS 6
2.8 WEATHER DATA COLLECTION 6

3.0 REPORTING 7
3.1 FATALITY ESTIMATES 7
3.2 OPERATIONAL CURTAILMENT ASSESSMENT 8

4.0 LITERATURE CITED 8

ATTACHMENT A FIELD DATASHEETS

1.0 BACKGROUND

This document details a study protocol to estimate bird and bat fatalities during the first 2 years of operation at the Hancock Wind Project (Project). The Project received its Site Location of Development Act (SLODA) and Natural Resources Protection Act (NRPA) permit issued by the Maine Department of Environmental Protection (MDEP) in July 2013. In 2014, the Project submitted an application to amend the permit to allow for construction of taller turbines, resulting in removal of 1 permitted turbine and reduction in Project footprint. MDEP issued the SLODA permit amendment in March 2015. The original permit stated,

> "*As the turbines will be curtailed to minimize impacts to bats, the Department will not require post-construction mortality monitoring of the project.*"

However, at the request of the Maine Department of Inland Fisheries and Wildlife (MDIFW), Condition 10 of the March 2015 permit amendment requires that the Project implement a post-construction wildlife monitoring plan (PCMP) and that the PCMP and an implementation schedule be submitted to MDEP for review and approval prior to Project operation.

A PCMP dated January 2013 was included in the amended MDEP permit application. That PCMP was amended during the permit review process and submitted to MDEP for approval in July 2016. MDEP subsequently requested additional changes to address comments received from MDIFW. This final document replaces the PCMP submitted to MDEP in July 2016. Monitoring protocols herein consider MDIFW's comments, and were developed based on currently accepted fatality monitoring practices in the industry, post-construction monitoring (PCM) results of the nearby Bull Hill Wind Project, comments received by MDIFW on wind projects still under review, and recently approved PCMPs for other wind projects in Maine. The permit condition stipulates that monitoring will occur in years 1 and 2 of operation, with a third year of monitoring occurring between years 3 and 5. This protocol is for years 1 and 2; the monitoring protocol for the third year will be determined based on the findings during years 1 and 2.

The Project will implement the bat curtailment regime as described under the permit amendment, which is 6 meters per second one-half hour before sunset to one-half hour after sunrise, April 20 to October 15. Cut-in speed will be calculated based on mean wind speeds over a 10-minute interval measured at hub height at each turbine. Below this cut-in speed, turbine blades will be feathered so that rotation of the rotor will be approximately 1-3 rotations per minute.

2.0 BIRD AND BAT FATALITY MONITORING PROTOCOL

The objectives of the PCMP are twofold. First, to assess the species involved in collision mortality. Second, to estimate the number of bird and bat fatalities at the Project using fatality estimator models that correct for survey biases such as searcher efficiency, carcass persistence, and unsearchable area. Fatality estimates will be derived using 3 statistical models: the first 2 are commonly used for bird and bat fatality estimates in the Northeast wind industry, Shoenfeld (2004) and Huso (2010). The third is not as widely used but was recently requested by MDIFW at other projects in Maine, Smallwood et al. (2013).

Monitoring will include the following:

- Standardized searches during peak activity periods for birds and bats (spring migration, summer roosting and late summer swarming, and fall migration);
- Searcher efficiency trials to estimate the percentage of carcasses found by searchers in each visibility class[1];
- Carcass persistence trials to estimate the length of time that carcasses remain in the field for possible detection during the search interval; and
- Search plot and visibility class mapping, and area corrections to account for carcasses that may land outside of searchable areas.

2.1 SCHEDULE AND SEARCH EFFORT

Monitoring will occur in 3 distinct survey periods:

- April 15 – June 1 to represent the spring migration period;
- June 2 – August 31 to represent the summer pup-rearing and late summer swarming period; and
- September 1 – October 15 to represent the fall migration period.

Monitoring under this plan will involve searching the area beneath all 17 turbines (100%) and the permanent meteorological (met) tower for bird and bat fatalities during the first 2 full years of Project operation (years 1 and 2). Trained technicians will systematically search turbines at a rate of once approximately every 3.5 days (2 times per week)[2]. This search interval was chosen in order to minimize bias in the fatality estimate models, bias that is increased by frequent searches at sites where carcass persistence is long. Two years of PCM results at the nearby Bull Hill Wind project found carcass persistence to be long, and similar persistence is expected at this Project.[3]

---

[1] Where 1 (easy) = >90% bare ground, ground cover is sparse and ≤12 inches in height; 2 (moderate) = >25% bare ground, all ground cover is ≤12 inches in height and mostly sparse; 3 (difficult) = <25% bare ground, <25% of ground cover is >12 inches in height; 4 (very difficult/unsearchable) = little or no bare ground, >75% of ground cover is >12 inches in height.
[2] Searches at any individual turbine will vary between 3 and 4 days but the average search interval of 3.5 days will be used during the estimation of total fatality at the site.
[3] At the Bull Hill Wind project, carcass persistence was long during both years of monitoring: in 2013 during the first year of monitoring, the mean number of days that trial carcasses persisted was 14.36 days for bats and 11.20 days for birds, and in 2014 during the second year of monitoring the mean number of days that trial carcasses persisted was 20.64 days for bats and 24.03 days for birds.

In order to achieve the most accurate fatality estimates, the appropriateness of the 3.5-day search interval will be assessed during the first year of monitoring. Multiple carcass persistence trials (3) will be conducted during the first 2 months of monitoring. If 67% of trail carcasses remain after Day 3 of the trials, the search interval of 3.5 days will be continued; if less than 67% of carcasses persist, the search frequency will be increased to every 2 days. An open dialogue about the results of carcass persistence trials will be maintained with MDIFW to assess the appropriateness of the search interval over the course of the 2-year study period.

Due to weather and other logistical challenges (i.e., ice falling from turbine blades, drop zone exclusion if maintenance is occurring, or lightning), searches may not be completed as scheduled on all survey days. In those situations, surveyors will continue where the searches ended on the preceding day in an effort to maintain an even search interval at individual turbines.

In addition to systematic monitoring during the periods specified above, Operations staff and on-site searchers will document all fatalities discovered incidentally throughout the year.

2.2 SEARCH PLOT SIZES

Standardized searches will include all cleared and leveled lay-down areas, gravel roads, and other searchable ground cover areas within an 80-meter (m) radius around the turbines and met tower. In addition, where feasible, searches will extend out to adjacent roads to a distance of 140 m from turbines. A schematic of the search area and transects will be provided to MDIFW at the onset of spring surveys.

A Global Positioning System (GPS) will be used to map the area of each search plot as well as the boundaries of each visibility class within search plots (e.g., bare ground and grass). The GPS data will be overlain on aerial imagery of each search area, then digitized, and the search area will be calculated in ArcMap. A schematic showing the search area and the visibility classes within each search area will be provided in the report (see Section 3.0). Steep slopes, unsafe walking terrain (e.g., boulder fields), forest and other areas where searcher efficiency is expected to be low, will be excluded from search plots. During data analysis, the area distribution of carcasses found within searched areas will be used to estimate the number of fatalities that may have fallen in unsearchable areas.

2.3 SEARCH TIMING AND FREQUENCY

Systematic searches will be conducted at 17 turbines and the met tower at a rate of 1 search approximately every 3.5 days from April 15 to October 15. This monitoring schedule will result in 26 consecutive weeks of fatality monitoring.

2.4 SCIENTIFIC COLLECTION PERMITS

Applications for the appropriate state and federal scientific collection permits necessary for the collection and possession of birds and bats will be submitted in advance of initiating fatality searches. If permits are not obtained prior to the initiation of fatality searches, all data will be collected for each carcass, but carcasses will be left in place where found and the location marked (as described in Section 2.5).

2.5 SEARCH PROTOCOL

Searchable areas of plots will be searched by a trained technician who will walk along marked, parallel transects across the turbine lay-down area and spaced at 4-m (13-foot [ft]) intervals in areas where visibility is classified as easy and moderate, and at 2-m (6.6-ft) intervals in areas were visibility is classified as difficult. The search area will extend approximately 3–4 m (10–13 ft) on each side of each transect. The searcher will walk along each transect at a rate of approximately 45–60 m (148 ft) per minute and will search both sides of each transect for fatalities. During the next search of the same plot, the searcher will walk between the marked transects to increase the chances of finding carcasses that fall between transects. Ground conditions and visibility class at each search plot will be recorded once per week. Transect spacing may be narrowed if ground cover and visibility class change during the monitoring period.

All fatalities found will be documented on standardized field forms (Attachment A), photographed, and handled according to state and federal collection permit conditions (if a permit was obtained by the time of the discovery). If a state- or federally listed threatened or endangered species is found, it will be reported to the appropriate agency within 24 hours of identification. Any eagle fatality that is discovered will be reported to the US Fish and Wildlife Service (USFWS) within 24 hours. If an eagle fatality is found, it will not be moved, and will be covered or otherwise protected on-site. Fatality events involving 3 or more birds or bats at a single turbine believed to have collided in a single night, or 15 or more birds or bats across the entire Project during a single search day and believed to have collided on the same night, will be reported to MDIFW within 24 hours of discovery.

Surveyors will record the turbine number searched, start and end time of search, weather conditions, and ground conditions (on a weekly basis) on standard datasheets. For each carcass found, the following information will be recorded: date and time; turbine number; if the carcass was found during a search or incidentally; the type of observation/condition of carcass (e.g., intact carcass, scavenged, or feather spot); the estimated night of collision (based on carcass characteristics); distance to the carcass from the turbine (determined via laser range finder); direction of carcass from turbine (determined via compass); ground conditions under carcass; carcass species identification (if known, or lowest taxonomic level); carcass age, sex, and reproductive condition (as possible); carcass condition (e.g., fresh, decomposed, intact or scavenged, dead, or live/injured); for bats, the forearm measurement in millimeters, and any evidence of scavenger activity in plot (e.g., tracks or scat).

Carcasses will be given unique identification numbers, will be collected or left in place per the state and federal permits, and will be retained (if allowed) and frozen in a freezer at the Operations and Maintenance building. Non Endangered Species Act (ESA)-listed carcasses may be used during searcher efficiency trials and carcass persistence trials. State- or federal

ESA-listed bat carcasses will be frozen and delivered to the MDIFW Bangor Office (Attn: Charlie Todd or Cory Mosby) as soon as possible as long as all permits required for this possession are obtained. Photos of all bat carcasses found will be submitted to MDIFW (Cory Mosby) within 2 business days of discovery.

Fatalities found incidentally by searchers outside the search period or during normal on-site operations by Operations staff, also will be documented. Operations personnel will report occurrences using SunEdison's in-house reporting system in accordance with SunEdison's Downed Wildlife Observation Program (DWOP).

2.6 SEARCHER EFFICIENCY TRIALS

Searcher efficiency trials will be conducted to estimate the percentage of bird and bat fatalities that are found by searchers. The trials will consist of periodic placement of carcasses early in the morning prior to scheduled searches. Searchers will be unaware of the timing or location of these trials. Estimates of searcher efficiency will be used to adjust for detection in fatality estimators (Section 3.1).

Carcasses used for trials will be non-ESA-listed species collected during earlier searches at the Project or other facilities. A list of carcasses to be used in each trial will be provided to MDIFW prior to trial implementation. If too few native carcasses are available, then surrogate species of similar size will be used (e.g., quail chicks or mice). Trial carcasses will be marked with a small piece of string or elastic band placed around a leg.

Carcasses will be placed within the various ground cover types and visibility classes (easy, moderate, or difficult) under turbines, including the gravel access way immediately surrounding each turbine and the restored (loamed, seeded, and mulched) portions of the lay-down areas. On trial days, carcasses will be placed at multiple turbines scheduled to be searched that day, and will be placed at random distances and azimuths from turbine towers. To avoid carcass "swamping" (Strickland et al. 2011 and USFWS 2012), no more than 2 trial carcasses will be placed at any given time at a single turbine. For each carcass placed, the trial coordinator will record the following: date and set up time; name of searcher; turbine number; carcass species; carcass distance and direction from tower; and ground conditions under carcass. After scheduled searches are completed, the trial coordinator will contact the searcher, and will determine how many and which trial carcasses were found by the searcher. The trial coordinator will recover all trial carcasses, traces of carcasses, and remains of carcasses (including feathers) if they were scavenged during the trial.

Trials will be conducted during each survey season to test searcher efficiency during variable weather and ground cover conditions. Three trials will be conducted per year, one in each season (spring, summer, fall). As required by the Huso Estimator, a target of 30 carcasses will be placed in search plots during each trial: 20 birds (10 of small size classes and 10 of medium size classes), and 10 bats. Trial carcasses will be evenly distributed within each of the 3 searchable visibility classes (easy, moderate, and difficult), resulting in a total of 10 carcasses in each of the 3 visibility classes over the course of the study.

Searcher efficiency rates will be estimated separately for birds and bats. Rates will be expressed as the proportion of trial carcasses found by searchers: the number of trail carcasses found divided by the total number of trial carcasses placed during trials. As sample sizes allow, seasonal fatality estimates will incorporate corresponding seasonal searcher efficiency rates and visibility class.

2.7 CARCASS PERSISTENCE TRIALS

Carcass persistence trials will be performed during the study period independently of the searcher efficiency trials (see Section 2.6). The objective will be to estimate the percentage of bird and bat fatalities that disappear from study plots due to scavengers or other factors (e.g., weather or decomposition), rendering them undiscoverable to searchers. Estimates of carcass persistence will be used to adjust the number of carcasses found, thereby correcting for this bias.

A list of carcasses to be used in each trial will be provided to MDIFW prior to trial implementation. Trial carcasses will be placed by searchers randomly throughout the study area. To avoid carcass “swamping” (Strickland et al. 2011 and USFWS 2012) no more than 2 trial carcasses will be placed at any given time at a single turbine.

Three trials will be conducted per year, one in each season (spring, summer, fall). As required by the Huso Estimator, a target of 30 carcasses will be placed in search plots during each trial: 20 birds (10 of small size classes and 10 of medium size classes), and 10 bats. Trial carcasses will be placed within each of the 3 searchable visibility classes (easy, moderate, and difficult), resulting in a total of 10 carcasses in each of the 3 visibility classes over the course of the study. The following will be recorded on datasheets during each trial: date; set-up time; searcher; turbine number; carcass number and species; carcass distance and direction from tower; ground cover type under carcass; and detailed notes and photos describing any scavenging, evidence of scavenger identification, and stage of decomposition.

Trial carcasses will be checked on days 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, and 30 or until all evidence of the carcass is absent. On day 30, carcasses, feathers, or parts will be retrieved and properly discarded. Each time a trial carcass is checked, searchers will indicate whether the carcass is present (intact, or partially scavenged but readily detectable), or absent (completely removed, or with so few feathers or tissue remaining that it would not be readily detectable).

Carcass persistence rates will be estimated separately for birds and bats. The mean, median, range, and percent of carcasses that remain for the 3.5-day search interval will be calculated and reported. If spring trials indicate that less than 67% of carcasses are persisting during the 3-day search interval, then it will be determined if the search interval needs to be adjusted to searches every other day or daily.

2.8 WEATHER DATA COLLECTION

Searchers will record general weather conditions as reported by the closest weather station KMEEASTB2 in Eastbrook, Maine. Parameters recorded will include: sky conditions, percent cloud cover, cloud type, and dew point. Searchers will qualitatively assess cloud ceiling and visibility. In addition, onsite and prior to the start of each turbine search, the searcher will record daytime weather conditions including sky conditions, precipitation, and visibility.

In addition, weather conditions will be recorded throughout the duration of the survey effort to inform the conditions under which observed fatalities are likely to have occurred. Weather parameters, such as temperature, wind speed, wind direction, barometric pressure, relative humidity, and precipitation amounts recorded at turbines will be provided to the consultant for analysis. In addition, hub speed and curtailment data as recorded by the nacelle(s) will be provided to the consultant for analysis. For the night prior to the discovery of each fresh carcass, weather and operations data from the turbine or met tower at which each carcass was discovered will be reviewed in an attempt to recognize any relationships between fatality and weather.

3.0 REPORTING

A report will summarize the methods and results of each yearly survey effort. The report will be submitted to USFWS and MDIFW by December 31 of each monitoring year. Raw data including fatality, searcher efficiency, carcass persistence, and search area will be provided to MDIFW.

The report will include the following:

- Numbers of bird and bat fatalities and species found;
- Seasonal timing of fatalities;
- Nighttime weather conditions for nights prior to days when fresh fatalities were found;
- Range of distances and average distance from towers that birds and bats were found;
- Distances and azimuths of carcasses from turbine bases, plotted on a scatterplot diagram with 10-m concentric distance increments from turbine centers;
- Distribution of bird and bat fatalities among individual turbines;
- Distribution of bird and bat fatalities by landscape setting (saddle, crest, or side slope);
- Distribution of fatalities by Federal Aviation Administration (FAA) lit versus unlit turbines; and
- Number of bird and bat fatalities, by species, found incidentally.

In order to assess the likelihood of Operations staff incidentally finding carcasses in the Project area, the report will include a summary of Operations staff activity in proximity of the turbines, including how frequently turbines are visited for maintenance or other reasons. The summary will consider how likely carcasses of different sizes would be found both near and far from towers.

3.1 FATALITY ESTIMATES

The report will include estimates of the total number of wind turbine-related fatalities based on 4 components: 1) observed number of carcasses; 2) searcher efficiency expressed as the proportion of trial carcasses found by searchers; 3) carcass persistence rates expressed as the length of time a carcass remains in the study area and available for detection by searchers during the search interval; and 4) the proportion of fatalities likely to land in unsearchable areas. The number of bird and bat fatalities on a per turbine per study period basis, and/or other possible metrics (i.e., per megawatt per year) will be calculated as the estimators allow.

Fatality totals and rates will be estimated using 3 fatality estimators, or models: Shoenfeld (2004) and Huso (2010; following methods described in Huso et al. 2015), and Smallwood et al. (2013). Fatality estimates will be calculated both with and without area corrections and for birds and bats separately. Fatality estimates will be calculated with 95% confidence intervals. Fatality estimator models are not designed to incorporate incidental carcasses so they will be excluded. Assumptions and biases related to each model will be discussed in the report.

3.2 OPERATIONAL CURTAILMENT ASSESSMENT

In order to assess the effectiveness of curtailment, the report will include a summary of the number of nights and the number of hours turbines actually curtailed compared to the number of nights and hours when curtailment parameters were met by retrieving and analyzing operations and weather data. Additionally, turbine operations data will be reviewed to verify that rotor rotation below the cut-in wind speed is sufficiently slowed (maximum of 2–3 revolutions per minute [rpm]). The report will also summarize if fresh bat carcasses were found at turbines that were curtailed the previous night.

4.0 LITERATURE CITED

Huso, M.M.P. 2010. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22: 318–329.

Huso, M., N. Som, and L. Ladd. 2015. Fatality Estimator User's Guide: U.S. Geological Survey Data Series 729 Version 1.1, 32 p. Available at http://pubs.usgs.gov/ds/729/pdf/ds729.pdf.

Shoenfeld, P. 2004. Suggestions regarding avian mortality extrapolation. Technical memo provided to FPL Energy. Davis, WV, West Virginia Highlands Conservancy. 6 p.

Smallwood, K.S., D.A. Bell, B. Karas, S.A. Snyder. 2013. Response to Huso and Erickson's Comments on Novel Scavenger Removal Trials. The Journal of Wildlife Management. 02/2013; 77(2):216-225. DOI: 10.2307/23361279.

Strickland, M. D., E. B. Arnett, W. P. Erickson, D. H. Johnson, G. D. Johnson, M. L. Morrison, J.A. Shaffer, and W. Warren-Hicks. 2011. Comprehensive Guide to Studying Wind Energy/Wildlife Interactions. Prepared for the National Wind Coordinating Collaborative, Washington D.C., USA.

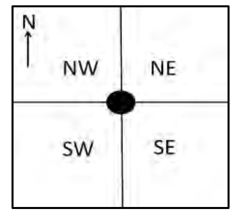
USFWS. 2012. U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines. 23 March 2012.

ATTACHMENT A - FIELD DATASHEETS

Fatality Datasheet

Carcass ID: ______________________ **Searcher:** ___________
Date: __________ **Time:** _________ **Type (circle):** *Search* *Incidental*

Carcass Location (from turbine to carcass)
Turbine #: _________ **UTM:** ____________________________
Transect: _________ **Quardrant:** *NE SE NW SW* *map approx. location*
Distance (m): _______ **Azimuth:** _____________________



Vegetation
Dominant Cover: _________ **Visibilty Index:** ________

Carcass
Bird / Bat *Fatality / Live*
Collected: *Y N* **If Live:** *Euthanized / Released / Transported to rehab. facility*
Species: ____________________________
Age: *A J U* **Sex:** *M F U*
Position: *Face Up* *Face Down* *On Side*
If Bat, forearm length: _____ mm **Evidence of WNS?** ___________
Physical Condition at time of find: *Complete* *Partial* *Feather Spot* *Scavenged*
Describe injuries: ____

Scavenging: *Yes* *No* *Possible*
Scavenger (circle most prevalent):
small *large* *rodents* *corvids* *insects* *other*_________
Scavenging Notes: ____

Carcass Condition (circle):
Fresh (no visible signs of decomp.)
Decomposing – early (flesh mostly present)
Decomposing – late (flesh mostly absent)
Desiccated
N/A (e.g., feathers only)

Infestation:
None *Bees/Wasps*
Ants *Grasshoppers*
Flies *Beetles*
Maggots *Other*

Eyes:
Round/fluid filled
Dehydrated
Sunken
Absent (empty skull)
N/A (e.g., head missing)

Wing pliability:
Easily bent, supple
Flexible but stiffening
Stiff
Rigid

Estimate time death:
Last night *> 2 weeks*
2-3 days *> 1 month*
4-7 days *Unknown*
7-14 days

Photo Numbers (at least 5 photos of fatality and surrounding landscape):

Notes ____

DATA ENTRY:

Appendix B HANCOCK WIND DOWNED WILDLIFE OBSERVATION PROGRAM (DWOP)

2017 Downed Wildlife Observation Program (DWOP) Description and Instructions

What is the DWOP?

The DWOP is a process through which any observations of downed birds or bats at operating projects are reported to Novatus Management through Solas Energy Consulting, LLC.

Why do we have it?

Nearly all of the 900+ species of birds in North America are protected by the Migratory Bird Treaty Act (MBTA) and a smaller number of these species are protected by other federal laws such as the Endangered Species Act (ESA) and the Bald and Golden Eagle Protection Act (BGEPA). "Take" of any of these species, even by accident, is a violation of these acts unless special permission is granted by the federal government ("take permits"). Even possession of a carcass requires a permit. The DWOP is designed to help us understand how frequently fatalities occur, and which species are found, in order to assess ways to prevent additional similar accidents from occurring at a particular site or across a number of sites that share a common characteristic or location. Acting on ways to prevent these situations also reduces liability of enforcement actions by the federal government.

Who reports observations?

DWOP reports should be filed by a Site Operations staff. The initial observation may be made by on-site contractors but an E.On employee with knowledge of the DWOP data reporting requirements should fill out and submit the report.

What information is needed in a DWOP report?

The information needed for the report is straightforward and should answer the questions of When? What? Where? and Who? The report should also provide ***a minimum of three photographs*** of each animal; two close up photos and one photo that shows the general context of where the animal was found (preferably with project infrastructure in the background).

The DWOP report should provide enough information on the animal that Solas can have a reasonable chance of identifying exactly what type of bird (or bat) the carcass is. So, if more than three photographs are needed to show the most distinguishing characteristics of the animal (shape of beak, type of legs and feet, dramatic color patterns, etc.) then more than three photos should be submitted. The carcass can be turned over and moved slightly (if deemed safe to do so) to get better photos. Also, placing a ruler, tape, or other common object of known size next to the carcass to provide a sense of scale is extremely helpful.

How is a DWOP report completed and submitted?

The reporting process is as follows:

1. Take as many pictures you feel needed for a wildlife biologist in Environmental Affairs to have a good chance of making a positive ID of the species. Focus on head, beak, overall coloration, drastic color patterns, feathering on legs, type of feet/toes, and overall size…

2. Obtain a blank DWOP reporting file (an MS Word document) from the site Plant Manager, Custodial Lead, or your Service Area Manager

3. Fill out the basic data fields in the DWOP reporting file. These fields are:

    a. DWOP Tracking Number – This is "DWOP.[site name and designation].yyyymmdd". For example a report from the Bingham site would be; DWOP.BIN.20150818.

    b. Who? – Please identify who is reporting the incident but also who found it, if different (such as if it was a contractor on site who discovered it).

    c. What? – What it appears to be. This may include just bird or bat, though some people may be able to identify the type of bird (hawk or duck) or even the species.

    d. Where? – Describe the location where the carcass was found. Please try to be fairly specific with respect to what project features or infrastructure it is located near (including distance and general direction). ***Include the facility name in this description.***

    e. When? – The date of the discovery.

    f. Additional Notes – Please add any other information that you think might be useful for identifying the species and, more importantly, identifying how it may have died at the site. What specific equipment do you think it hit or landed on that caused the fatality? If it was an electrocution and it caused an outage, please report the timing that the outage happened.

4. Paste the photos you want to submit with the report onto as many pages of the report file that you need to use.

5. Either "Save As" the file as a pdf document or Print it as a pdf document. In either case, when promted for the file name use the DWOP Tracking Number (see 3.a., above). (Please try to keep the size of the file limited by using the "Save As Other" then "Reduced File Size" options in Adobe, once the pdf is generated.)

6. Email the pdf report to kanderson@solasenergyconsulting.com

Should the carcass be picked up at the site?

NO! A special federal permit is needed to pick up and posess birds protected under these Acts and individual sites (and Novatus Energy, Solas Consulting and E.On as a whole) do not currently have the needed permits.

When does the DWOP report need to be filed?

The report must be filed before the end of the day the carcass is found. The sooner the better. This is in case the carcass is suspected to be an eagle or an endangered species, which would require immediate reporting to the government.

What happens after a report is submitted?

When you send the report to the DWOP email address it is received by the DWOP administrator. Usually, the DWOP Administrator will get back to you as soon as possible after reviewing the file. In most cases, you can expect that a species ID will be provided and any further instructions will be that no additional actions are necessary, except perhaps for scraping a small hole in the ground and burying the carcass on-site.

In some cases, there may be a request for additional photographs to assist in a difficult ID. This is where ‘more is better’ with respect to photos to include in the report.

In the case that the carcass may be an eagle or an endangered species you will likely be instructed to find a way to protect or secure the carcass in-place. This could be done with a sturdy box over the carcass, held in place with a rock or cement block. For large carcasses, a plastic barrel cut in half lengthwise may be needed to completely cover it. The proper authorities will then be notified and retrieval of the carcass would then be coordinated by the wildlife agency, Environmental Affairs, and Operations/Field Services staff.

Are there other things to be aware of with respect to downed wildlife?

There are things that can be done to reduce risk at projects. These include:

- Minimization of nighttime lighting to reduce the chances of attracting birds and bats or causing them to confuse the site with a water body (this is particularly important at solar sites), and

- If the site is located near any livestock areas be aware that carcasses of livestock can attract scavenging birds such as eagles, vultures, and condors. If you notice a carcass near project infrastructure work with the landowner to have the animal moved away from features that large birds could collide with or get electrocuted on.

Finally, if you discover any live, crippled wildlife at the site - that should be reported immediately. Please send a flagged, High Importance email to the DWOP address immediately, and follow up with a phone call to (701) 373-1117 for best approach for containing an animal and options for wildlife rehabilitators who may be able to get the animal and provide care for it.

2017 Downed Wildlife Observation Program

Reporting Form

The following information must be reported for each observation of downed wildlife[1]:

Tracking Number ("DWOP."SITE".YYYYMMDD"):

WHO? (Who found the animal? Who is reporting it?)

WHAT? (What does it appear to be - bird, bat, raptor?)

WHERE? (Please provide site name and a clear description of where it was found and what site infrastructure it was found near.)

WHEN? (What date and time?)

NOTES: (Provide any additional information that might be useful. How was it found? Is it dead or crippled? What is the ground cover where it was found? Is there evidence of electrocution? If it cause an outage – at what time did it occur?)

PHOTOGRAPHS: (Take as many photographs as necessary to show any distinguishing aspects of the animal. ***A minimum of three photos is required***. Attach photos to following page(s))

REPORT: Complete this form, attach at least 3 photographs, and "print" or "save as" the document as an Adobe pdf file with the file name the same as the DWOP Tracking Number. Then email pdf to kanderson@solasenergyconsulting.com

---

[1] As a reminder, Downed Wildlife should not be retained by E.On personnel or their contractors unless specific individuals have been informed by the owner that they are covered by necessary State and Federal collection permits (or direct authorization by federal wildlife agents).

Appendix B

Fatality Model Descriptions and Inputs

Estimator Calculations

Many estimators have been proposed for estimating bird and bat fatality at wind farms (Bernardino et al. 2013). The fundamental strategy is to search and find carcasses, then adjust the number of carcasses found by a number of factors, including: the proportion of towers searched, the proportion of searchable space under each searched tower, the time interval between searches in days, the search efficiency (probability a carcass is observed by a searcher), the carcass persistence (the time a carcass stays on the ground available to be found before scavenged by an animal), and covariates such as the size or species of birds and bats. Surveys are conducted to assess searchable areas. The search schedule (typically every 2, 4, or 7 days) determines the time interval. Controlled trials are conducted to estimate searcher efficiency and carcass persistence, and how these rates depend on the covariates. Finally, it takes work to reconcile the differences between estimators because of differences in notation and definitions. Below, we provide the basic structure of most estimators, define notation, then define the three estimators as they are currently implemented in this package (Erhardt 2017).

The typical estimate for total fatality has this structure:

$$\hat{M} = \frac{C}{(\mathrm{SE})(\mathrm{CP})(\mathrm{DWP})},$$

where M is the true number of carcasses produced by the windfarm during the survey period (dead population size) ; $\hat{M}$ is the estimate of M; SE is the search efficiency, $0 \leq \mathrm{SE} \leq 1$, where 0.75 indicates a searcher finds 3 of every 4 carcasses; CP is the carcass persistance, $0 \leq \mathrm{CP} \leq 1$, where 0.75 indicates 3 of every 4 carcasses are available to be found at the time of a search (that is 1 of 4 have been scavenged); and DWP is the density-weighted proportion, a term used by Huso to represent the proportion of the area under a tower that *is* searchable after excluding features of the area, such as the edge of a forest, where searches are not feasible. The differences between estimators often comes down to how the three terms in the denominator are defined. The standard error of $\hat{M}$ is also of interest for the purposes of constructing confidence intervals for M; some methods use an emperical bootstrap while others use a large-sample normal approximation using the delta method. Because samples are rarely "large" enough to trust for an estimate defined by ratios of several quantities, we use the bootstrap to estimate estimate uncertainty.

Huso Fatality Estimate

The Huso fatality estimator software "Estimator" for Windows is available from the USGS website and described in their user's guide (M. M. Huso, Som, and Ladd 2015), originally defined in a manuscript (M. M. P. Huso 2011). Their R code from https://pubs.usgs.gov/ds/729/InputPlaceholderV1.1.zip has been incorporated in the windturbfate package (Erhardt 2017).

The Huso estimator as implemented (M. M. Huso, Som, and Ladd 2015) is defined as

$$\hat{M} = \frac{C}{(p\nu)\left(\frac{\bar{t}(1 - \exp\{-i/\bar{t}\}}{d}\right)(\pi)}.$$

The search efficiency is based on the product of two terms $\mathrm{SE} = (p\nu)$, where p is the average probability that the carcass is detected by the searchers (based on carcass persistence trials) and ν (pronouced "nu") is the effective search interval based on the most common search interval observed in the observed fatality data; ν is used as it was implemented (M. M. Huso, Som, and Ladd 2015), rather than as it was originally defined (M. M. P. Huso 2011). The carcass persistence $\mathrm{CP} = \left(\frac{\bar{t}(1-\exp\{-i/\bar{t}\}}{d}\right)$ is based on integrating an exponential survival function for the "survival time" of a carcass with average scavenge rate $\bar{t}$ evaluated at day i, where $d = \min(i, \tilde{\imath})$ normalizes the expression, with $\tilde{\imath}$ (pronounced "iota tilde") defined as the length of time beyond which the probability of a carcass persisting is less than 1%. The $\mathrm{DWP} = \pi$ is defined as the product of the proportion of actual fatalities contained in the searchable area of the plot, and the probability of including that plot in the sample; this quantity is precalculated and provided on a per-tower basis.

Covariates can be included for the submodels for both SE and CP (for $\bar{t}$ and p), with model selection based on minimizing the Akaike information criterion (AIC) value. Confidence intervals are calculated based on equal-tail quantiles from the nonparametric bootstrap resampling routine which accounts for variance of each of the quantities on the estimator equation's right-hand side.

Shoenfeld Fatality Estimate

The Shoenfeld fatality estimator is defined (Shoenfeld 2004) as

$$\hat{M} = \frac{C}{\frac{\bar{t}p}{i}\left(\frac{\exp\{i/\bar{t} - 1\}}{\exp\{i/\bar{t} - 1 + p\}}\right)(\mathrm{DWP})}.$$

The large expression in the denominator is the overall probability that a fatality is observed, combining both SE and CP in a single expression, where i is the search interval (days), $\bar{t}$ is the mean carcass removal time, and p is the mean probability a carcass is detected by searchers. The estimates for $\bar{t}$ and p are the same as in Huso. In the original definition of the estimator, $\mathrm{DWP} = n'/n$ which is the proportion of turbines sampled, however, because Huso's estimate of DWP is preferred, it is substituted in the calculation.

Covariates can be included for the submodels for both SE and CP (for $\bar{t}$ and p), with model selection based on minimizing the Akaike information criterion (AIC) value. Confidence intervals are calculated based on equal-tail quantiles from the nonparametric bootstrap resampling routine which accounts for variance of each of the quantities on the estimator equation's right-hand side.

Smallwood Fatality Estimate

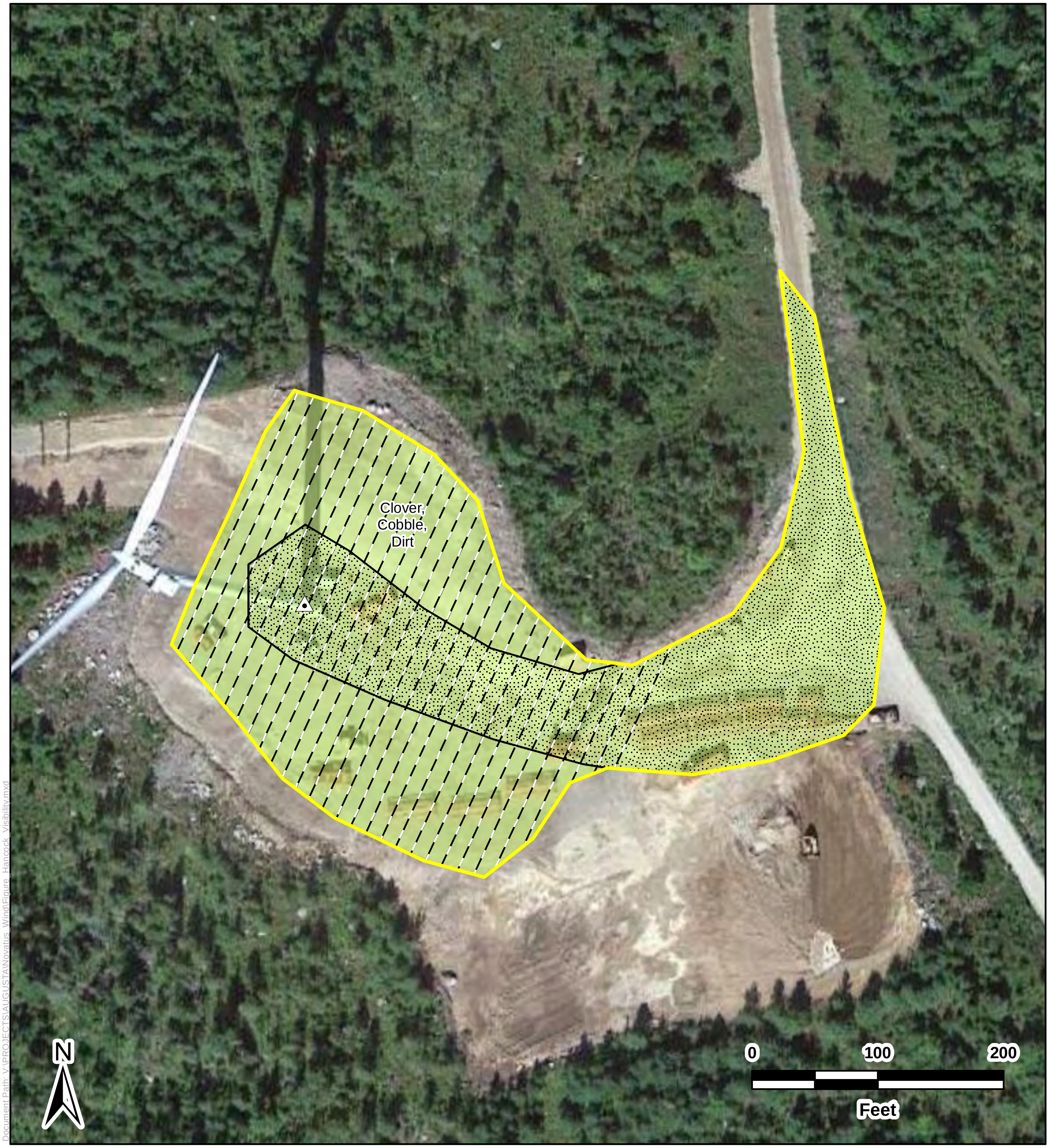
The Smallwood fatality estimator is implemented slightly differently than originally defined (Smallwood 2013) as

$$\hat{M} = \frac{C}{(S)(R_C)(d)}.$$

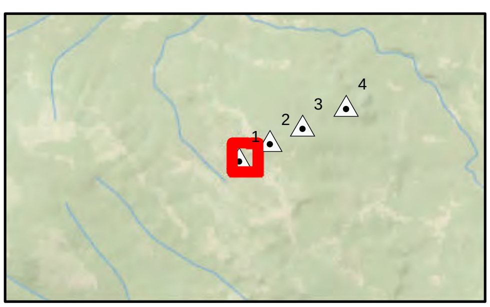
The search efficiency is $\mathrm{SE} = S$, where S is the mean SE quantity from the Huso estimator. $\mathrm{CP} = R_C$ is called the "scavenger removal rate", but is expressed as the average proportion of carcasses remaining at the time of the next periodic search. Let $R_C = \sum_{i=1}^{I} R_i / I$, where R_i is the predicted proportion of carcasses remaining each day i into the CP trial and I is the average search interval. The calculation of R_i is the proportion of survival event non-0s for the ith day. Finally, I is sum of survival events that are left censored (Event = 1 or 2), right censored (Event = 0), and interval censored (mean(left, right) (Event = 3)), divided by the number of trails. The $\mathrm{DWP} = d$ is defined based on emperical tables from previous reports; thus we substituted Huso's DWP value instead of implementing a complicated table-matching algorithm.

Appendix C

Visibility Class Figures



Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

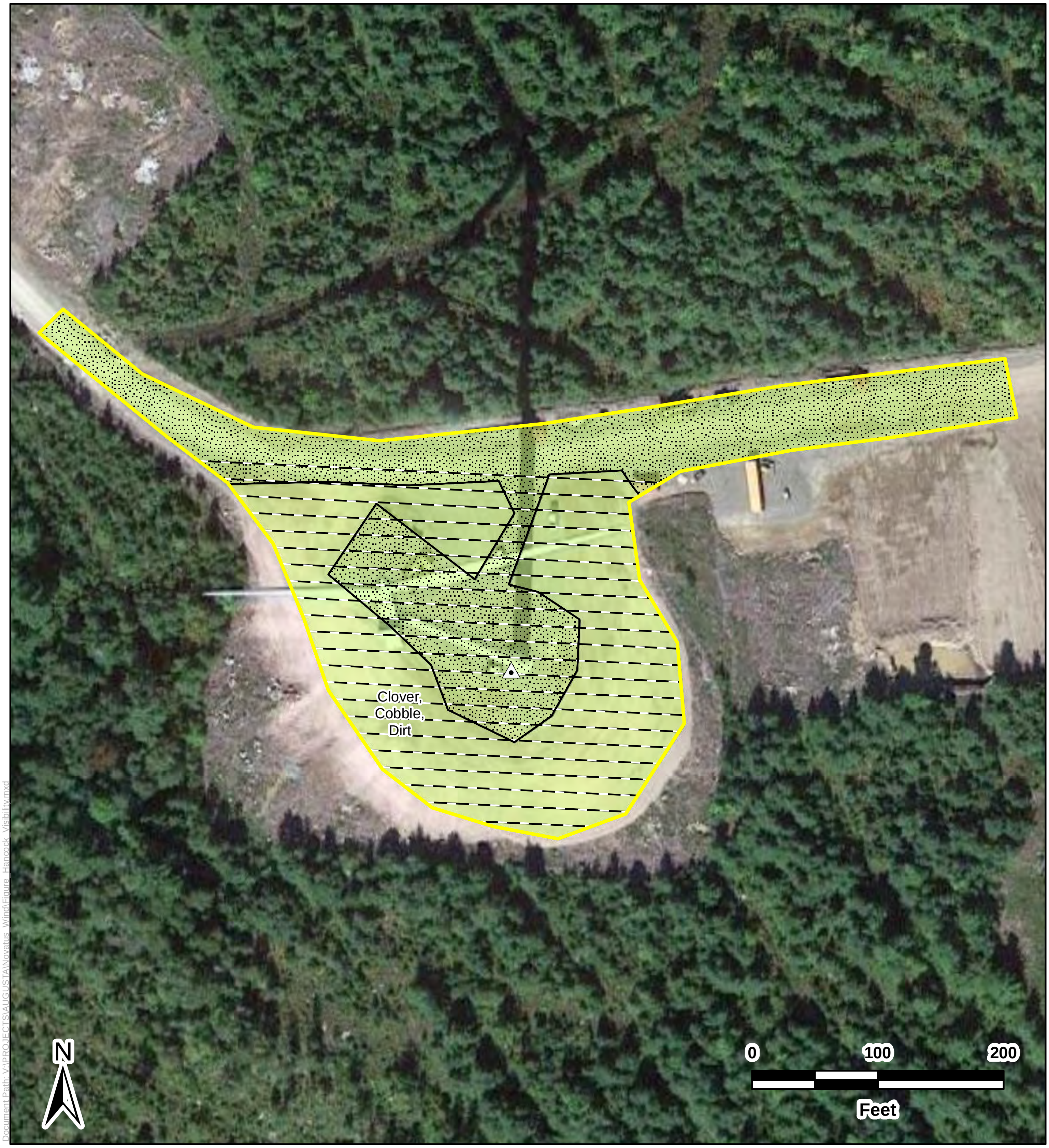
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

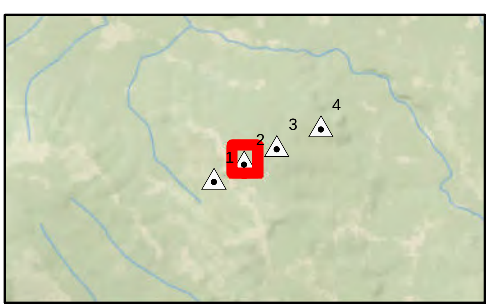
H01

TRC

Map Created on: 10/9/2017



Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

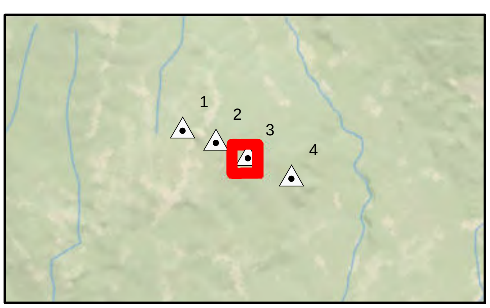
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H02

TRC

Map Created on: 10/9/2017

Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

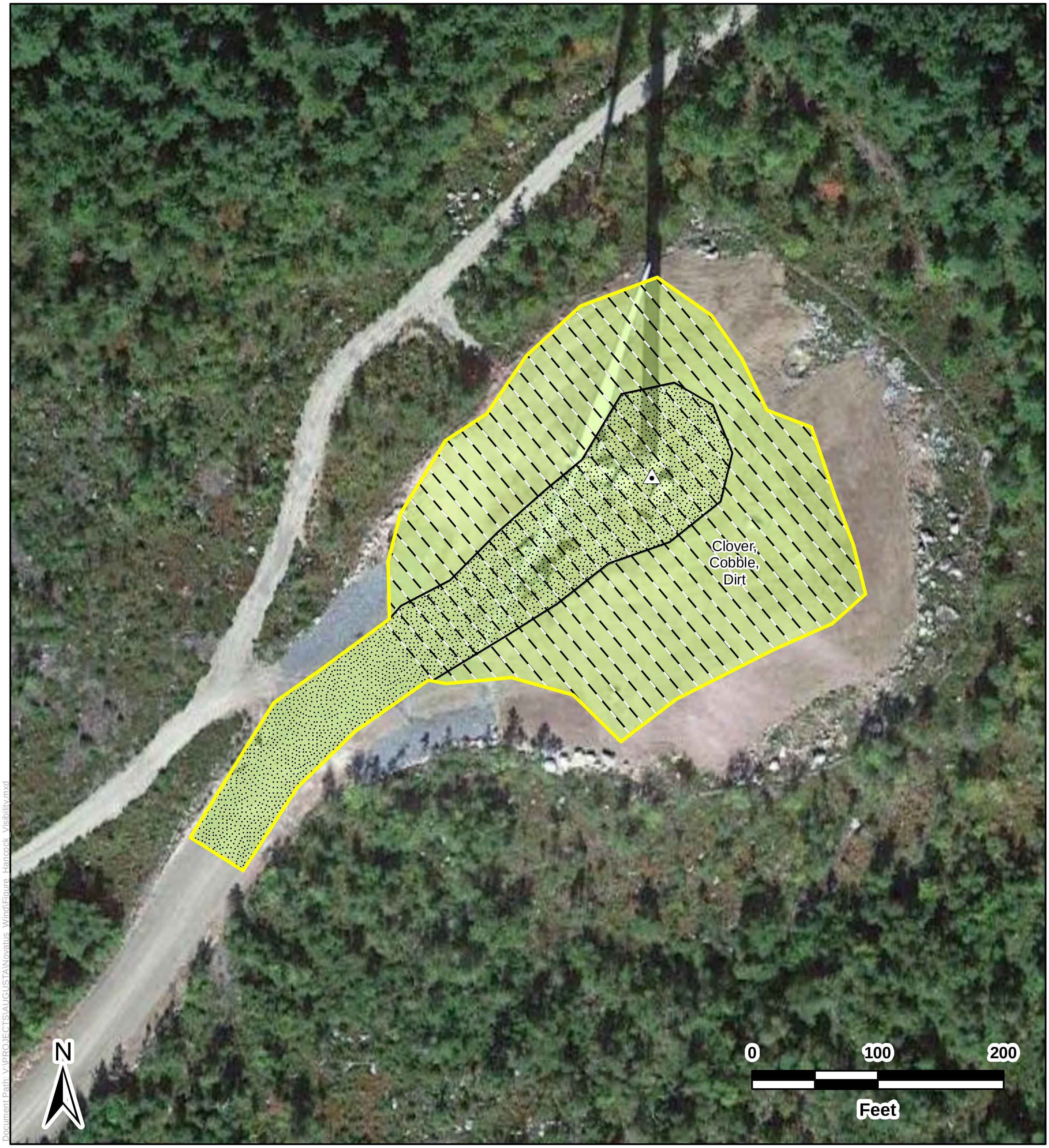
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

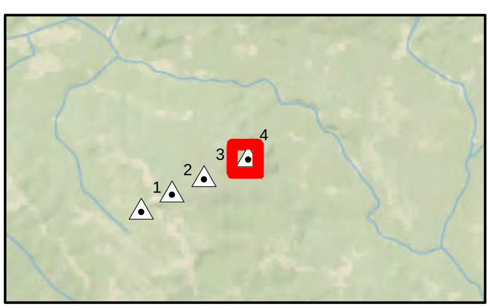
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H03

TRC

Map Created on: 10/9/2017





Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

- Easy
- Moderate
- Difficult
- Very Difficult

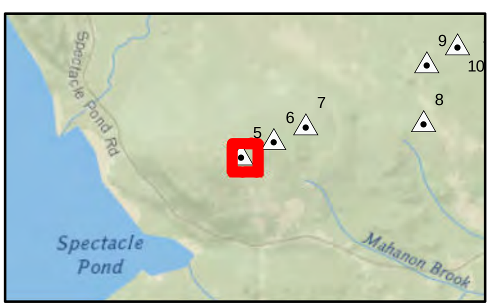
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

H04

TRC

Map Created on: 10/9/2017



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

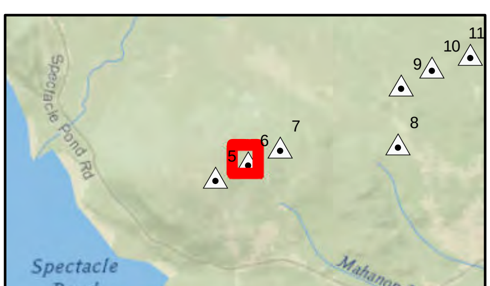
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

H05

TRC

Map Created on: 10/9/2017



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

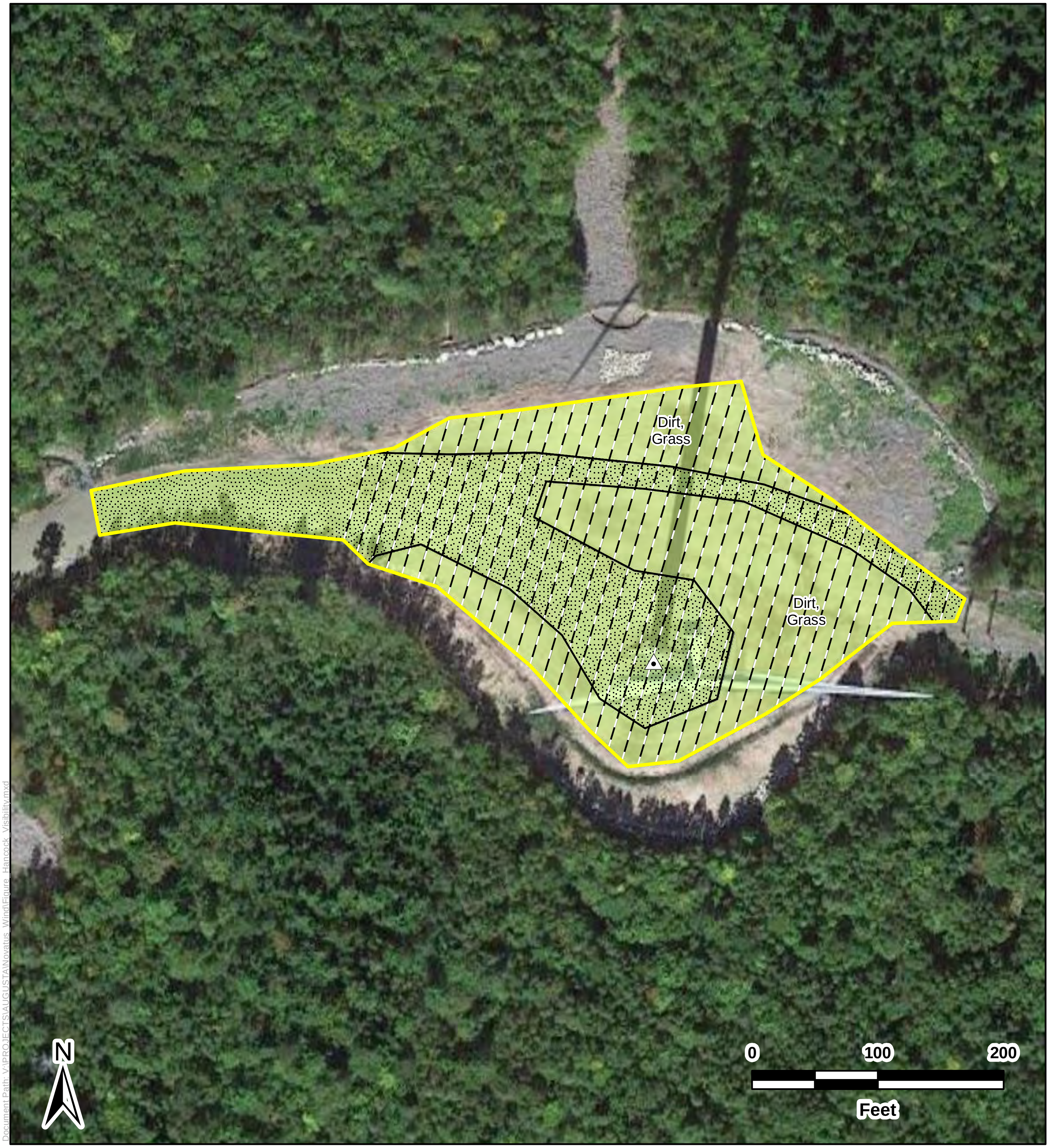
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

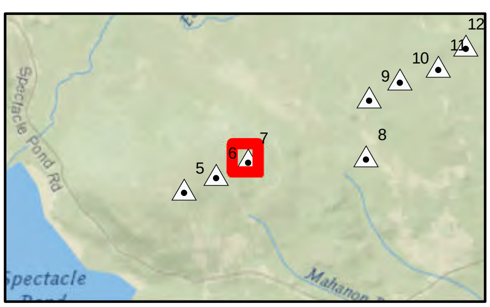
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H06

TRC

Map Created on: 10/9/2017





Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

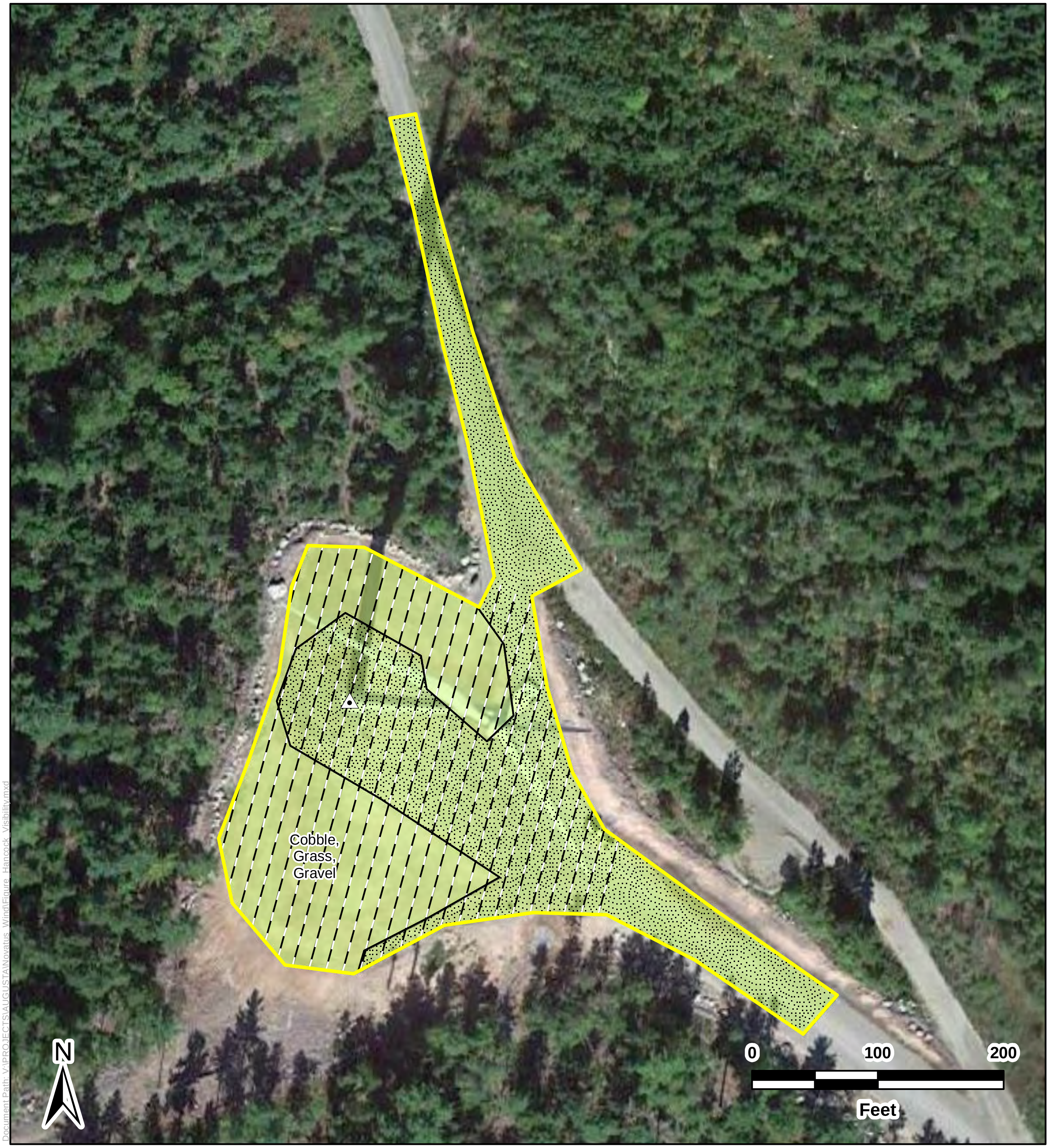
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

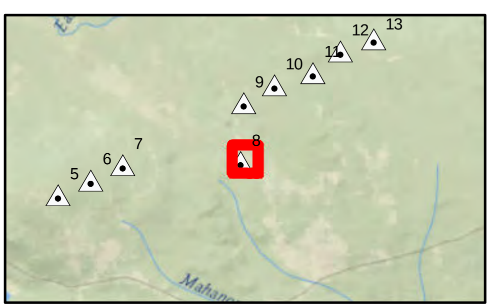
H07

TRC

Map Created on: 10/9/2017



Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

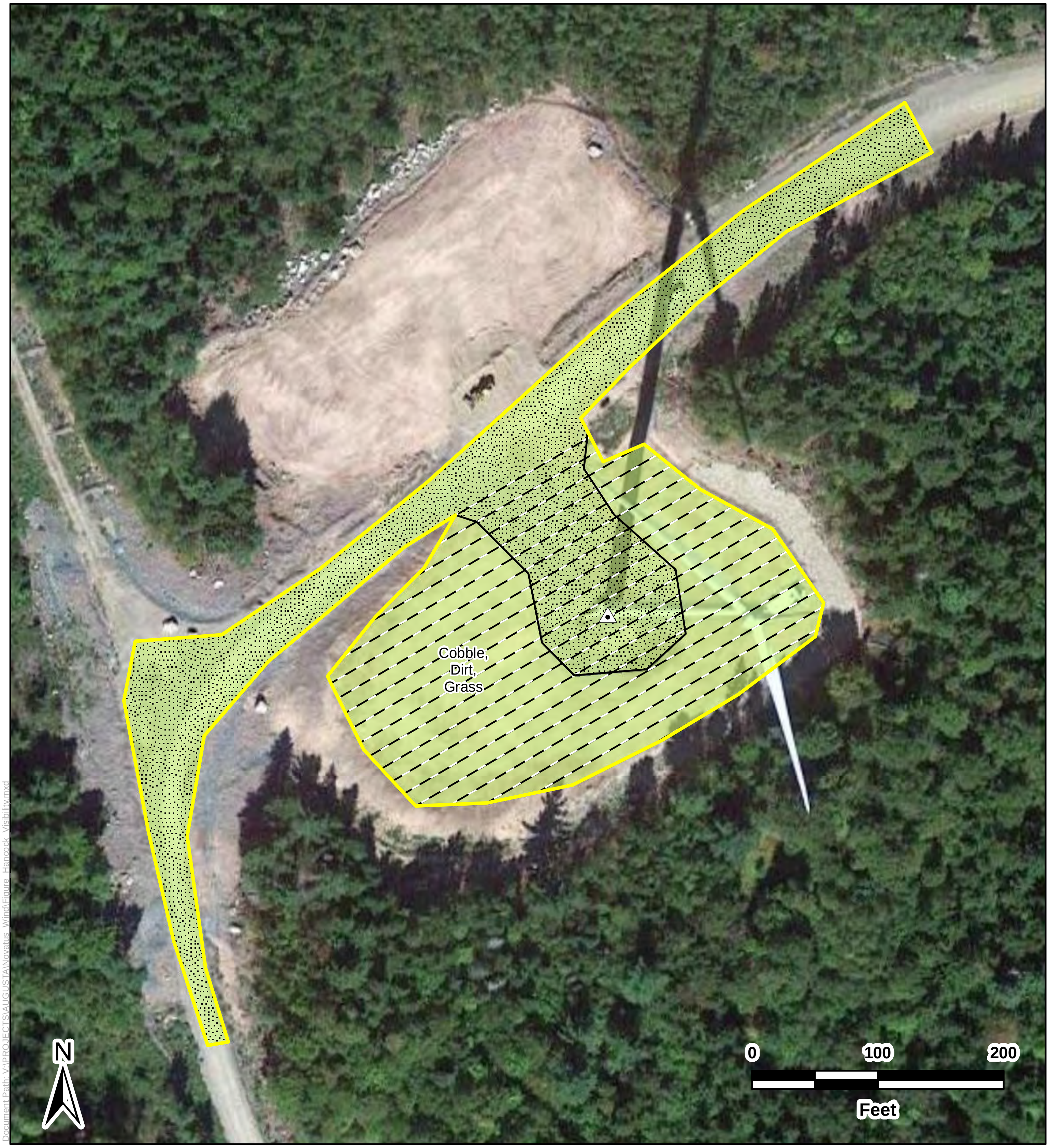
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

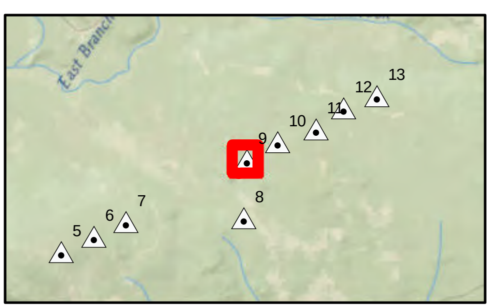
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H08

TRC

Map Created on: 10/9/2017





Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

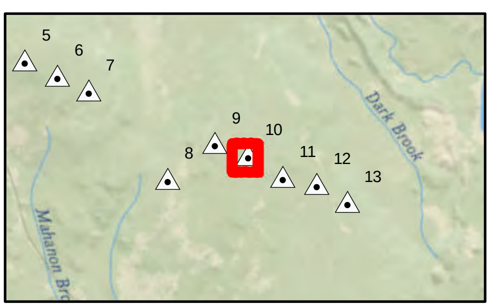
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H09

TRC

Map Created on: 10/9/2017

Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

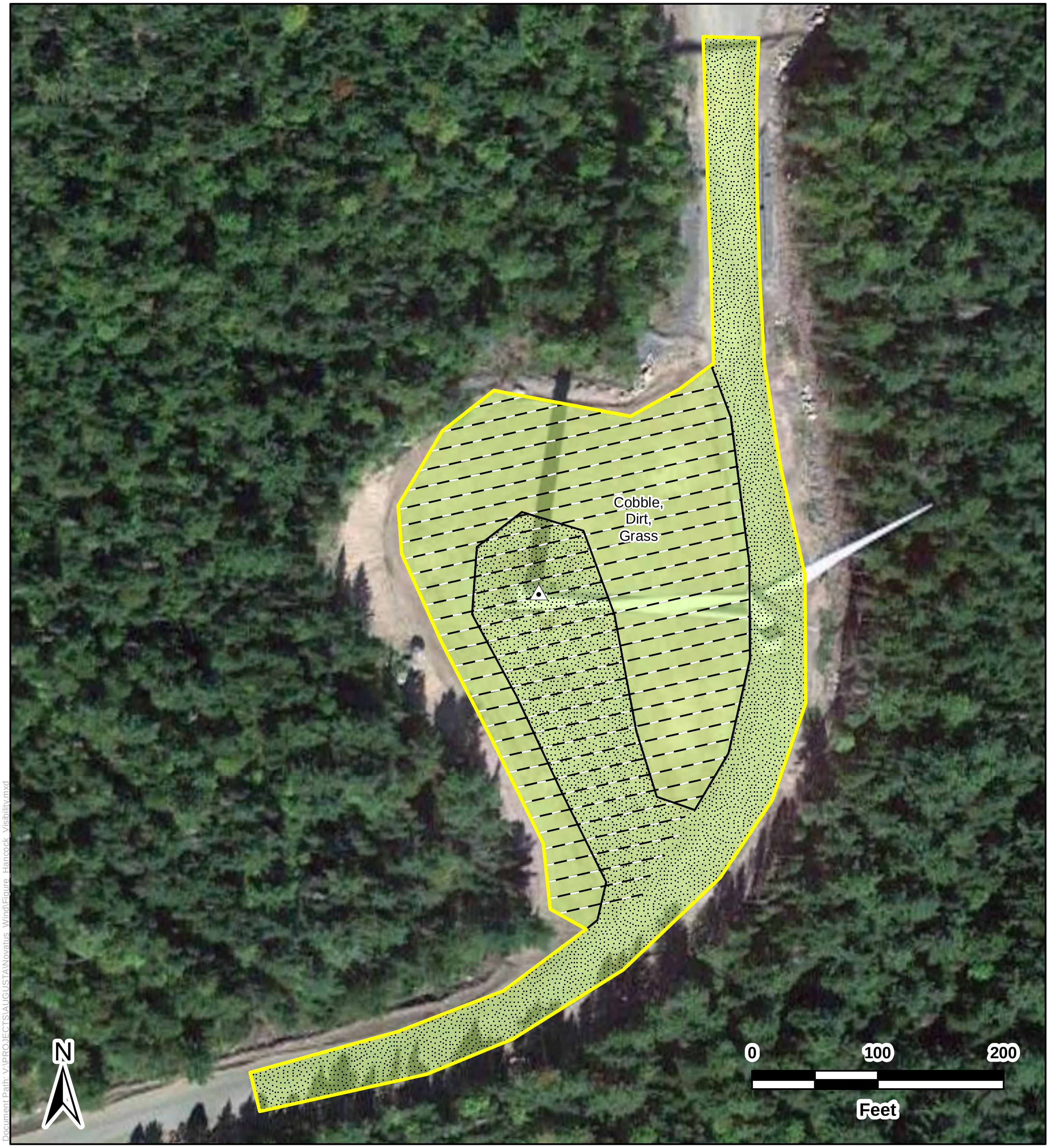
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

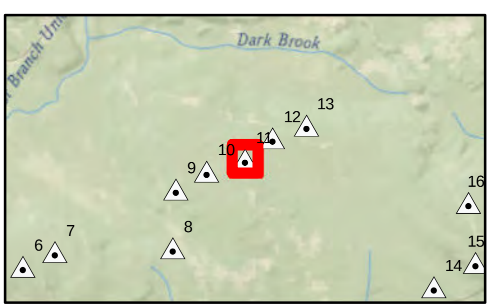
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H10

TRC

Map Created on: 10/9/2017





Turbine

Survey Area

Transect

Access Road and Turbine Pad

Visibility Classes*

Easy

Moderate

Difficult

Very Difficult

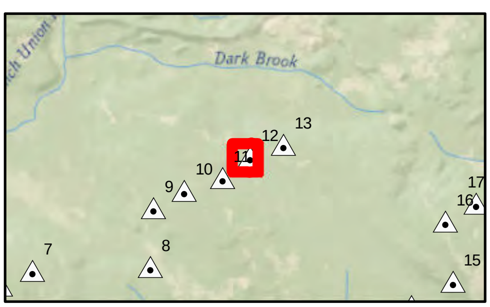
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

H11

TRC

Map Created on: 10/9/2017



Turbine		**Visibility Classes***	
Survey Area		Easy	
Transect		Moderate	
Access Road and Turbine Pad		Difficult	
		Very Difficult	

*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

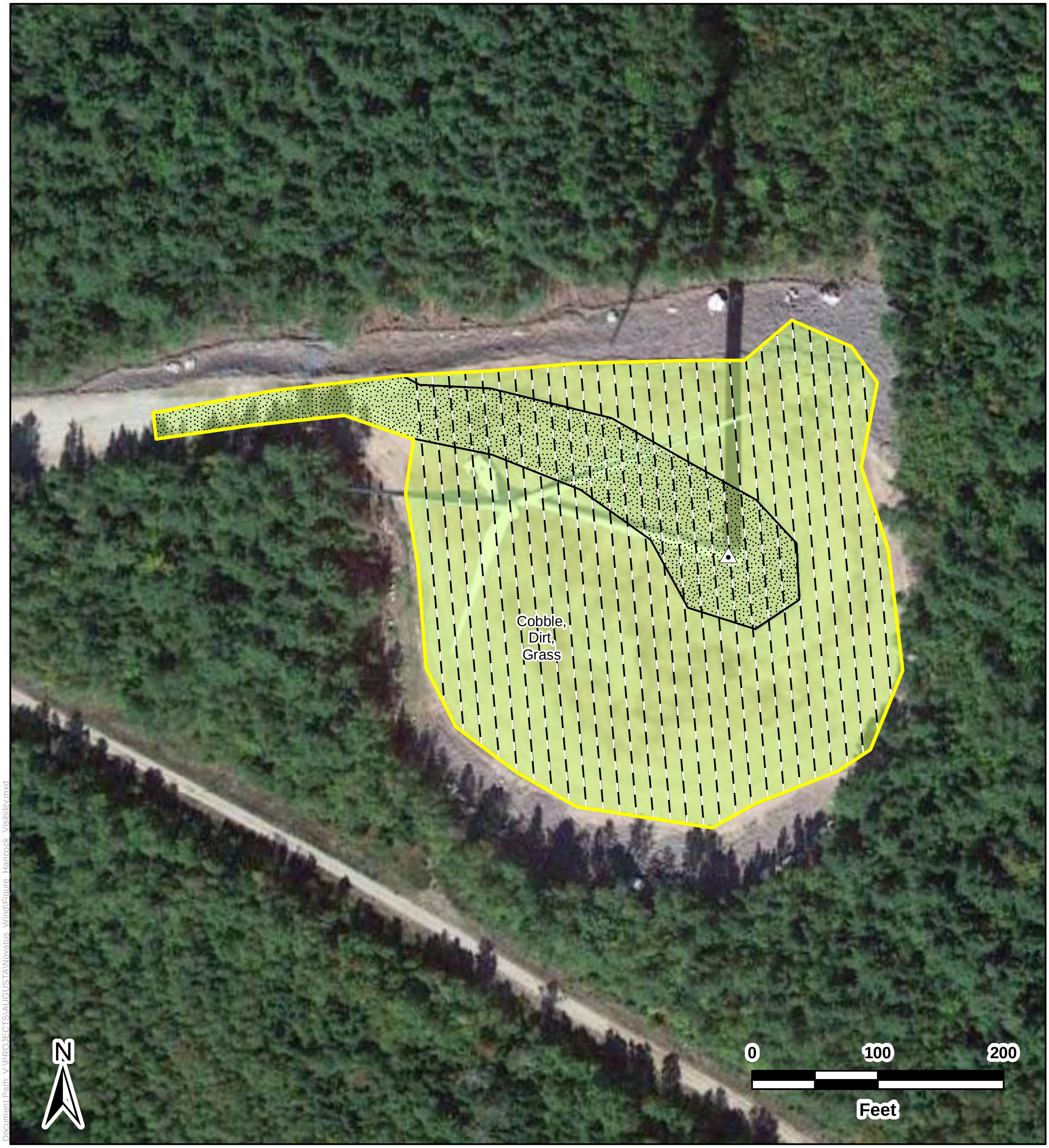
Hancock Wind Project
Visibility Classes
and Vegetation Cover

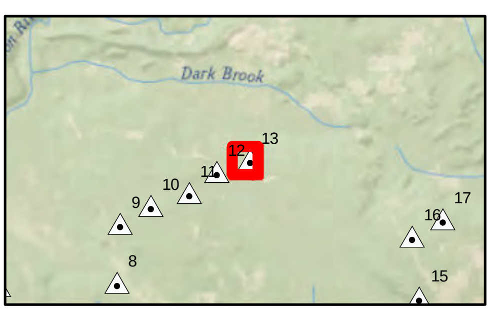
H12

TRC

Map Created on: 10/9/2017

Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd





Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

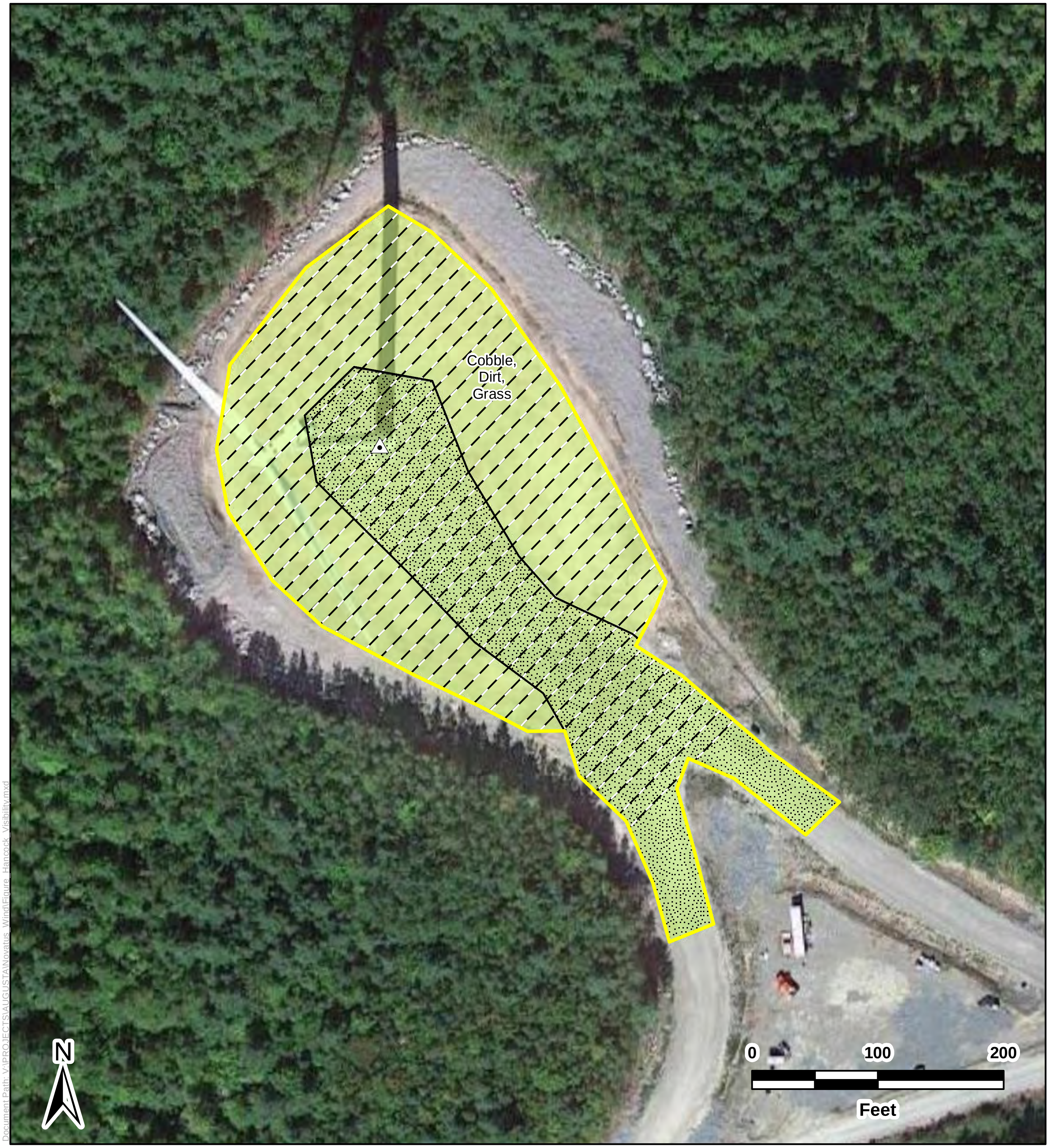
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

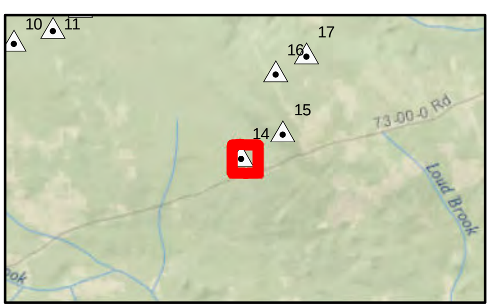
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H13

TRC

Map Created on: 10/9/2017





Turbine
Survey Area
Transect
Access Road and Turbine Pad

Visibility Classes*

Easy
Moderate
Difficult
Very Difficult

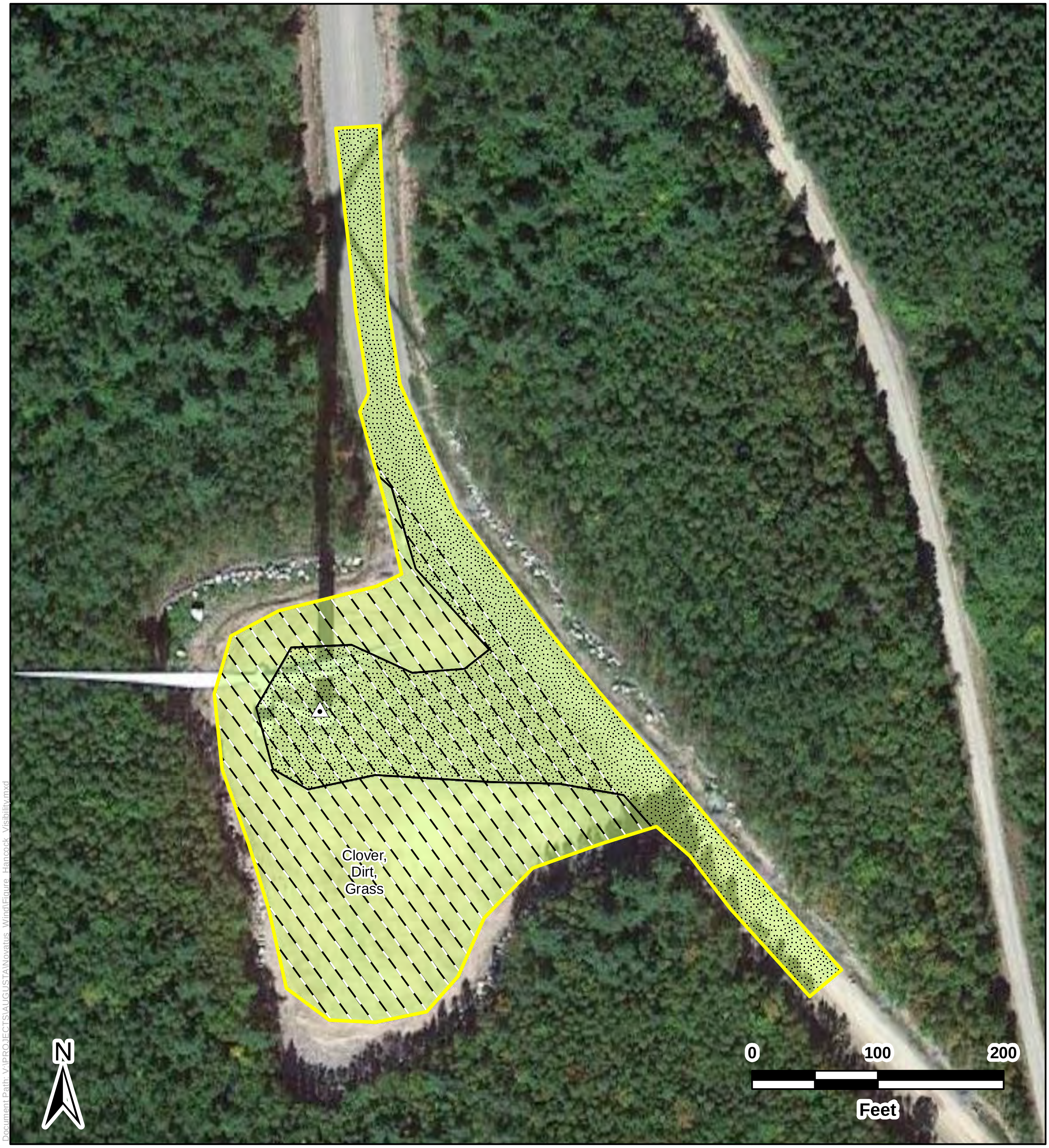
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

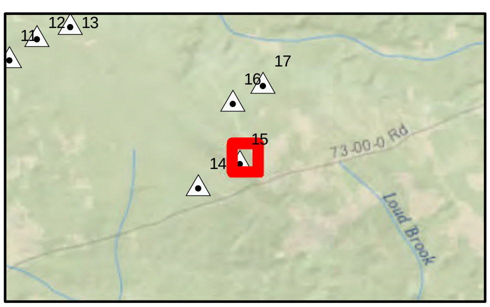
H14

TRC

Map Created on: 10/9/2017



Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine

Survey Area

Transect

Access Road and Turbine Pad

Visibility Classes*

Easy

Moderate

Difficult

Very Difficult

*Visibility classes were determined in August 2017

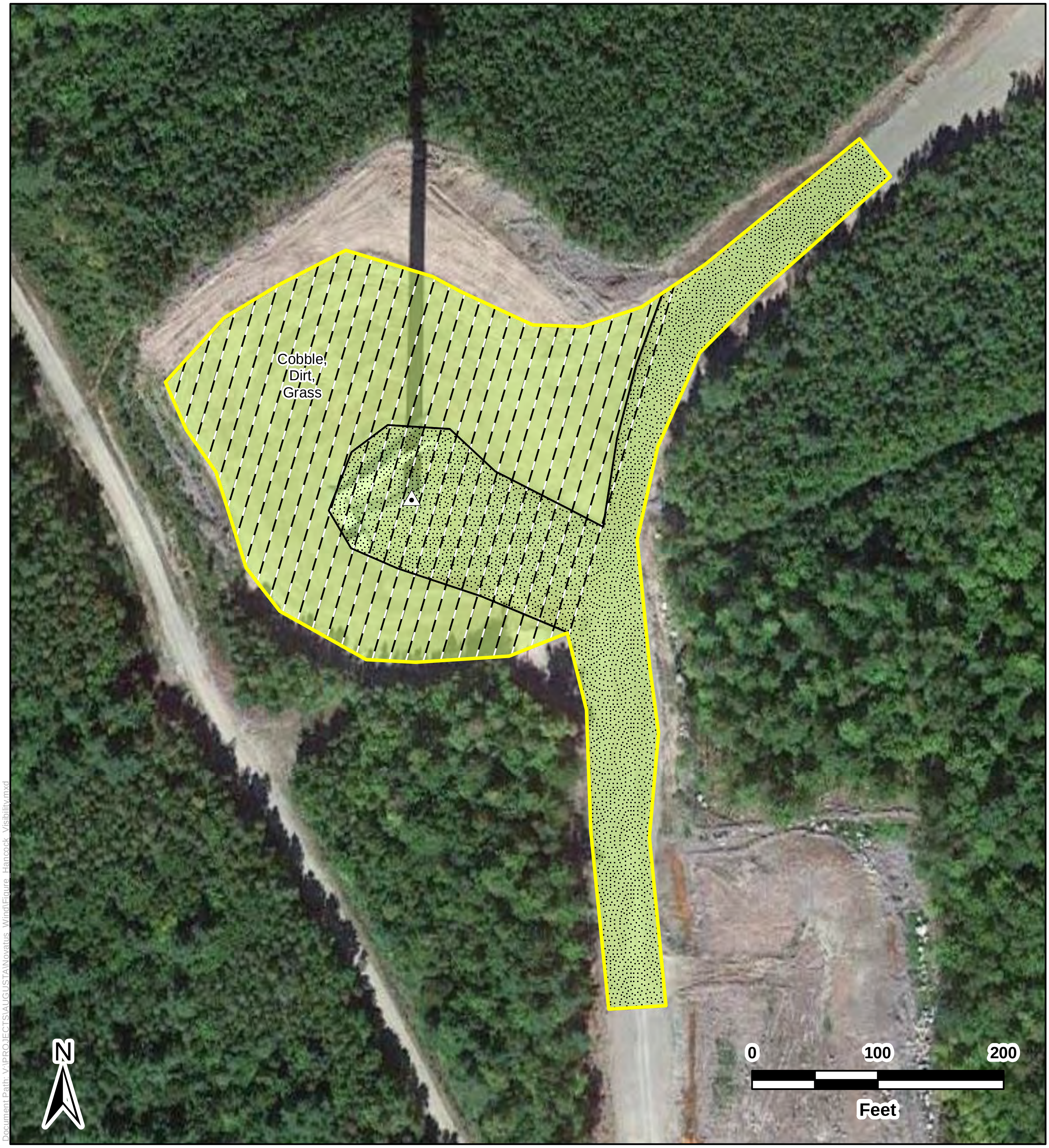
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

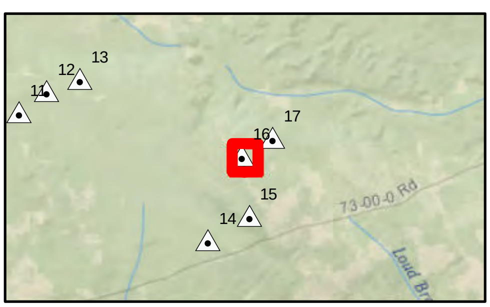
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H15

TRC

Map Created on: 10/9/2017





Legend	
Turbine	
Survey Area	
Transect	
Access Road and Turbine Pad	

Visibility Classes*

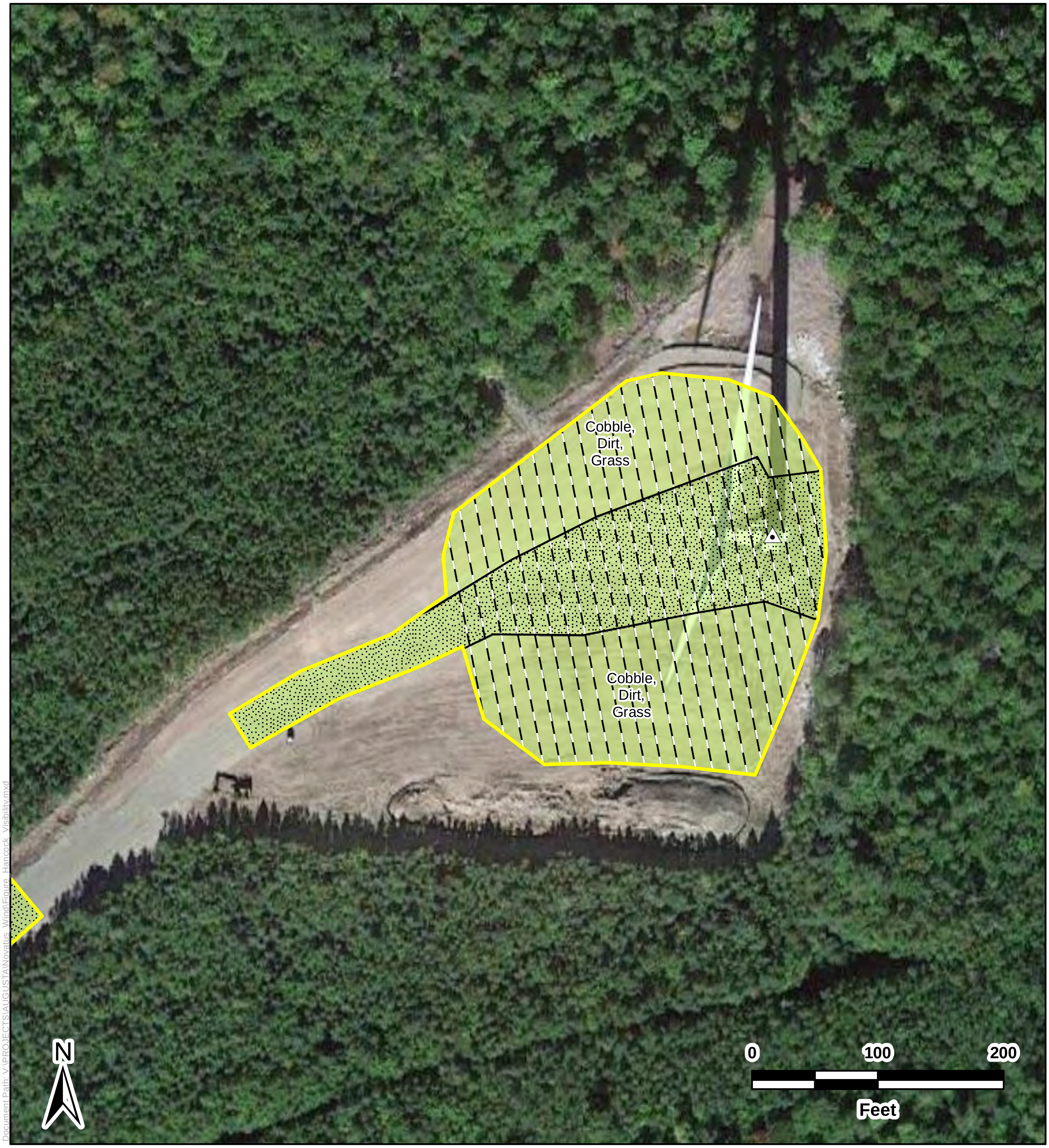
- Easy
- Moderate
- Difficult
- Very Difficult

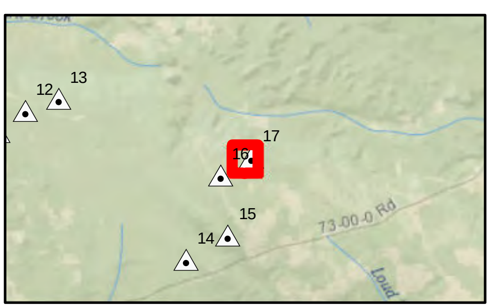
*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes and Vegetation Cover
H16

TRC

Map Created on: 10/9/2017





- Turbine
- Survey Area
- Transect
- Access Road and Turbine Pad

Visibility Classes*

- Easy
- Moderate
- Difficult
- Very Difficult

*Visibility classes were determined in August 2017
Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

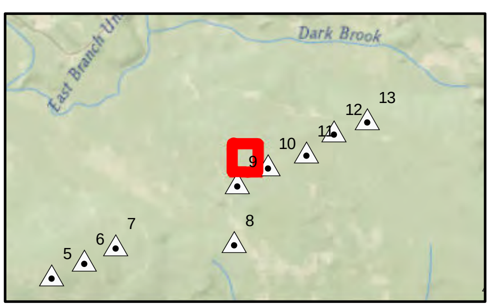
Hancock Wind Project
Visibility Classes
and Vegetation Cover

H17

TRC

Map Created on: 10/9/2017

Document Path: V:\PROJECTS\AUGUSTA\Novatus_Wind\Figure_Hancock_Visibility.mxd



Turbine

Survey Area

Transect

Access Road and Turbine Pad

Visibility Classes*

Easy

Moderate

Difficult

Very Difficult

*Visibility classes were determined in August 2017

Source: Novatus, TRC and ESRI. Map Projection: NAD 1983 UTM ZONE 19N

Hancock Wind Project
Visibility Classes
and Vegetation Cover

Met Tower

TRC

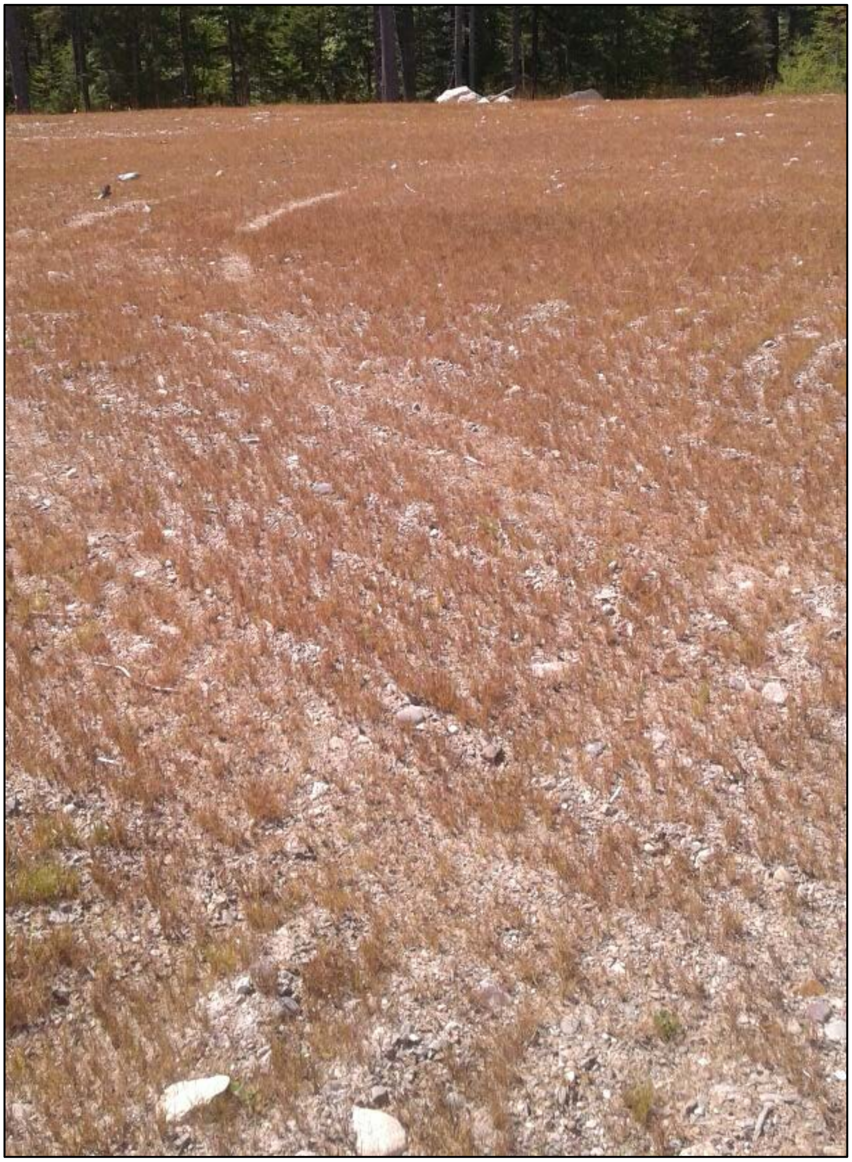
Map Created on: 10/9/2017

Appendix C Table 1. Visibility Classes and Ground Cover Types for Turbines and Met Tower

Turbine	Search Area (square feet)	Visibility Class a/	Cover Types
01	114,823	1	Cobble, dirt, clover, gravel/pad, road
02	106,98	1	Cobble, dirt, clover, gravel/pad, road
03	111,658	1	Cobble, dirt, clover, gravel/pad, road
04	100,252	1	Cobble, dirt, clover, gravel/pad, road
05	95,978	1	Grass, gravel/pad, road
06	116,157	1	Cobble, grass, clover, gravel/pad, road
07	95,292	1	Dirt, grass, gravel/pad, road
08	94,725	1	Cobble, grass, gravel/pad, road
09	111,713	1	Cobble, dirt, grass, gravel/pad, road
10	102,748	1	Cobble, dirt, grass, gravel/pad, road
11	126,602	1	Cobble, dirt, grass, gravel/pad, road
12	100,716	1	Cobble, dirt, grass, gravel/pad, road
13	130,971	1	Cobble, dirt, grass, gravel/pad, road
14	110,511	1	Cobble, dirt, grass, gravel/pad, road
15	104,918	1	Dirt, clover, gravel/pad, road
16	121,512	1	Cobble, dirt, grass, gravel/pad, road
17	82,062	1	Cobble, dirt, grass, gravel/pad, road
Met Tower	33,034	1	Cobble, dirt, mulch, road

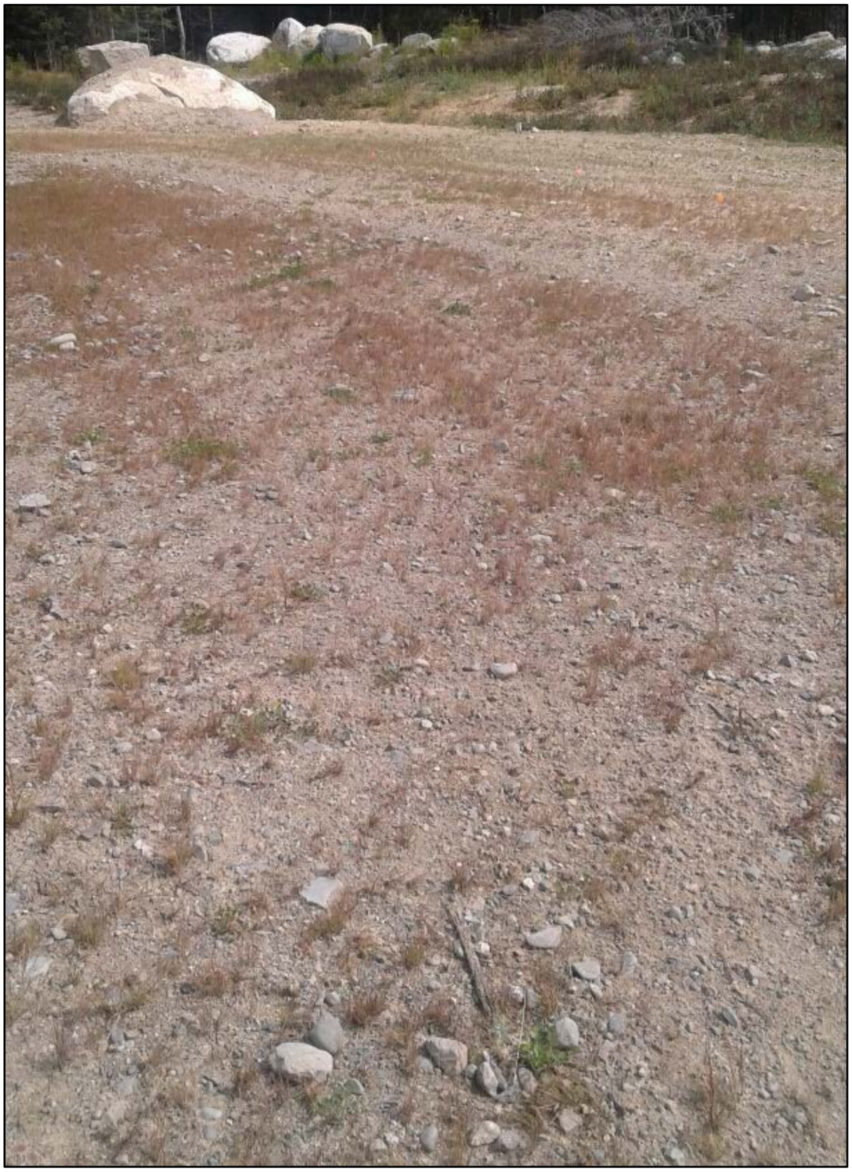
a/ Visibility Class 1 = Easy (>90% bare ground; ground cover sparse and height <12 inches).

Turbine 5 search area depicting short grass and dirt.

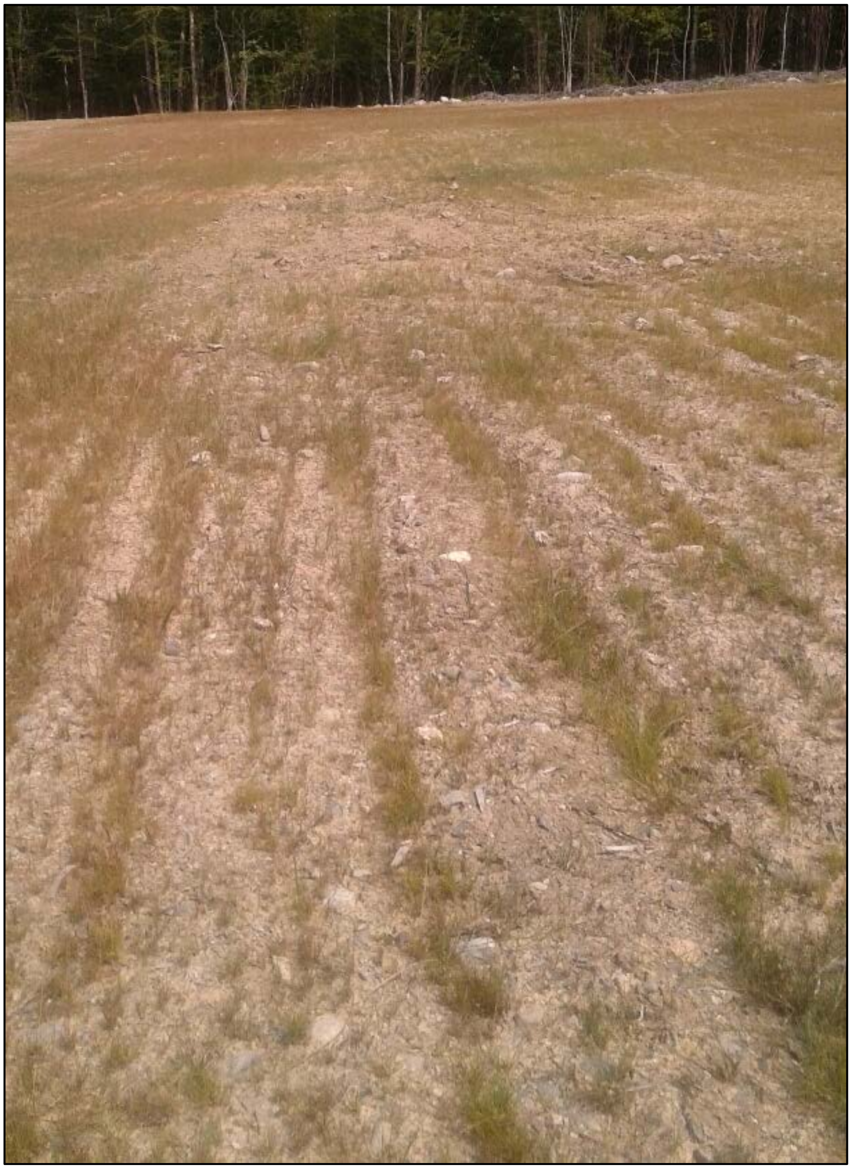


Turbine 8 search area depicting short grass and dirt.

Turbine 9 search area depicting short grass, sparse clover, and dirt.



Turbine 10 search area depicting dirt.



Turbine 17 search area depicting short grass and dirt.

Exhibit 7-9

Comparison of Pre-Construction Bird and Bat Activity and Post-Construction Mortality at Commercial Wind Projects in Maine (Revised 2018)

Comparison of Pre-construction Bird/Bat Activity and Post-construction Mortality at Commercial Wind Projects in Maine

Prepared by:
Stantec Consulting Services Inc.
Principal Author: Trevor Peterson

March 2017 rev September 2018

Table of Contents

EXECUTIVE SUMMARY I

1.0 INTRODUCTION 1

2.0 METHODS 1
2.1 PRE-CONSTRUCTION AND POST-CONSTRUCTION DATA SUMMARY AND ANALYSIS 1
2.2 REGIONAL CONTEXT 3

3.0 RESULTS 4
3.1 PRE-CONSTRUCTION BIRD AND BAT ACTIVITY SURVEYS 4
3.1.1 Radar Surveys 4
3.1.2 Raptor Surveys 6
3.1.3 Acoustic Bat Surveys 6
3.2 POST-CONSTRUCTION MORTALITY ESTIMATES 8
3.3 COMPARING PRE-CONSTRUCTION AND POST-CONSTRUCTION RESULTS 10
3.3.1 Radar Surveys 10
3.3.2 Acoustic Surveys 13
3.3.3 Raptor Surveys 15
3.4 REGIONAL MORTALITY PATTERNS 15

4.0 DISCUSSION 16

5.0 REFERENCES 19

LIST OF TABLES

Table 1. Description of raw data and derived metrics from typical pre- and post-construction bird and bat surveys conducted at wind projects in Maine 3

LIST OF FIGURES

Figure 3-1. Mean radar passage rates from pre-construction surveys at Maine wind projects (proposed and existing) 5
Figure 3-2. Mean percent of radar targets below turbine height from pre-construction surveys at Maine wind projects (proposed and existing). 5
Figure 3-3. Mean number of raptors observed per survey day from pre-construction surveys at Maine wind projects (proposed and existing). 6
Figure 3-4. Mean number of bat passes per detector night by detector type from pre-construction surveys at Maine wind projects (proposed and existing). Note the varying y-axis scale for each detector type and the differing detector heights among the 12 sites. 7
Figure 3-5. Mean bat mortality estimates by year from Maine wind projects by year. 9
Figure 3-7. Mean bird mortality estimates by year from Maine wind projects. 10

Figure 3-8. Mean adjusted annual bat mortality rates (gray columns) plotted with radar passage rate (orange dots) for commercial wind projects in Maine. 11
Figure 3-9. Mean adjusted annual bat mortality rates (gray columns) plotted with percent radar targets below turbine height (yellow dots) for commercial wind projects in Maine. 12
Figure 3-10. Mean adjusted annual bird mortality rates (black columns) plotted with radar passage rate (orange dots) for commercial wind projects in Maine. 12
Figure 3-11. Mean adjusted annual bird mortality rates (black columns) plotted with percent radar targets below turbine height (yellow dots) for commercial wind projects in Maine. 13
Figure 3-12. Mean adjusted annual bat mortality rates (gray columns) plotted with acoustic bat activity levels (blue dots) by detector type for commercial wind projects in Maine. Note different secondary y-axis scales for each detector type. 14
Figure 3-13. Bat (left) and bird (right) mortality estimates from publicly available post-construction studies at commercial wind farms operating without curtailment in the Northeast. 16

LIST OF APPENDICES

APPENDIX A INVENTORY OF PRE- AND POST-CONSTRUCTION DATA 5.1

APPENDIX B PRE-CONSTRUCTION BIRD AND BAT ACTIVITY METRICS 5.1

APPENDIX C POST-CONSTRUCTION BIRD AND BAT MORTALITY ESTIMATES 5.1

APPENDIX D LINEAR MODEL RESULTS 1

APPENDIX E BIRD AND BAT MORTALITY ESTIMATES FROM NORTHEAST STATES 5.1

Executive Summary

Wind developers are required to conduct pre-construction assessments of bird and bat activity at proposed wind farms. Directly measuring the distribution, abundance, and activity levels of birds and bats through pre-construction surveys is presumed to provide a basis for evaluating the mortality risk of a site. However, for pre-construction bird and bat activity to be a useful predictor of post-construction bird and bat mortality, there must be a strong and consistent relationship between the two. Stantec tested the relationship between pre-construction bird and bat survey results and post-construction mortality estimates from commercial wind farms in Maine, specifically evaluating whether variation in estimated bird and bat mortality rates was correlated with variation in corresponding pre-construction survey results. Our results showed no strong or consistent relationship between bird and bat activity measured prior to construction and post-construction mortality rates. The results in Maine are similar to others conducted at broader regional scales, challenging the assumption that pre-construction surveys are a meaningful predictor of risk. Wind projects have been operating in Maine since 2006. Stantec compiled all publicly available pre-construction and post-construction bird and bat survey results for proposed and operating wind projects in the state. Pre-construction data included 682 nights of radar surveys at 14 proposed sites, 442 raptor survey days at 13 proposed sites, and 10,644 detector-nights of acoustic bat surveys at 12 proposed sites. Post-construction bird and bat mortality estimates were available from 11 sites, 10 of which also had corresponding pre-construction data. Where both pre- and post-construction data are available, we assessed relationships between pre-construction bird and bat activity and post-construction mortality rates at the site level (overall and yearly), evaluating radar, bat acoustic, and raptor data separately.

Pre-construction bird, bat, and raptor activity levels and bird and bat mortality rates varied among sites, suggesting differing levels of risk. However, based on evaluation of multiple pairings of variables there is no consistent relationship between pre-construction activity levels and annual mortality estimates at the sites. Of all available pairings of pre-construction and post-construction results we compared, only one showed a statistically significant positive correlation. As such, existing data representing most operating wind projects in Maine fail to support the assumption that pre-construction bird and bat activity provides a reliable indicator of mortality rates during operation.

Similar attempts to compare pre-construction activity versus post-construction mortality rates in other states and on a national level have also failed to support this assumption. Despite some overall seasonal trends, which have been consistently demonstrated in pre-construction and post-construction surveys throughout North America, variation in overall pre-construction bird and bat activity appears to have no consistent relationship with mortality. Our understanding of other factors (e.g., weather, lighting) influencing mortality at wind projects and other projects (e.g., buildings, communication towers) suggest that risk to birds and bats is anything but static, and is instead influenced by a variety of seasonal, behavioral, and conditions-based factors.

This report was initially drafted in 2017 and updated in August 2018 to include results of post-construction studies conducted at 3 sites (Hancock, Bingham, and Oakfield) in 2017. We have updated all analyses and figures to reflect these updates and modified text to account for any changes in the results of statistical tests. Overall, the inclusion of data from sites monitored in 2017 did not change the results or Stantec's conclusions based on our analysis.

1.0 INTRODUCTION

The reality that commercial wind turbines can kill birds and bats has prompted a substantial effort to identify factors that predict the magnitude of risk for proposed project sites and explain why bird and bat mortality rates are higher at some wind farms than others. Pre-construction bird and bat surveys have been used in and outside of Maine to document distribution, abundance, species composition, and temporal/seasonal activity patterns of birds and bats at proposed wind power sites, and the results of such surveys have been used to evaluate the risks that development of such a site might present. However, for pre-construction bird and bat activity to be a meaningful predictor of risk at wind projects in Maine, the relationship between activity and post-construction mortality rates should be relatively strong and consistent.

Stantec analyzed the relationship between publicly available pre-construction bird and bat survey results and post-construction mortality estimates from commercial wind farms in Maine. We tested whether variation in estimated bird and bat mortality rates was correlated with variation in corresponding pre-construction survey results using straightforward linear regressions at the site level. This report summarizes the methods and results of our analyses, compares our results to similar efforts conducted in other states, and provides a regional context for the variation in mortality rates documented at wind projects in Maine. The results showed inconsistent relationships between bird and bat activity measured prior to construction and post-construction mortality rates. The results in Maine are aligned with those of similar analyses based on projects outside of Maine and challenge the assumption that pre-construction surveys are a meaningful predictor of risk.

2.0 METHODS

2.1 PRE-CONSTRUCTION AND POST-CONSTRUCTION DATA SUMMARY AND ANALYSIS

Stantec first compiled publicly available pre-construction bird, raptor, and bat survey results for commercial wind projects in Maine. These included results from projects that have gone through permitting and pre-construction survey results are therefore part of the public record. Because the level of effort and survey methods varied among sites[1], we derived a set of standardized metrics for each survey type based on the raw daily/nightly data to improve comparability of data among sites (Table 1).

We next obtained post-construction mortality estimates from all publicly available survey reports, tracking the survey interval, mortality estimator used, turbine characteristics, and operational parameters. To improve comparability of mortality estimates among sites, we converted per-

[1] For example, in collecting pre-construction data, 13 of the projects analyzed used an X-band radar system and 1 used the MERLIN™ radar system.

turbine bird and bat fatality estimates to per-megawatt (MW) estimates. To account for varying survey lengths among studies, we also adjusted each estimate based on the ratio of the survey period compared to the mean survey period of all projects in Maine. When present, we combined separate seasonal estimates (e.g., spring, summer, fall) and size-specific estimates for birds (e.g., small bird, medium bird, large bird) to generate annual[2] bird and bat mortality estimates. In cases where multiple mortality estimates existed for a given site/year (e.g., based on different search intervals), we calculated a mean mortality estimate for each year. We also generated a per-site overall average for birds and bats for sites with more than 1 year of post-construction monitoring (Table 1). The intent of calculating these summary statistics was to improve comparability of results among projects.

We plotted post-construction mortality versus pre-construction bird and bat activity rates at the site level and used linear regression to determine whether there were correlations between mortality estimates and pre-construction results. We used separate linear regressions for each pairing of pre-construction and post-construction data, analyzing annual mortality estimates and site-level mean mortality estimates separately. We conducted separate analyses of bat mortality datasets with and without 3 Maine projects (Bull Hill, Oakfield, and Passadumkeag) operating under curtailment; curtailment reduces bat mortality rates and could therefore affect results. Finally, to provide a regional context for bird and bat mortality documented at Maine wind projects, we compared magnitude of bird and bat mortality estimates from Maine projects to those from nearby states. We implemented all data summary, graphing, and analysis using statistical software and reported adjusted R^2 values for all regressions (R Core Team 2014).

[2] Mortality surveys in Maine typically occur between April/May and October and, therefore, do not necessarily reflect the full year, although they cover much of the period during which bats and songbirds are active and are generally presented as annual estimates in the reports.

Table 1. Description of raw data and derived metrics from typical pre- and post-construction bird and bat surveys conducted at wind projects in Maine.

Survey Type	Raw Data	Calculated Metric(s)
Acoustic bat survey	• Nightly passes per detector-night, grouped by detector and species/species guild	• Mean/median passes per detector-night, grouped by detector type • Percent of surveyed nights with bat activity • Overall species composition by detector type
Nocturnal radar survey	• Nightly passage rate • Nightly flight height • Percent targets below turbine height • Flight path direction	• Mean/median passage rate • Mean/median flight height • Mean/median percent targets below turbine height
Raptor migration surveys	• Raptors observed per species per day • Flight height and behavior • Flight path direction	• Mean raptors observed per day
Post-construction mortality surveys	• Estimated bird/bat carcasses per turbine per season • Bird/bat carcasses (by species) found per turbine search	• Estimated bird/bat carcasses per MW, adjusted for length of survey period (annual and overall per site) • Mean monthly bird/bat carcasses found per search

2.2 REGIONAL CONTEXT

To put the Maine results in context, we also compiled data from publicly available post-construction mortality monitoring reports for wind projects in 6 northeastern states (Maine, New Hampshire, Vermont, New York, Pennsylvania, and West Virginia). For the regional comparison, we excluded mortality estimates from sites implementing curtailment to minimize variation due to factors other than siting. We did not have access to original raw data used to calculate bias estimates and correction factors in all cases. In order to compare similarly reported projects, our regional analyses only include reported estimates that incorporated bias and correction factors such as searcher efficiency and carcass removal. In most cases, estimates had also been adjusted to account for areas not surveyed. We combined separate seasonal and size-class estimates into overall annual bird and bat estimates, as described above. We converted per-turbine estimates to per-MW estimates and incorporated the same scaling factor mentioned above to account for variable survey lengths. If multiple estimates were reported for a site during a year, based on different search intervals or calculation methods, we calculated the mean bird and bat mortality rates for that year to ensure each site/year combination was represented only once in the dataset.

3.0 RESULTS

Stantec obtained pre-construction and/or post-construction survey results from 15 proposed or operating wind projects in Maine including nocturnal radar data (14 sites), raptor migration data (13 sites), bat acoustic data (12 sites), and post-construction bird and bat mortality data (11 sites) (Appendix A Table 1). Ten of those sites had both pre-construction and post-construction data readily available. Because analysis focused on site-level relationships, we considered data from multiphase projects (e.g., Stetson I and II) as representative of one site.

3.1 PRE-CONSTRUCTION BIRD AND BAT ACTIVITY SURVEYS

3.1.1 Radar Surveys

Radar surveys and analytical approaches used in Maine have followed consistent methods since the mid-2000s[3]. All except one radar survey we analyzed were conducted using the same radar technology (x-band 12 kilowatt marine radar operated in horizontal and vertical modes) and using the same analysis methods (randomly selected subsamples of data analyzed by hand to quantify passage rates, flight directions, and flight height). One other survey was conducted using the MERLIN™ radar system, which uses horizontal and vertical radars simultaneously to automatically and continuously record bird and bat activity. The pre-construction radar survey dataset consisted of 682 nights of radar surveys from 14 sites (Appendix B).

We report radar survey results in terms of "passage rates", which represent the number of "targets" flying through the airspace sampled by the radar in horizontal mode, and the "percent of targets below turbine height" based on vertical operation. "Below turbine height" includes targets at or below the maximum height of the turbines. Among the 14 Maine projects with nocturnal radar data, mean passage rates ranged from 310.5 – 746.2 targets/kilometer/hour, with an overall mean of 438.0 (Figure 3-1). The mean percent of targets below turbine height ranged from 11% to 33% with an overall mean of 23% (Figure 3-2).

[3] The first nocturnal radar surveys in Maine occurred in the mid-1990s and used 25 kilowatt marine radars.

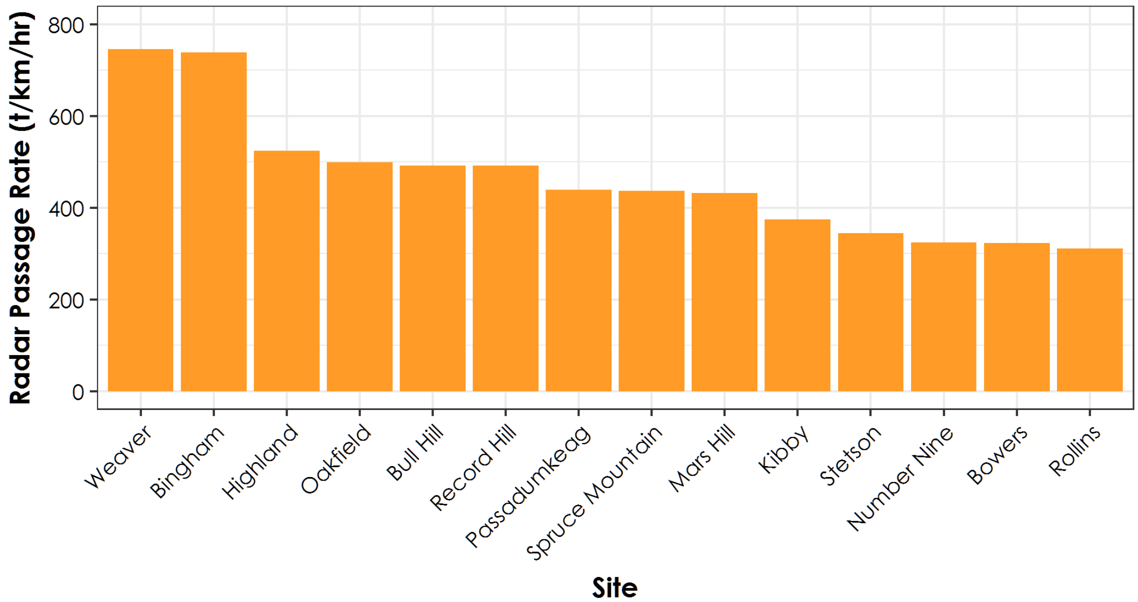


Figure 3-1. Mean radar passage rates from pre-construction surveys at Maine wind projects (proposed and existing).

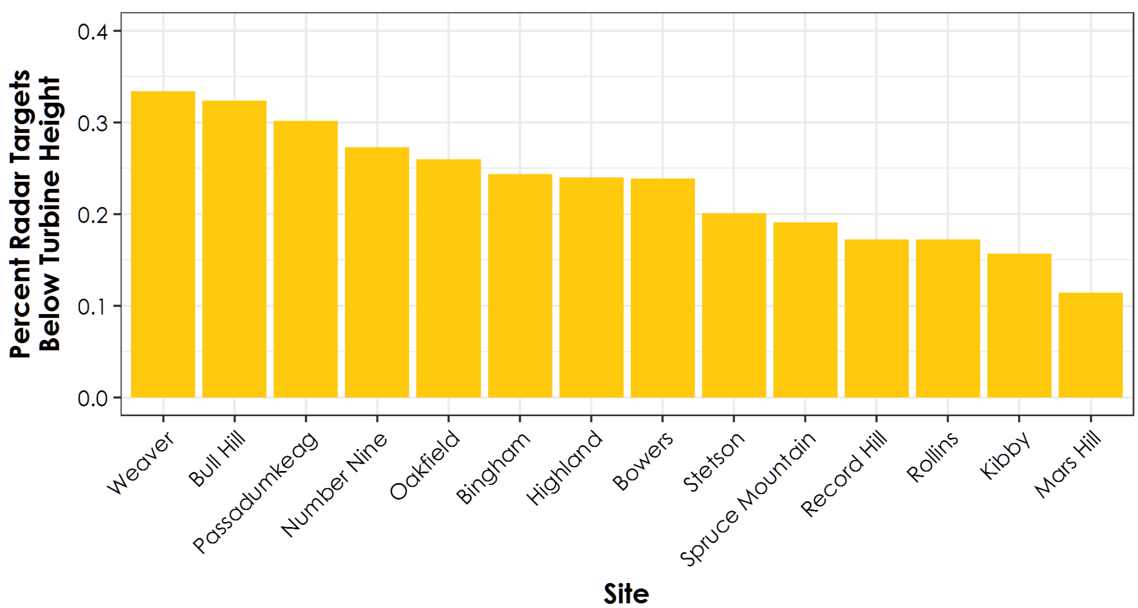


Figure 3-2. Mean percent of radar targets below turbine height from pre-construction surveys at Maine wind projects (proposed and existing).

3.1.2 Raptor Surveys

Raptor surveys followed consistent methods among sites, based on visual surveys conducted by a single observer equipped with binoculars and spotting scope. Pre-construction raptor survey results were available for 442 survey days from 13 sites, observing more than 4,053 raptors during the project area surveys. The mean number of raptors observed per survey day ranged from 5.1 to 18.7 raptors/day among sites (mean = 10.3; Figure 3-3).

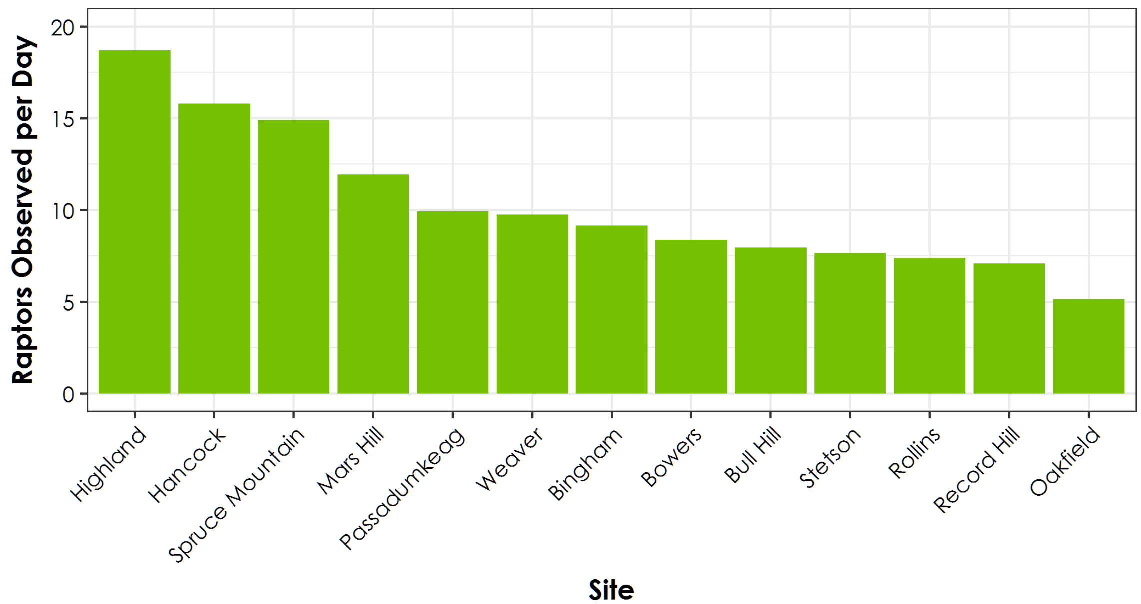


Figure 3-3. Mean number of raptors observed per survey day from pre-construction surveys at Maine wind projects (proposed and existing).

3.1.3 Acoustic Bat Surveys

Acoustic bat surveys can vary widely in scope and methods, although most pre-construction surveys in Maine have involved deploying "Met High" (>20 m above ground level [agl] in meteorological [met] towers), "Met Low" (~10 – 20 m agl in met towers), or "Tree" detectors (~2 m agl) in trees. Because multiple detectors may be at different heights each night, the results are tracked as "detector nights" (DN), rather than just nights (i.e., 3 detectors during 1 calendar night equals 3 DN per night). We analyzed nightly pre-construction bat acoustic data to Tree detectors (n = 5,346 DN), Met High detectors (n = 2,676 DN), and Met Low detectors (n = 2,622 DN), resulting in a dataset representing 10,644 detector nights from 121 sites over 9 years (2006–2014). In cases where multiple detectors were deployed, we calculated mean nightly activity levels for each detector type (hereafter referring to position as Met High, Met Low, or Tree).

Because mean rate of passes per DN calculated per site varied significantly among detector types ($R^2 = 0.53$, $p < 0.001$, $F(2,26) = 16.66$), we plotted and analyzed results separately for each detector type. Mean bat passes per night ranged from 0.10 to 1.96 at Met High detectors (mean = 0.67), from 0.25 to 3.60 at Met Low detectors (mean = 1.12), and from 4.3 to 68.45 (mean = 29.48) for Tree detectors (Figure 3-4).

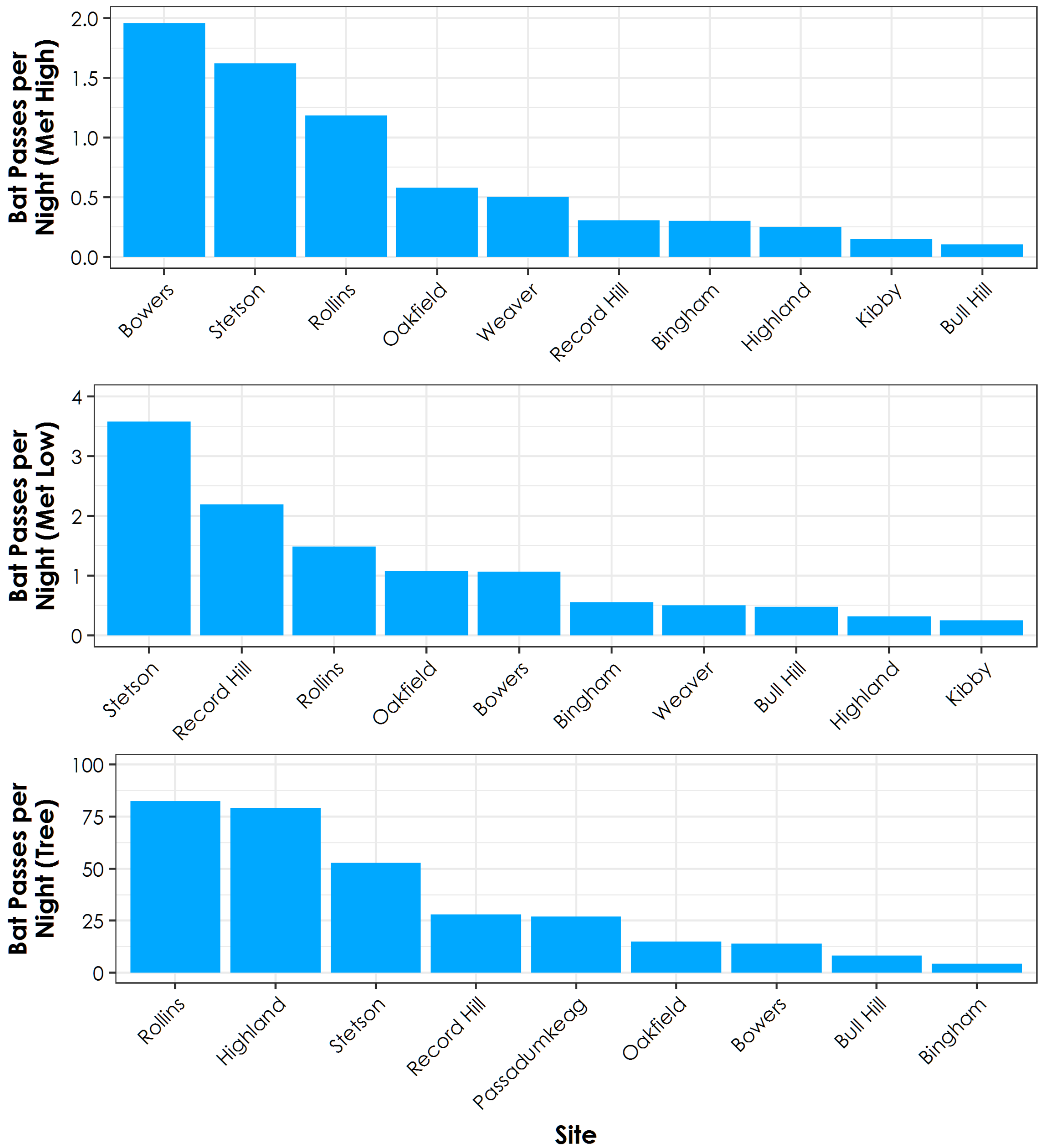


Figure 3-4. Mean number of bat passes per detector night by detector type from pre-construction surveys at Maine wind projects (proposed and existing). Note the varying y-axis scale for each detector type and the differing detector heights among the 12 sites.

3.2 POST-CONSTRUCTION MORTALITY ESTIMATES

Bird and bat mortality estimates are based on standardized counts of carcasses found by trained observers walking regularly spaced transects within the cleared turbine pad. Because the number of days between turbine searches (search interval), the size of searchable area, the ability of searchers to see carcasses (searcher efficiency), and the rate at which carcasses are removed by scavengers (scavenging rate) vary among sites and years, the total number of carcasses is adjusted upwards by correction factors to generate a cumulative, per-turbine estimate representing the entire survey period (usually encompassing spring, summer, and fall).

Several methods exist to adjust estimates based on search interval, searcher efficiency, carcass removal, and search area. The most commonly applied methods in Maine have been the "Huso" estimator (Huso 2010, Huso et al. 2012), the "Jain" estimator (Jain et al. 2009), and the "Shoenfeld" estimator (Shoenfeld 2004). Each of these estimators results in an annual per-turbine estimate (separate for birds and bats) and associated confidence intervals, although the methods have different biases and would not yield the same results if used on the same dataset. Although this introduces a source of variation when comparing mortality rates, we did not have access to the raw data necessary to recalculate mortality estimates using a common estimator. Our analyses are, therefore, based on reported estimates. In cases where multiple estimates exist, based on different search intervals or estimators, we calculated mean estimated values.

Bird and bat mortality rates have been estimated for 11 operating wind projects in Maine. Estimates of bat and bird mortality rates and associated confidence intervals varied widely among sites and among years for individual sites. Mean annual bat mortality estimates ranged from 0.12 to 2.95 bats/MW (mean = 0.76;

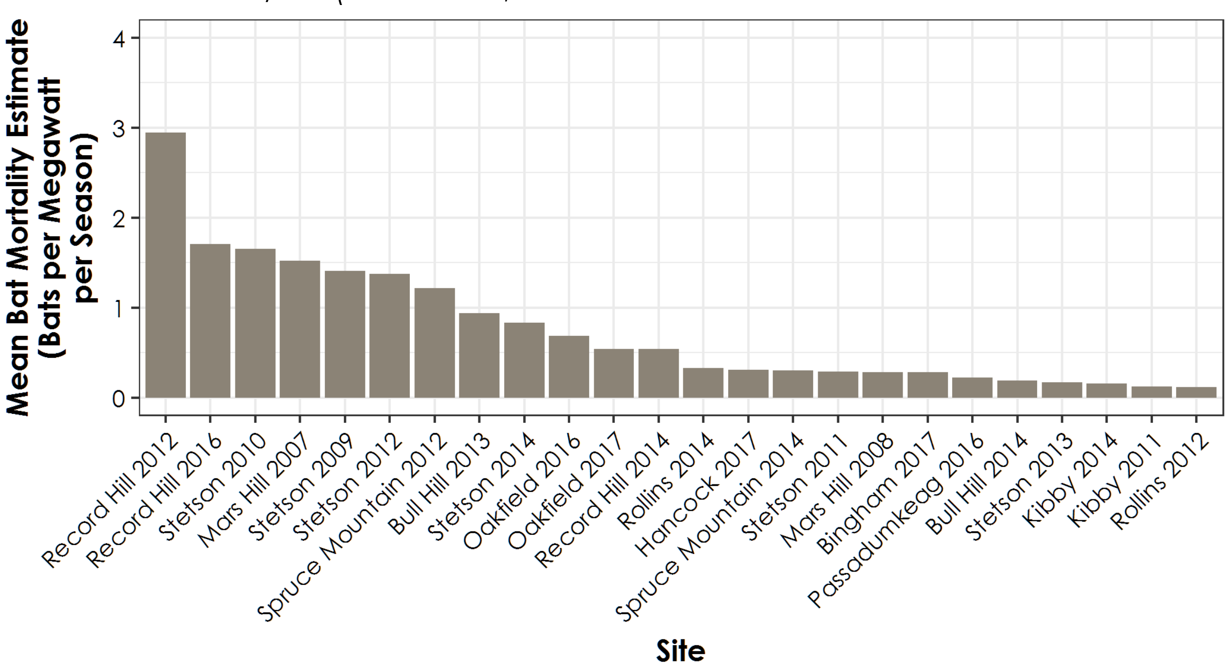


Figure 3-5) and estimated annual bird mortality ranged from 0.54 to 6.95 birds/MW (mean = 2.78; Figure 3-6) per site. Of the 11 sites from which mortality estimates were available, 5 sites (Bingham, Bull Hill, Hancock, Oakfield, and Passadumkeag) were implementing feathering below an increased cut-in speeds ranging from 5.0 to 6.0 m/s during certain times of year and the remaining 6 sites were operating turbines according to manufactured standard cut-in speed. Appendix C contains site-level post-construction bird and bat estimates on which the plotted mean values were based.

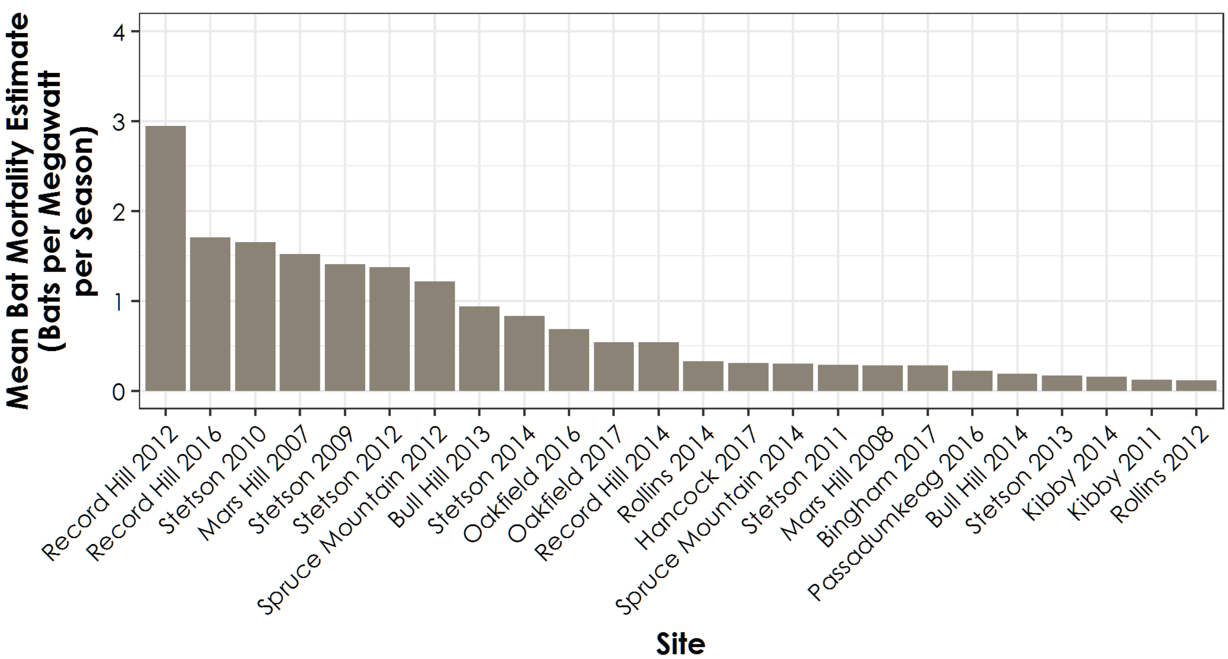


Figure 3-5. Mean bat mortality estimates by year from Maine wind projects by year.

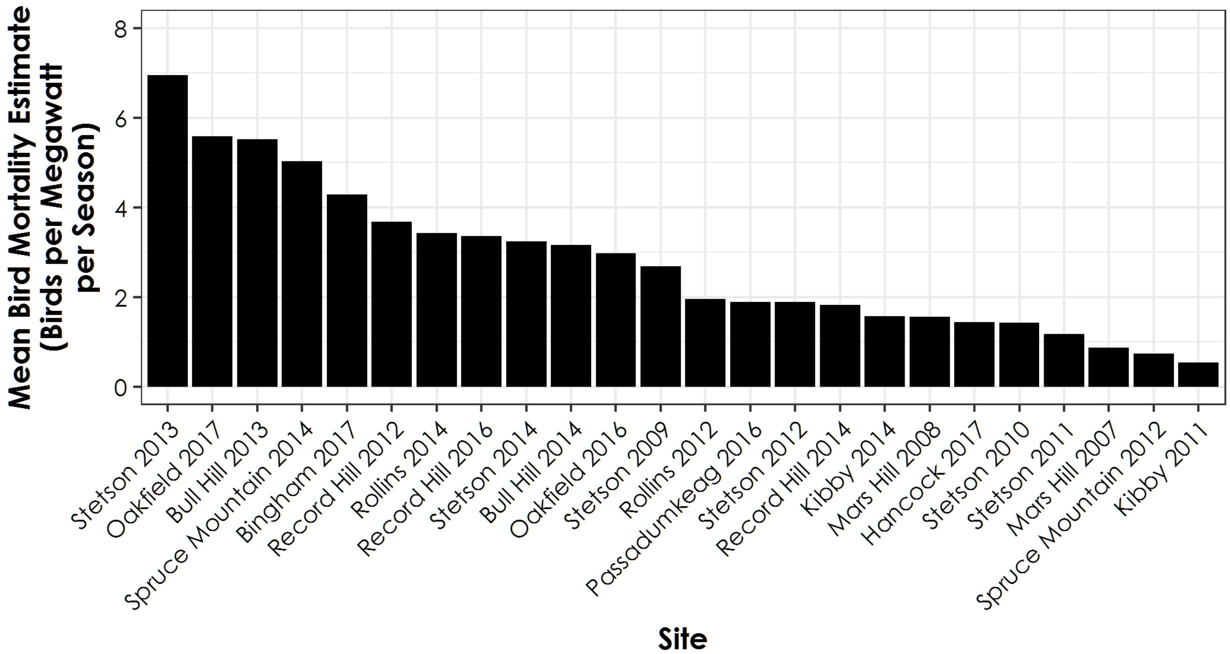


Figure 3-6. Mean bird mortality estimates by year from Maine wind projects.

3.3 COMPARING PRE-CONSTRUCTION AND POST-CONSTRUCTION RESULTS

Paired pre-construction survey results and post-construction mortality estimates were available for 10 sites in Maine.

3.3.1 Radar Surveys

Estimated bat mortality rates (adjusted to account for variable survey periods) showed no apparent trends with pre-construction radar passage rates (Figure 3-7) or the percent of radar targets below turbine height (Figure 3-8)). Linear models comparing estimated bat mortality versus pre-construction radar data indicated that no significant relationships existed between these variables at the site level whether analyses were done using overall averages or annual mortality data (Appendix D Figures 1 and 2). Shown are figures that include 5 sites using curtailment (Bingham, Bull Hill, Hancock, Oakfield, and Passadumkeag); excluding these sites did not affect the results of the analysis. Some of the highest radar passage rates were associated with the lowest estimated mortality rates, contributing to a low correlation coefficient (R^2) and non-significant *P*-value (see equations inset in Appendix D figures).

Comparisons of radar passage rates with bird mortality at the site level using annual mortality estimates suggested a slight trend towards higher mortality rates at sites with higher passage rates (Figure 3-9). Although linear regression suggested a slight positive correlation, this relationship was not statistically significant whether using annual or site-level average mortality estimates (Appendix D Figure 3). Sites with higher estimated rates of bird mortality appeared to also have higher percentages of radar targets below turbine height in pre-construction surveys (Figure 3-10), although linear regression indicated that this trend was marginally significant only when using site-level annual estimates (Appendix D Figure 4).

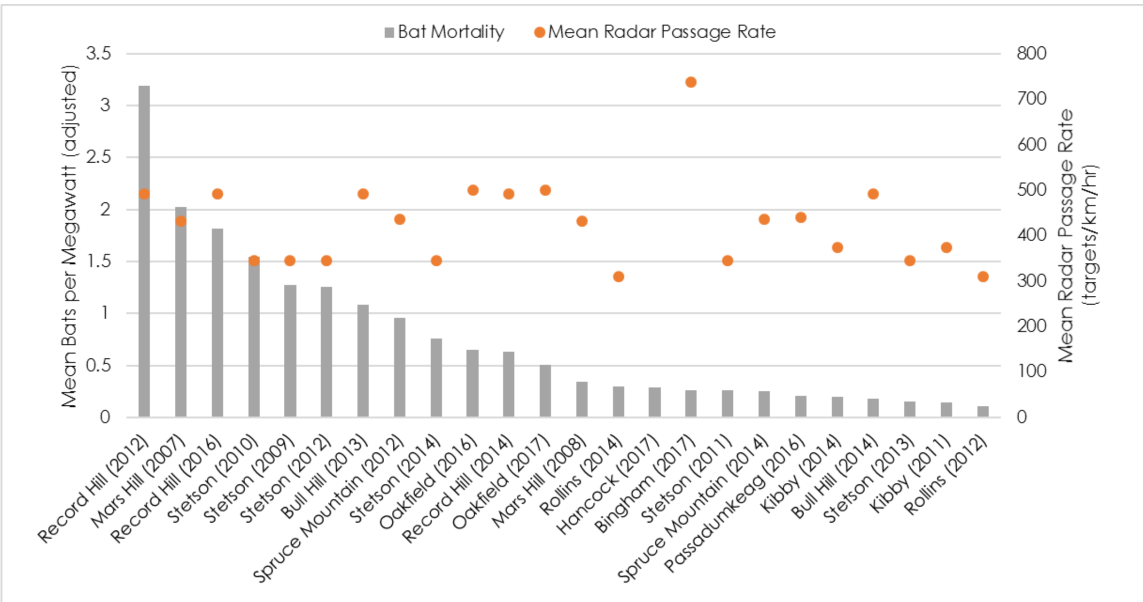


Figure 3-7. Mean adjusted annual bat mortality rates (gray columns) plotted with radar passage rate (orange dots) for commercial wind projects in Maine.

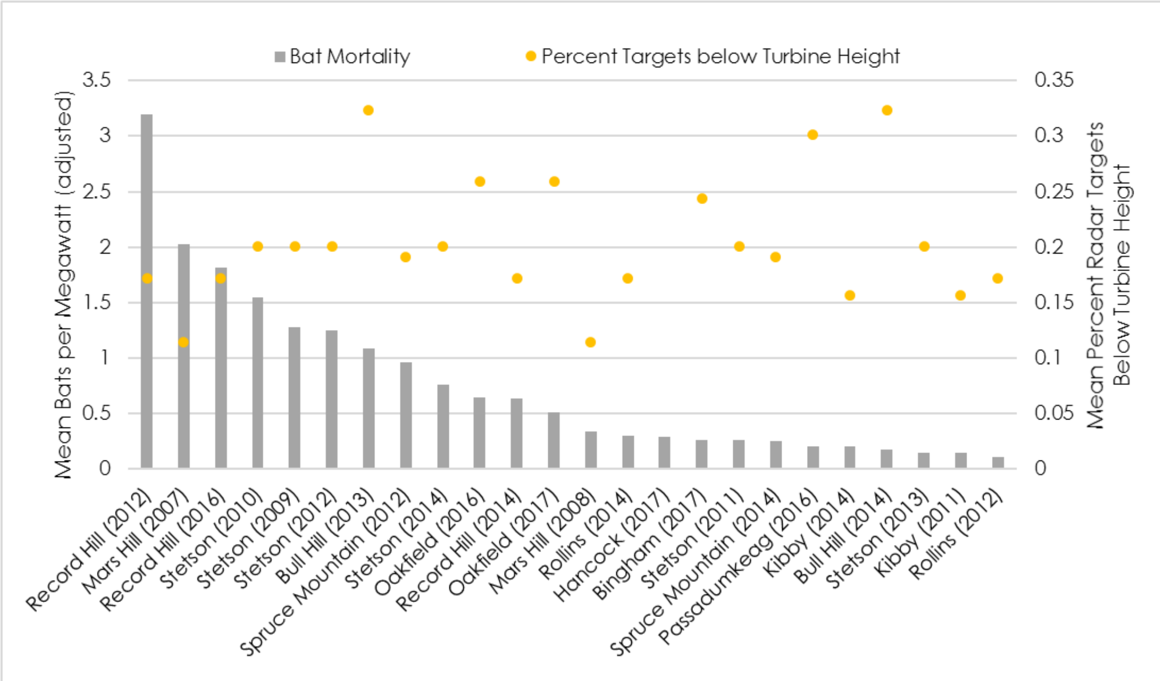


Figure 3-8. Mean adjusted annual bat mortality rates (gray columns) plotted with percent radar targets below turbine height (yellow dots) for commercial wind projects in Maine.

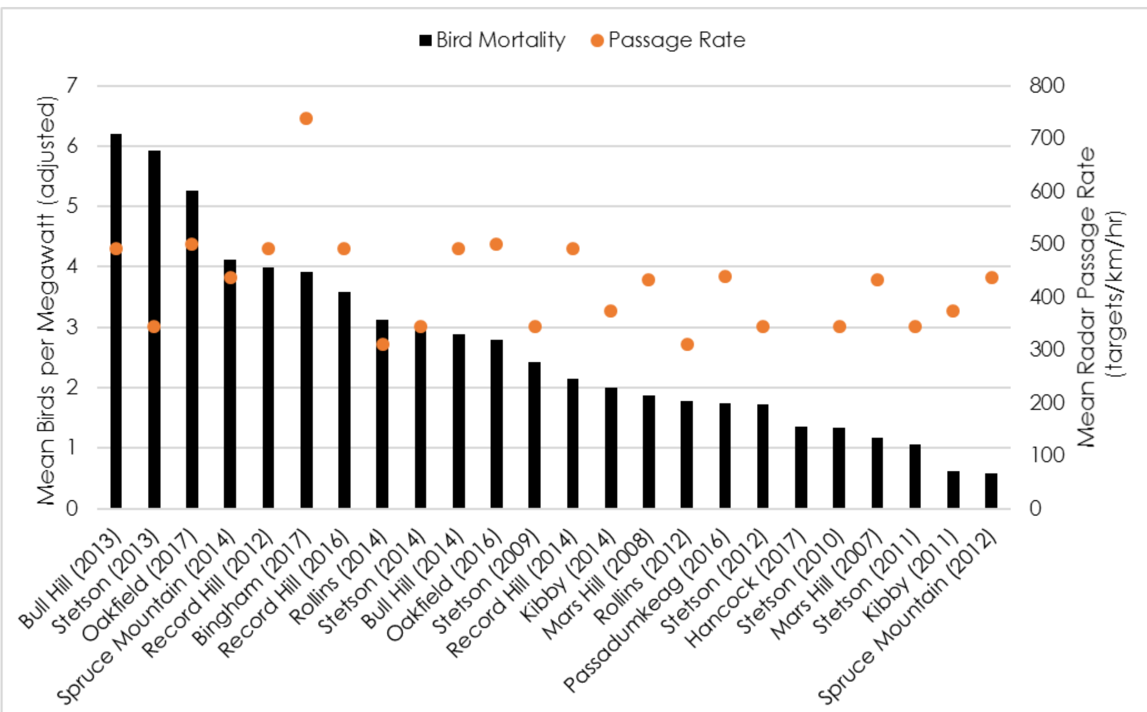


Figure 3-9. Mean adjusted annual bird mortality rates (black columns) plotted with radar passage rate (orange dots) for commercial wind projects in Maine.

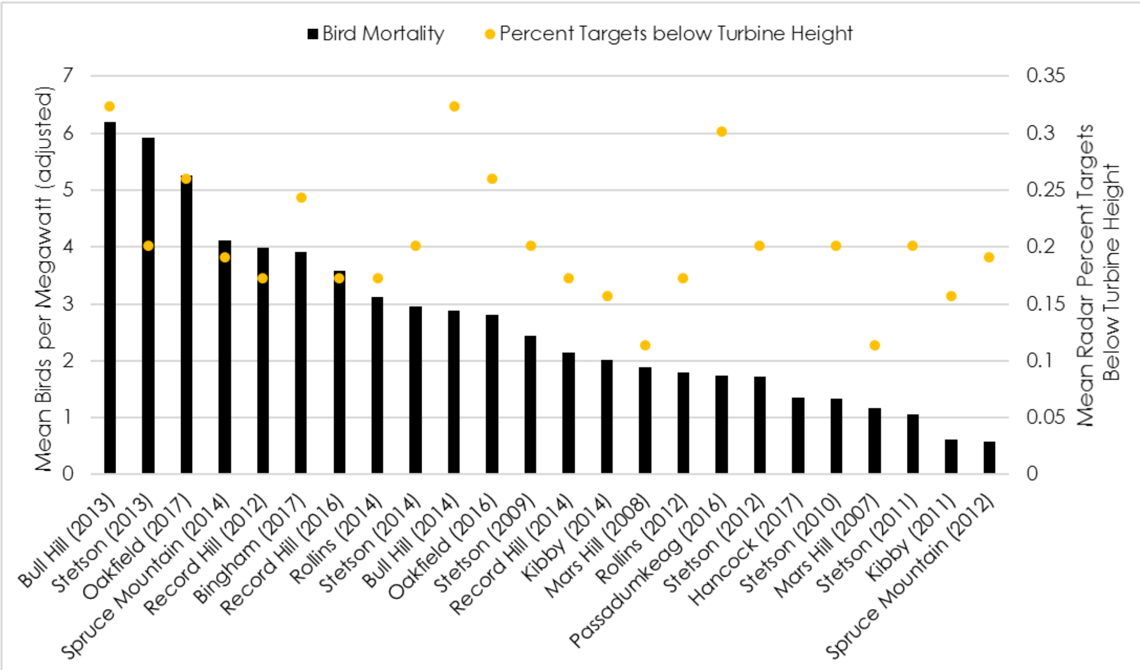


Figure 3-10. Mean adjusted annual bird mortality rates (black columns) plotted with percent radar targets below turbine height (yellow dots) for commercial wind projects in Maine.

3.3.2 Acoustic Surveys

Pre-construction bat acoustic activity rates, whether measured at Met High, Met Low, or Tree detectors, showed no discernable relationship with post-construction bat mortality estimates (Figure 3-11). Linear regression of bat mortality estimates as a function of pre-construction bat activity based on annual data (Appendix D Figure 5) or site-level averages (Appendix D Figure 6) also demonstrated no consistent or statistically significant relationships. As with radar data, the results were similar whether including or excluding the 5 sites implementing curtailment.

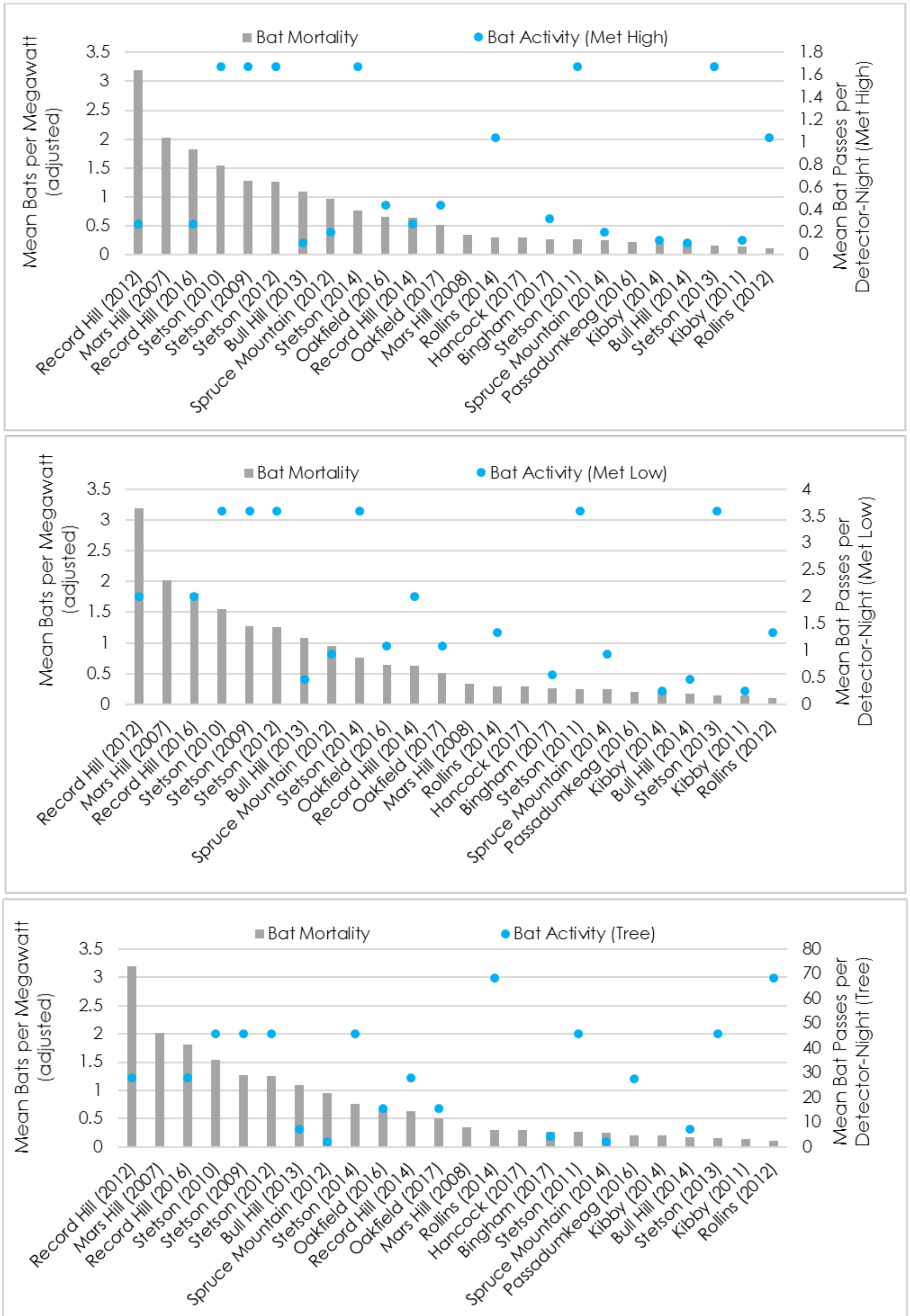


Figure 3-11. Mean adjusted annual bat mortality rates (gray columns) plotted with acoustic bat activity levels (blue dots) by detector type for commercial wind projects in Maine. Note different secondary y-axis scales for each detector type.

3.3.3 Raptor Surveys

Although raptors are abundant, raptor mortality at wind projects in Maine has been infrequent, preventing calculation of raptor mortality rates and a comparison to pre-construction raptor survey results.

In summary, only one pair of pre-construction and post-construction data had a statistically significant relationship (percent of radar targets below turbine height was positively correlated with estimated bird mortality rates), whether analyzed at the site level or using annual mortality estimates. Considered together, statistical analyses based on both bird and bat pre-construction surveys demonstrate weak relationships (dots in scatterplots do not fall close to a line) and inconsistent relationships (slopes of linear regressions were not all positive or negative). Although only 10 datapoints were available for site-level analyses after combining survey years, 10 points could sufficiently demonstrate a linear relationship where a strong relationship is present.

3.4 REGIONAL MORTALITY PATTERNS

To provide context for the Maine results, Stantec also compiled 132 empirical bat and bird mortality estimates from 46 wind projects in the Northeast to identify consistency or variation. After removing results from sites with curtailment, as explained above, the dataset included 75 mortality studies conducted at 37 total sites; including 17 studies at 6 sites in Maine, 6 studies at 3 sites in New Hampshire, 22 studies at 12 sites in New York, 24 studies at 12 sites in Pennsylvania, and 6 studies at 4 sites in West Virginia (Appendix E).

Mean adjusted bat mortality rates summarized at the state level increased steadily from a low in Maine (mean = 0.9 bats/MW) to a high in West Virginia (mean = 17.3 bats/MW). Bird mortality rates, on the other hand, were less variable among states, ranging from 1.4 birds/MW in Pennsylvania to 3.1 birds/MW in West Virginia (Figure 3-12).

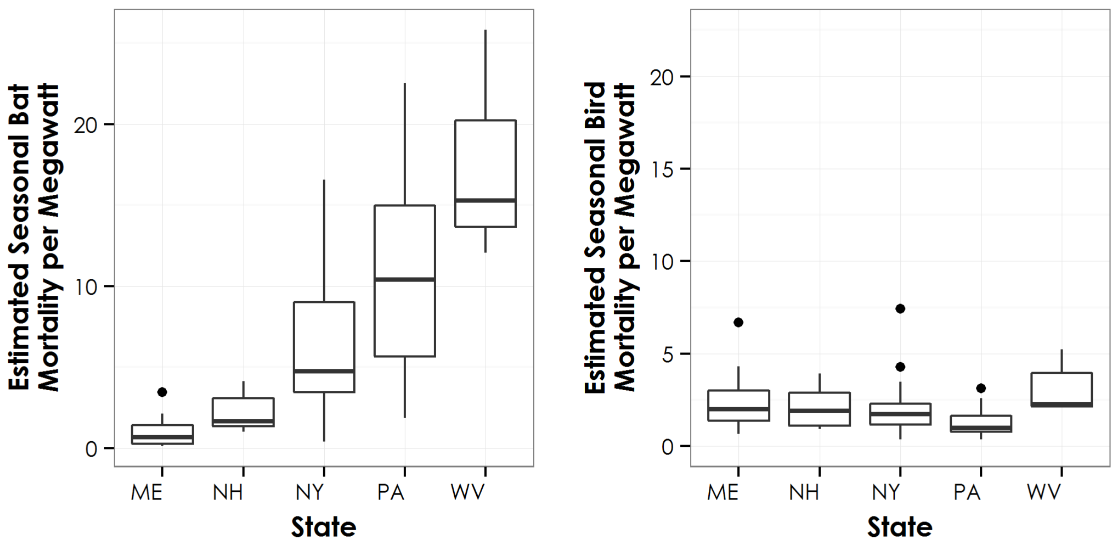


Figure 3-12. Bat (left) and bird (right) mortality estimates from publicly available post-construction studies at commercial wind farms operating without curtailment in the Northeast.

4.0 DISCUSSION

Predicting bird and bat mortality rates based on pre-construction bird and bat activity levels requires a strong link between presence/abundance of birds and bats with the magnitude of mortality. Overall, despite weak positive relationships between bird mortality rates and pre-construction radar survey results, the data from Maine fails to support such a link. Although only 10 paired pre-construction and post-construction datasets exist in Maine (corresponding to the 10 projects for which mortality estimates and pre-construction data are publicly available), the sample size would be sufficient where a strong and consistent relationship would exist between any paired variables. Because we tested each paired dataset using mortality estimates averaged at the site level (which reduces some of the scatter among years) and treating annual mortality estimates from each site as independent datapoints, our analysis was comprehensive yet straightforward. Of all relationships we tested, only the relationship between the percent of targets below turbine height was positively correlated with bird mortality rates when using annual data.

Overall, bird and bat mortality rates at Maine wind projects showed no consistent relationship to bird and bat activity levels measured before construction. Whether based on mean mortality estimates per site (averaged over multiple years at a site) or separate annual estimates, variation in pre-construction bird and bat activity explained little if any of the variation in mortality rates. The correlation coefficients for linear regressions (labeled as R^2 in figures in Appendix D), which indicates the strength of the relationship between two variables and typically ranges from 0 (indicating no relationship) to 1 (indicating a very strong relationship), was less than or equal to 0.3 in all relationships we tested. This indicates that variation in pre-construction bird and bat activity explained less than 30% of the variation in mortality rates among sites. In other words, variation in mortality attributable to variation in pre-construction data could not be distinguished from random variation. The 4 raptor mortalities documented in 23 publicly available Maine post-construction studies involving more than 13,000 turbine searches indicates low magnitude of risk to raptors even at sites with higher pre-construction raptor activity levels.

The lack of strong correlations between pre-construction and post-construction surveys is not unique to Maine. A recently published study comparing rankings of perceived pre-construction risk to bats and post-construction mortality rates from 29 European wind projects documented a marginally significant relationship and concluded that the substantial effort and cost associated with pre-construction assessments was largely unjustified by their analyses (Lintott et al. 2016). Similarly, a study comparing pre-construction raptor abundance at 20 wind projects in Spain documented significant differences among sites in terms of predicted risk but found no relationship between pre-construction bird activity and post-construction mortality rates (Ferrer et al. 2012). Analysis of results from 12 North American wind projects with pre-construction and post-construction data documented a weak positive relationship between bat activity and bat mortality, although the relationship explained only a small portion of variation in mortality (Hein et al. 2013). The Pennsylvania Game Commission concluded that raptor abundance measured pre-construction at 12 wind farms in Pennsylvania showed no correlation with post-construction mortality rates and indicated that data from the same 12 wind farms with paired data were insufficient for establishing relationships between pre-construction bat activity and bat mortality rates (Taucher et al. 2012). This study further detected no correlation between raptor activity and mortality rates measured concurrently based on post-construction raptor activity surveys.

Several factors could explain the lack of correlation between pre-construction bird and bat activity and mortality rates at wind farms in Maine and elsewhere. Pre-construction metrics do not necessarily reflect the abundance of birds and bats in an area. For example, acoustic bat surveys cannot distinguish individual bats or determine whether individuals are detected more than once (Hayes 1997) and radar cannot reliably and consistently differentiate between individual species or even birds from bats. In addition to characteristics of the data themselves, numerous factors beyond the abundance of birds and bats may affect mortality rates observed at wind projects including turbine characteristics (e.g., height, size of rotor-swept area, lighting arrangements, algorithms controlling turbine operation and startup/shutdown conditions), site conditions (e.g., topography, elevation, habitat types), or behavioral processes (e.g., attraction, avoidance, migratory strategies, species-specific risk factors)(Marques et al. 2014; Cryan and Barclay 2009; Kunz et al. 2007). The presence of the turbines themselves may further manipulate the distribution and behavior of birds and bats, affecting the predictive power of pre-construction surveys.

Since current pre-construction measures of bird and bat activity are not strong predictors of risk, factors such as weather conditions (e.g., temperature and wind speed), the presence of lighting, and details of turbine operation (which can be modified through curtailment) appear to have greater influence on mortality rates.

It is important to evaluate the data in the context of a broader region when evaluating whether the observed variation in mortality, both among Maine wind projects and in total, is ecologically significant. The difference between the highest and lowest bat mortality estimates in Maine was 3.3 bats/MW (based on site-level average adjusted mortality estimates for sites without curtailment). To put that in a regional context, the highest adjusted annual bat mortality rate documented at any Maine project was lower than the statewide average bat mortality rate for West Virginia, Pennsylvania, and New York. Statewide bat mortality estimates diminish steadily northward from West Virginia to Maine and is likely tied to regional abundance and extended periods of activity in more southern areas. Although this trend has been noted previously, there have been no clear associations between mortality rates and landscape or habitat features in the Northeast (Hein and Schirmacher 2016).

The same geographic trend was not apparent for birds. Mean bird mortality rates and ranges among projects in each state were similar in Northeast states. Comparing mortality rates among states compounds issues related to survey methods, as states often recommend varying levels of effort or use of different mortality estimators (Arnett et al. 2013). Nevertheless, the distinct trend observed for bat mortality estimates among 5 northeastern states is noteworthy, particularly because no such trend existed for bird mortality. Since bird and bat mortality estimates are almost always generated in pairs using the same search and analysis methods, the contrast between the trends is strengthened.

Despite the growing number of paired pre- and post-construction datasets across regions, efforts to link these datasets have not revealed strong relationships. The lack of a clear and consistent relationship between the pre-construction bird and bat activity and mortality rates in our results as well as those of other studies in the U.S. and abroad warrants a re-evaluation of how pre-construction survey data are used in project siting decisions.

Approaching project siting with the idea of differentiating "high" and "low" risk sites based on pre-construction bird and bat activity levels may fail to accomplish the stated goals of avoiding and reducing risk. Our understanding of the factors influencing mortality patterns suggest that risk to birds and bats is dynamic, and is influenced by a variety of seasonal, site-specific, behavioral, and conditions-based factors. Additionally, the relationship between activity and risk may vary dramatically between these two very different taxa and is likely governed by numerous interacting factors. If our current methods do not provide a meaningful tool for evaluating collision risk, more meaningful data may be collected through alternative methods.

Diverting resources away from pre-construction metrics that have shown little utility in predicting bird and bat mortality (e.g., raptor migration surveys, tree-level bat acoustic surveys, extensive radar surveys) and towards efforts to better identify high risk conditions or develop mitigation (e.g., nacelle-mounted acoustic surveys to document wind speed and temperature conditions during which bats are present in the rotor zone; correlate weather conditions with avian mortality; clean up roadkill to reduce vehicle collisions with raptors and eagles; gate known hibernacula; provide research funding for MDIFW or others to mist net for bats and find maternity roosts) would help wind developers and resource agencies better predict and manage impacts. Comparing the extent of high-risk conditions among potential projects would be far more effective at reducing mortality than knowing that pre-construction bat activity was 50% higher at one site versus another. Accurate characterization of high-risk conditions would in turn enable predictions of how frequently such conditions occur and the cost and effectiveness of appropriate management actions.

Although typical pre-construction survey methods do not predict the magnitude of turbine-related impacts, methods could be revised to focus not only on habitat-related impacts but also determining the relative frequency of high-risk conditions linked to bird and bat mortality. This approach would provide a more comprehensive understanding of the types of impacts expected for a proposed project and could help project developers evaluate and design site-specific adaptive management measures (e.g., threshold wind speeds, temperatures, and seasons where curtailment would be most effective at reducing bat mortality while minimizing the cost of lost power generation). Traditional meteorological measurements and GIS-based landscape/habitat analyses could play a far greater role in such assessments, supplemented by field surveys to document rare species presence and/or sensitive habitats that could be affected by construction of the projects.

True adaptive management requires a better understanding of not only the relationship between risk and conditions but also the efficacy of varying levels of operational management, which could be achieved through simultaneous comparison of multiple management strategies. Ultimately, the cost of operational management actions could be reduced and effectiveness improved if such measures are focused on the demonstrated periods of highest risk.

5.0 REFERENCES

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, and R. D. Tankersley, Jr. 2008. Patterns in bat fatalities at wind energy facilities in North America. The Journal of Wildlife Management 72(1): 61–78.

Arnett, E. B., G. D. Johnson, W. P. Erickson, and C.D. Hein. 2013. A synthesis of operational mitigation studies to reduce bat fatalities in North America. Report prepared for the National Renewable Energy Laboratory, Golden, CO.

Cryan, P. M., and R. M. R. Barclay. 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. Journal of Mammalogy 90(6): 1330 – 1340.

Ferrer, M., M. de Lucas, G. F. E. Janss, E. Casado, A. R. Muñoz, M. J. Bechard, and C. P. Calabuig. 2012. Weak relationship between risk assessment studies and recorded mortality in wind farms. Journal of Applied Ecology 49(1):38 – 46.

Hayes, J. P. 1997. Temporal variation in activity of bats and the design of echolocation-monitoring studies. Journal of Mammalogy 78:514-524.

Hein, C. D. and M. Schirmacher. 2016. Impact of wind energy on bats: a summary of our current knowledge. Human-Wildlife Interactions 10(1):19 – 27.

Hein, C. D., J. Gruver, and E. B. Arnett. 2013. Relating pre-construction bat activity and post-construction bat fatality to predict risk at wind energy facilities: a synthesis. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International, Austin, TX, USA.

Huso, M. M. P. 2010. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics. Wiley Blackwell. DOI:10.1002/env.1052

Huso, M., N. Som, and L. Ladd. 2012. Fatality estimator user's guide: U.S. Geological Survey Data Series 729, 22 p.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.

Kunz, T. H., E. B. Arnett, B. M. Cooper, W. P. Erickson, R. P. Larkin, T. Mabee, M. L. Morrison, M. D. Strickland, and J. M. Szewczak. 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. Journal of Wildlife Management 71:2449-2486.

Lintott, P. R., S. M. Richardson, D. J. Hosken, S. A. Fensome, and F. Mathews. 2016. Ecological impact assessments fail to reduce risk of bat casualties at wind farms. Current Biology 26:R1135 – R1136.

Marques, A.T., H. Batalha, S. Rodrigues, H. Costa, M.J.R. Pereira, C. Fonseca, M. Mascarenhas, and J. Bernardino. 2014. Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies. Biological Conservation 179:40 – 52.

R Core Team. 2014. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Shoenfeld, P. 2004. Suggestions regarding avian mortality extrapolation. Technical memo provided to FPL Energy. Davis, WV, West Virginia Highlands Conservancy. 6 p.

Taucher, J., T. Librandi-Mumma, and W. Capouillez. 2012. Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement Third Summary Report.

U.S. Fish and Wildlife Service. 2012. Land-Based Wind Energy Guidelines. U.S. Fish and Wildlife Service, Washington, DC.

APPENDICES

Appendix A INVENTORY OF PRE- AND POST-CONSTRUCTION DATA

Appendix A Table 1. Inventory of pre-construction and post-construction data compiled for proposed and existing commercial wind projects in Maine.

Site (Region) Bold=pre and post data	Megawatts (# Turbines)	Year	Data (sample size)	Reference
Bingham (Western)	250 (119)	2010	• Bat acoustic data from Tree (n = 602 DN), Met High (n = 390 DN) and Met Low detectors (n = 517 DN) • Nocturnal radar data (n = 40 nights) • Raptor migration data (n = 19 days)	Stantec Consulting Services Inc. 2012. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind, LLC. Stantec Consulting Services Inc. 2012. Fall 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind, LLC.
		2011	• Nocturnal radar data (n = 12 nights)	Stantec Consulting Services Inc. 2012. Fall 2011 Radar Survey Results and Comparison to Fall 2010 Results at the Bingham Wind Project. Memo to Blue Sky East Wind, LLC.
		2017	• Mortality monitoring (33 turbines, survey period = 184 days, interval = 3-day, Huso, Shoenfeld, and Smallwood estimators).	TRC. 2017. Bingham Wind Project Post-construction Bird and Bat Fatality Monitoring Report Year 1 (2017).
Bowers (Central)	Proposed	2009	• Bat acoustic data from Tree detectors (n = 342 DN) • Nocturnal radar data (n = 22 nights) • Raptor migration data (n = 15 days)	Stantec Consulting Services Inc. 2010. Fall 2009 Avian and Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
		2010	• Bat acoustic data from Tree (n = 498 DN), Met High (n = 143 DN), and Met Low detectors (n = 143 DN) • Nocturnal radar data (n = 20 nights) • Raptor migration data (n = 12 days)	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy LLC.
Bull Hill (Coastal Plain)	34.2 (19)	2009	• Bat acoustic data from Tree (n = 426 DN), Met High (n = 94 DN), and Met Low detectors (n = 114 DN) • Nocturnal radar data (n = 20 nights) • Raptor migration data (n = 18 days)	Stantec Consulting Services Inc. 2010. Summer and Fall 2009 Avian and Bat Survey Report for the Bull Hill Project. Prepared for Blue Sky East Wind, LLC.
		2010	• Bat acoustic data from Tree (n = 307 DN), Met High (n = 81), and Met Low detectors (n = 79 DN) • Nocturnal radar data (n = 20 nights) • Raptor migration data (n = 25 days)	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bull Hill Wind Project. Prepared for Blue Sky East Wind LLC.
		2011	• Nocturnal radar data (n = 20 nights)	Stantec Consulting Services Inc. 2011. Fall 2011 Radar Survey Results and Comparison to Fall 2009 Radar Results: Memo for the Bull Hill Wind Project. Prepared for Blue Sky East Wind, LLC.
		2013	• Bat acoustic data from turbine base detectors (n = 102 DN) • Mortality data (19 turbines, survey period = 130 days (daily) & 177 days (weekly), interval = daily/weekly by season, Huso estimator)	Stantec Consulting Services Inc. 2014. Bull Hill Year 1 Post-Construction Wildlife Monitoring Report, 2013. Prepared for First Wind, LLC.
		2014	• Bat acoustic data from Tree (n = 217 DN) and turbine base detectors (n = 500 DN) • Mortality data (19 turbines, survey period = 184 days, interval = daily/3-day by season, Huso estimator & Shoenfeld estimator)	Stantec Consulting Services Inc. 2015. Bull Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Prepared for First Wind, LLC.

Site (Region) Bold=pre and post data	Megawatts (# Turbines)	Year	Data (sample size)	Reference
Hancock (Coastal Plain)	51 (17)	2012	• Raptor migration data (n = 10 days)	Stantec Consulting Services Inc. 2012. Results of Fall 2012 Raptor Surveys: Memo for the Hancock Wind Project. Prepared for First Wind, LLC.
		2017	• Mortality data (17 turbines, survey period = 180 days, interval = 3.5 days (twice weekly), Huso, Shoenfeld, and Smallwood estimators)	TRC. 2017. Hancock Wind Project Post-construction Bird and Bat Fatality Monitoring Report Year 1 (2017).
Highland (Western)	Proposed	2008	• Bat acoustic data from Tree (n = 146, Met High (n = 144 DN) and Met Low detectors (n = 142 DN) • Nocturnal radar data (n = 20 nights) • Raptor migration data (n = 15 days)	Stantec Consulting Services. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC.
		2009	• Bat acoustic data from Met High (n = 300 DN) and Met Low detectors (n = 254 DN) • Nocturnal radar data (n = 40 nights) • Raptor migration data (n = 15 days)	Stantec Consulting Services. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC.
Kibby (Western)	132 (44)	2005	• Nocturnal radar data (n = 24 nights)	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
		2006	• Bat acoustic data from Met High (n = 145 DN) and Met Low detectors (n = 126 DN) • Nocturnal radar data (n = 25 nights	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
		2011	• Mortality data (22 turbines, survey period = 146 days, interval ~5 days, Shoenfeld estimator)	Stantec Consulting Services Inc. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
		2014	• Mortality data (10 turbines, survey period = 122 days, interval = daily [5 days/week], Huso estimator)	TRC. 2015. Post-Construction Avian and Bat Mortality Survey Report for the Kibby Wind Power Project. Prepared for TransCanada Energy Ltd.
Mars Hill (Northern)	42 (28)	2005	• Nocturnal radar data (n = 18 nights) • Raptor migration data (n = 8 days)	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
		2006	• Nocturnal radar data (n = 15 nights) • Raptor migration data (n = 7 days)	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
		2007	• Mortality data (28 turbines, survey period = 113 days, interval = 2 daily/26 weekly, Jain estimator)	Stantec Consulting Services Inc. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC.
		2008	• Mortality data (28 turbines, survey period = 135 days, interval = weekly, Jain estimator)	Stantec Consulting Services Inc. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.

Site (Region) Bold=pre and post data	Megawatts (# Turbines)	Year	Data (sample size)	Reference
Number Nine (Northern)	Proposed	2014	• Nocturnal radar data (n = 40 nights)	Stantec Consulting Services Inc. 2015. 2014 Nocturnal Radar Survey Report. Prepared for Number Nine Wind Farm LLC.
Oakfield (Northern)	148 (48)	2007	• Bat acoustic data from Tree (n = 228 DN) and Met High detectors (n = 37 DN)	Stantec Consulting Services Inc. 2008. Fall 2007 Bat Migration Survey Report. Prepared for UPC Wind Management, LLC.
		2008	• Bat acoustic data from Tree (n = 278 DN), Met High (n = 148 DN), and Met Low detectors (n = 141 DN) • Nocturnal radar data (n = 40 nights) • Raptor migration data (n = 23 days)	Stantec Consulting Services Inc. 2009. Spring and Summer 2008 Bird and Bat Migration Survey Report: Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for First Wind Management, LLC.
		2016	• Mortality data (29 turbines, survey period = 179 days, interval = 3 days, Huso, Shoenfield, Smallwood estimators)	Stantec Consulting Services Inc. 2016. Year 1 Post Construction Bird and Bat Fatality Monitoring Report.
		2017	• Mortality data (29 turbines, survey period = 179 days, interval = 2 days, Huso, Shoenfeld, Smallwood estimators)	TRC. 2017. Oakfield Wind Project Post-construction Bird and Bat Fatality Monitoring Report Year 2 (2017)
Passadumkeag (Central)	40 (13)	2011	• Bat acoustic data from Tree detectors (n = 691 DN) • Nocturnal radar data (n = 40 nights) • Raptor migration data (n = 24 days)	Stantec Consulting Services Inc. 2011. Summer and Fall 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Record Hill (Western)	50.6 (22)	2007	• Bat acoustic data from Tree (n = 43 DN), Met High (n = 90 DN), and Met Low detectors (n = 107 DN) • Nocturnal radar data (n = 40 nights) • Raptor migration data (n = 14 days)	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
		2008	• Bat acoustic data from Tree (n = 41 DN), Met High (n = 90 DN), and Met Low detectors (n = 84 DN) • Raptor migration data (n = 15 days)	Stantec Consulting Services Inc. 2008. Spring 2009 Bird and Bat Migration Survey Report: Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project, Roxbury, Maine. Prepared for Record Hill Wind, LLC.
		2012	• Bat acoustic data from Tree detectors (n = 639 DN) • Raptor migration data (n = 23 days) • Mortality data (22 turbines, survey period = 155 days, interval ~ 5 days, Huso estimator)	Stantec Consulting Services Inc. 2012. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.
		2014	• Raptor migration data (n = 35 days) • Mortality data (10 turbines, survey period = 139 days, interval = daily [5 days/week], Huso estimator)	Stantec Consulting Services Inc. 2015. Record Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report. Prepared for Record Hill Wind, LLC.
		2016	• Mortality data (10 turbines, survey period = 158 days, interval = daily [5 days/week], Huso estimator & Smallwood estimator)	Stantec Consulting Services Inc. 2017. Final Post-Construction Monitoring Report, Year 3, Record Hill Wind Project. Prepared for Record Hill Wind LLC and Wagner Forest Management, Ltd.
Rollins (Central)	60 (40)	2007	• Bat acoustic data from Tree (n = 274 DN), Met High (n = 95 DN), and Met Low detectors (n = 106 DN) • Nocturnal radar data (n = 21 nights) • Raptor migration data (n = 12 days)	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind Management, LLC.
		2008	• Bat acoustic data from Tree (n = 50 DN), Met High (n = 128 DN), and Met Low detectors (n = 99 DN) • Nocturnal radar data (n = 21 nights) • Raptor migration data (n = 15 days)	Stantec Consulting Services Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind Management, LLC.

Site (Region) Bold=pre and post data	Megawatts (# Turbines)	Year	Data (sample size)	Reference
		2012	• Raptor migration data (n = 38 days) • Mortality data (20 turbines, survey period = 184 days, interval = weekly, Huso estimator)	Stantec Consulting Services Inc. 2012. Rollins Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
		2013	• Raptor migration data (n = 25 days)	Stantec Consulting Services Inc. 2014. Rollins Wind Project Year 2 Post-Construction Eagle Monitoring Report. Prepared for First Wind, LLC.
		2014	• Mortality data (20 turbines, survey period = 184 days, interval = weekly, Huso estimator)	Stantec Consulting Services Inc. 2015. Rollins Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Prepared for First Wind, LLC.
Spruce Mountain (Western)	20 (10)	2009	• Raptor migration data (n = 21 days) • Nocturnal radar data (n = 93 nights) • Bat acoustic data from Met High (n = 157 DN), Met Low (n = 157 DN), and Tree detectors (n = 157 DN)	TetraTech. 2009. Spring 2009 – Bird and Bat Biological Survey Report. Prepared for Patriot Renewables.
		2012	• Mortality data (10 turbines, survey period = 205 days, interval = weekly, Huso estimator)	TetraTech. 2013. Spruce Mountain Wind Project Post-construction Bird and Bat Fatality and Raptor Monitoring Year 1 Annual Report. Prepared for Patriot Renewables.
		2014	• Mortality data (10 turbines, survey period = 199 days, interval =2x/week, Huso estimator)	TetraTech. 2015. Spruce Mountain Wind Project Post-construction Bird and Bat Fatality and Raptor Monitoring 2014. Prepared for Patriot Renewables.
Stetson I & II (Central)	82.5 (55)	2006	• Bat acoustic data from Met High (n = 149 DN) and Met Low detectors (n = 212 DN) • Nocturnal radar data (n = 12 nights) • Raptor migration data (n = 6 days)	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
		2007	• Bat acoustic data from Met High detectors (n = 160 DN) • Nocturnal radar data (n = 21 nights) • Raptor migration data (n = 8 days)	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
		2009	• Bat acoustic data from Tree detectors (n = 407 DN) • Nocturnal radar data (n = 18 DN) • Raptor migration data (n = 12 days) • Mortality data (19 Stetson I turbines, survey period = 185 days, interval = weekly, Huso estimator)	Stantec Consulting Services Inc. 2010. Stetson I Mountain Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
		2010	• Mortality data (17 Stetson II turbines, survey period = 180 days, interval = weekly, Jain estimator)	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
		2011	• Mortality data (19 Stetson I turbines, survey period = 187 days, interval = weekly, Huso estimator)	Normandeau Associates. 2010. Year 3 Post-construction avian and bat casualty monitoring at the Stetson I Wind Farm. Prepared for First Wind, LLC.
		2012	• Mortality data (17 Stetson II turbines, survey period = 184 days, interval = weekly, Huso estimator)	Stantec Consulting Services Inc. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.

Site (Region) **Bold=pre and post data**	Megawatts (# Turbines)	Year	Data (sample size)	Reference
		2013	• Mortality data (19 Stetson I turbines, survey period = 194 days, interval = weekly, Huso estimator)	Stantec Consulting Services Inc. 2014. Stetson I Wind Project 2013 Post-Construction Wildlife Monitoring Report, Year 5. Prepared for First Wind, LLC.
		2014	• Mortality data (17 Stetson II turbines, survey period = 184 days, interval = weekly, Huso estimator)	Stantec Consulting Services Inc. 2015. Stetson II Wind Project Year 3 Post-Construction Monitoring Report, 2014. Prepared for First Wind, LLC.
Weaver (Coastal Plain)	Proposed	2013	• Bat acoustic data from Met High (n = 325 DN) and Met Low detectors (n = 341 DN) • Raptor migration data (n = 8 days)	Stantec Consulting Services Inc. 2014. 2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project. Prepared for First Wind, LLC.
		2014	• Nocturnal radar data (n = 40 nights) • Raptor migration data (n = 19 days)	Stantec Consulting Services Inc. 2014. 2014 Pre-Construction Avian and Bat Surveys – Weaver Wind Project. Prepared for First Wind, LLC.

Appendix B PRE-CONSTRUCTION BIRD AND BAT ACTIVITY METRICS

Appendix B Table 1. Pre-construction bird and bat activity metrics derived from publicly available pre-construction survey data from Maine wind projects.

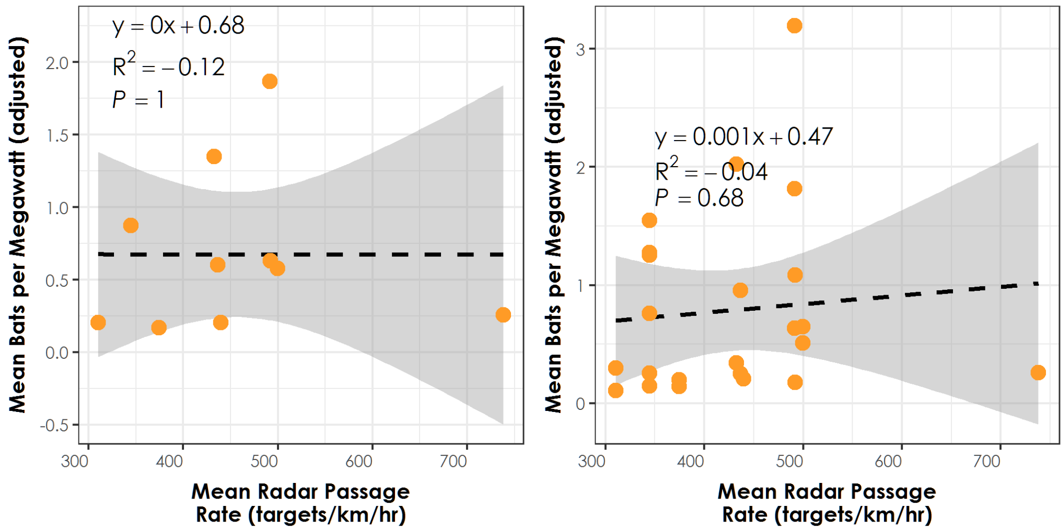
Site Name	Maine Region	Radar Passage Rate		Radar Passage Below Turbine Height		Acoustic Bat Activity						Raptor Passage Rate
						Met High		Met Low		Tree		
		Mean	SD	Mean	SD	Rate	SD	Rate	SD	Rate	SD	
Bingham	Western	738.3	488.6	0.24	0.14	0.32	0.62	0.54	0.75	4.31	7.76	9.2
Highland	Western	524.4	393.4	0.16	0.14	0.29	0.98	0.35	0.61	54.05	64.68	18.7
Kibby	Western	374.7	347.9	0.17	0.16	0.13	0.41	0.25	1.18	--		--
Record Hill	Western	491.4	301.0	0.17	0.12	0.27	0.74	2.01	6.48	28.02	41.53	7.1
Spruce Mountain	Western	436.4	421.7	0.19	0.09	0.20	--	0.94	--	2.04	--	
Bowers	Central	322.5	183.1	0.24	0.16	1.96	5.26	1.06	2.33	14.8		8.4
Passadumkeag	Central	439.6	450.9	0.30	0.19	--	--	--	--	27.37	51.73	9.9
Rollins	Central	310.5	225.4	0.17	0.10	1.04	4.07	1.33	5.42	68.45	176.37	7.4
Stetson	Central	344.7	316.5	0.20	0.22	1.68	4.09	3.60	5.47	45.77	91.57	7.7
Bull Hill	Coastal Plain	491.9	302.4	0.32	0.20	0.10	0.40	0.48	1.11	7.05	11.93	8.0
Weaver	Coastal Plain	746.2	440.5	0.33	0.17	0.49	1.00	0.48	1.29	--		9.7
Mars Hill	Northern	432.6	288.0	0.11	0.10	--	--	--	--	--	--	
Number Nine	Northern	323.7	240.6	0.27	0.10	--	--	--	--	--	--	
Oakfield	Northern	499.5	226.0	0.3	0.14	0.44	1.84	1.09	2.20	15.46	48.07	5.1

Appendix C POST-CONSTRUCTION BIRD AND BAT MORTALITY ESTIMATES

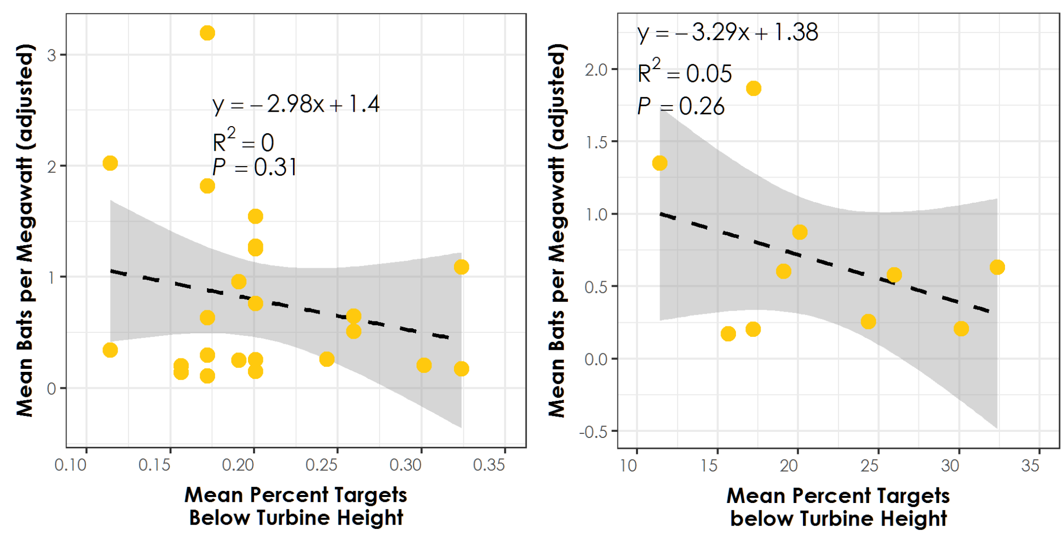
Appendix C Table 1. Post-construction bird and bat mortality estimates and project characteristics used to generate site-level mortality metrics for Maine wind projects.

Site	Region	Year	Curtailment	Survey Period Length (Days)	Search Interval	Searcher	Estimator	Turbine Specification (MW)	Estimated Bat Mortality per Turbine	Estimated Bird Mortality per Turbine
Bingham	Western	2017	6.0 m/s (April 20 – October 15)	184	3-day	human	Huso Shoenfeld Smallwood	3.3	0.74 (0.44 – 4.72) 0.32 (0.22 – 1.76) 1.73 (1.73 – 6.92)	11.43 (6.58 – 20.58) 5.98 (3.52 – 10.54) 25.09 (16.44 – 36.34)
Bull Hill	Coastal Plain	2013	5.0 m/s (June 15 – October 15 at 10 turbines; 9 control)	130	daily	human	Huso	1.8	2.5 (1.6 – 4.0)	12.1 (7.3 – 19.5)
				177	weekly	human	Huso		0.9 (0.7 – 1.4)	7.7 (4.8 – 13.2)
		2014	5.0 m/s (July 1 – Sept 30 at 19 turbines)	184	3-day	human	Huso		0.4 (0.1 – 1.1)	6.3 (4.3 – 10.4)
				184	weekly	human	Shoenfeld		0.3 (0.1 – 0.6)	5.1 (2.8 – 8.4)
Hancock	Coastal Plain	2017	6.0 m/s (April 20 – October 15)	180	3.5-day (2x/wk)	human	Huso Shoenfeld Smallwood	3.0	0.89 (0.26 – 2.01) 1.14 (0.31 – 2.75) 1.03 (0.34 – 2.07)	4.56 (2.06 – 9.69) 6.99 (2.93 – 16.04) 2.76 (1.38 – 4.14)
Kibby	Western	2011	None	146	5-day (3x/2wk)	human	Shoenfeld	3	0.4 (0.1 – 0.7)	1.6 (0.7 – 3.6)
		2014	None	122	daily (5 days/week)	human	Huso		0.5 (No CI)	4.7 (No CI)
Mars Hill	Northern	2007	None	113	weekly	human	Jain	1.5	0.4 (0.5 – 0.6)	0.4 (0.4 – 0.7)
				113	seasonal dog	dog	Jain		4.4 (1.8 – 4.5)	2.5 (2.7 – 8.4)
				113	daily	human	Jain		2.0 (1.1 – 1.4)	1.0 (-0.2 – 2.9)
		2008	None	135	weekly	human	Jain		0.7 (0.6 – 1.1)	2.0 (2.3 – 2.9)
				135	seasonal dog	dog	Jain		0.2 (0.2 – 0.2)	2.7 (2.1 – 4.7)
Oakfield	Northern	2016	5.0 m/s, temperature variable	179	3-day	human	Huso Shoenfeld Smallwood	3.0	1.77 (1.13 – 2.77) 2.11 (0.86 – 3.91) 2.31 (±0.01)	7.60 (5.33 – 10.75) 9.42 (5.87 – 14.23) 9.77 (±0.63)
		2017	5.0 m/s, temperature variable	179	2-day	human	Huso Shoenfeld Smallwood		1.54 (0.34 – 3.98) 1.00 (0.25 – 2.39) 2.32 (0.77 – 4.63)	12.7 (8.63 – 19.06) 10.13 (7.01 – 14.7) 27.4 (19.68 – 36.28)
Passadumkeag	Central	2016	5.0 m/s, seasonally variable temperature	183	3-day	human	Huso Shoenfeld Smallwood	3.3	0.79 (0.14 – 1.79) 0.56 (0.11 – 1.22) 0.87 (0.87 – 0.87)	6.32 (4.06 – 10.13) 4.28 (2.76 – 5.58) 8.15 (6.13 – 10.17)
Record Hill	Western	2012	None	155	5-day (3x/2wk)	human	Huso	2.3	6.8 (3.4 – 49.7)	8.5 (4.5 – 18.8)
		2014	None	139	daily (5 days/week)	human	Huso		1.2 (0.7 – 3.0)	4.2 (2.1 – 8.1)
		2016	None	158	daily (5 days/week)	human	Huso, Smallwood		3.10 (2.11 – 6.66) 4.74 (4.69 – 4.80)	6.51 (3.60 – 10.73) 8.93 (8.67 – 9.20)
Rollins	Central	2012	None	184	weekly	human	Huso	1.5	0.2 (0.1 – 0.5)	2.9 (1.6 – 6.0)
		2014	None	184	weekly	human	Huso		0.5 (0.3 – 1.0)	5.1 (3.2 – 8.3)
Spruce Mountain	Western	2012	None	205	weekly	human	Huso	2	2.4 (0.5 – 0.5)	1.5 (1.2 – 4.5)
		2014	None	199	2x per week	human	Huso		0.61 (0.19 – 1.18)	10.06 (5.39 – 15.77)
Stetson	Central	2009	None	185	weekly	human	Jain	1.5	2.1 (1.1 – 3.1)	4.0 (2.8 – 5.2)
		2011	None	187	Weekly	human	Jain		0.4 (0.4 – 0.5)	1.8 (1.5 – 2.0)
		2013	None	194	Weekly	human	Huso		0.3 (0.2 – 1.1)	10.4 (5.0 – 22.2)
		2010	None	180	Weekly	human	Jain		2.5 (2.2 – 2.8)	2.1 (1.9 – 2.4)
		2012	None	184	Weekly	human	Huso		2.1 (0.6 – 51.4)	2.8 (0.7 – 8.4)
		2014	None	184	Weekly	human	Huso		1.3 (0.5 – 5.9)	4.9 (2.0 – 14.7)

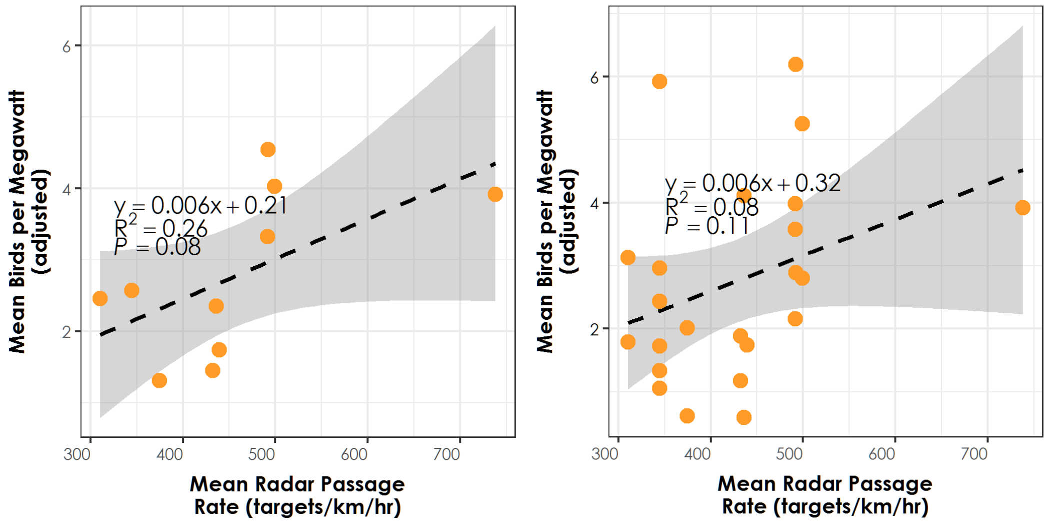
Appendix D LINEAR MODEL RESULTS



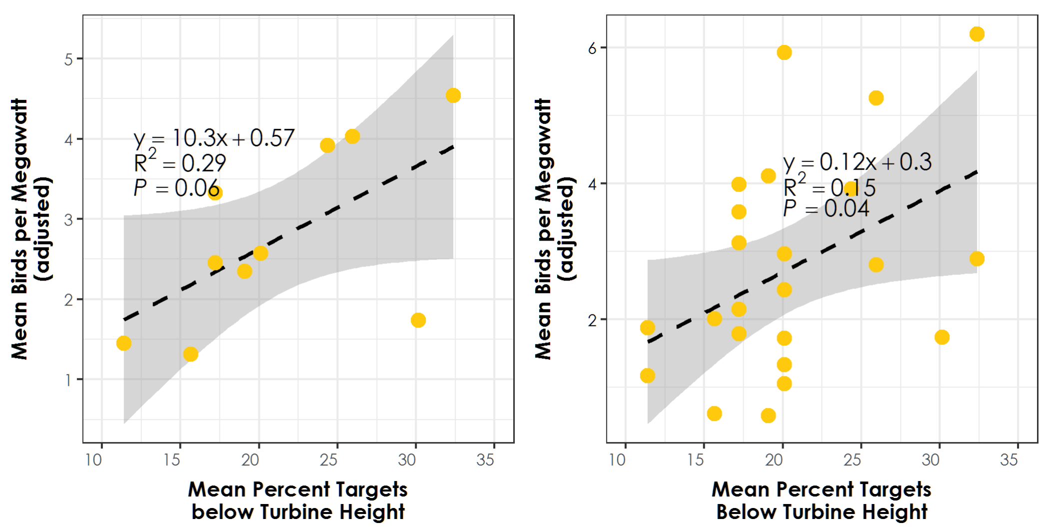
Appendix D Figure 1. Estimated bat mortality rates versus pre-construciton rardar passage rate based on site-level averages (left) and annual mortality estimates (right) for commercial wind projects in Maine. Shown are regressions including sites with curtailment.



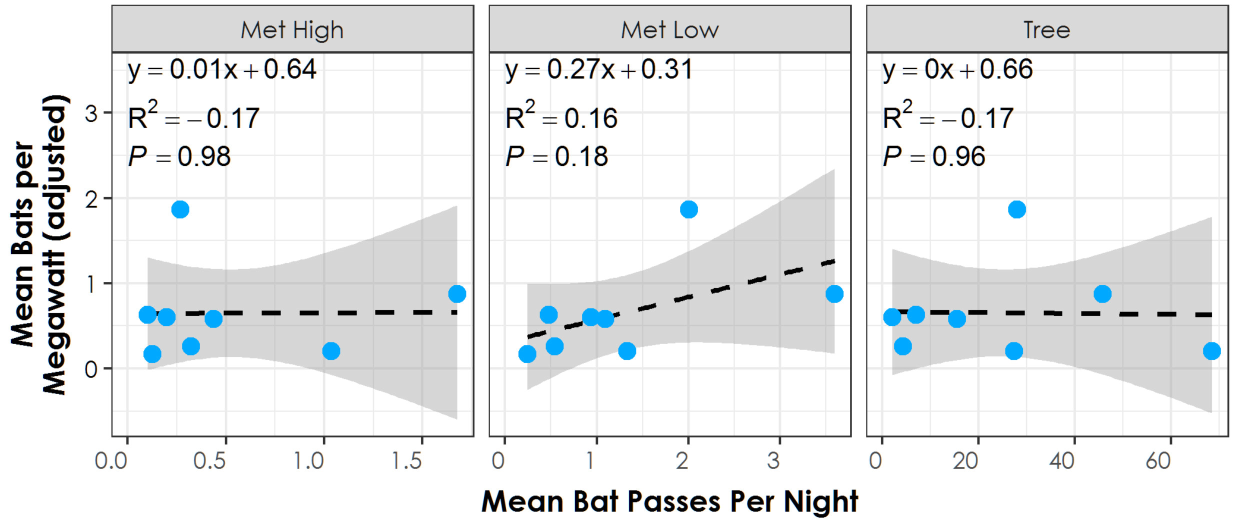
Appendix D Figure 2. Estimated bat mortality rates versus pre-construction percent radar targets below turbine height based on site-level averages (left) and annual mortality estimates (right) for commercial wind projects in Maine. Shown are regressions including sites with curtailment.



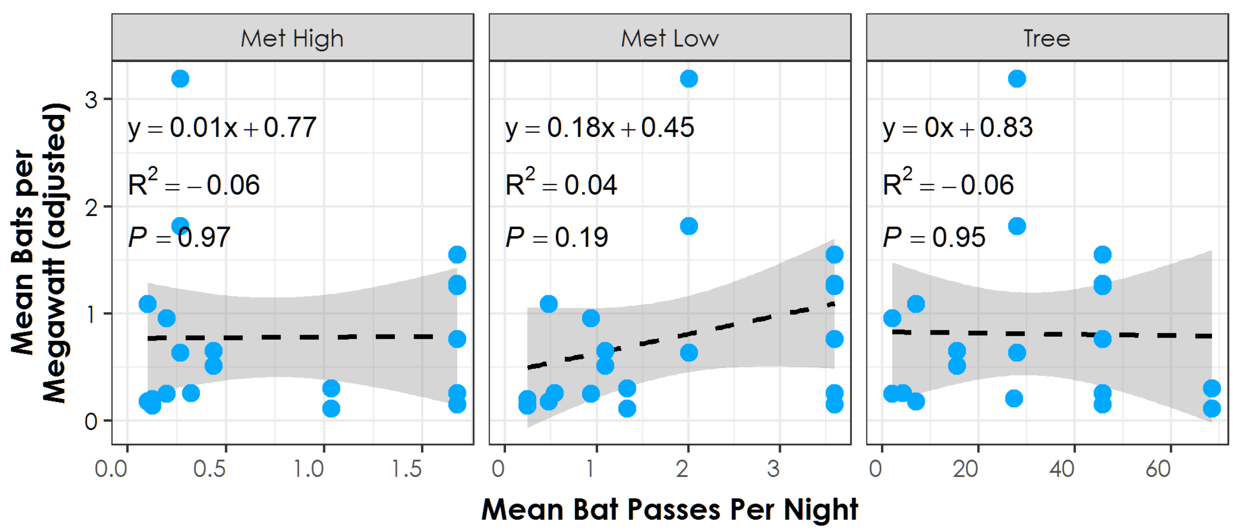
Appendix D Figure 3. Estimated bird mortality rates versus pre-construction radar passage rate based on site-level averages (left) and annual mortality estimates (right) for commercial wind projects in Maine.



Appendix D Figure 4. Estimated bird mortality rates versus pre-construction percent radar targets below turbine based on site-level averages (left) and annual mortality estimates (right) for commercial wind projects in Maine.



Appendix D Figure 5. Estimated bat mortality versus pre-construction bat activity levels based on site-level averages.



Appendix D Figure 6. Estimated bat mortality versus pre-construction bat activity levels on annual mortality estimates by detector type.

Appendix E BIRD AND BAT MORTALITY ESTIMATES FROM NORTHEAST STATES

Appendix E Table 1. Bird and bat mortality estimates from publicly available mortality survey reports for wind projects in New Hampshire, New York, Pennsylvania, and West Virginia used to compare statewide mortality rates.

Site	State	Turbine Size (MW)	Year	Estimated Bat Mortality per Turbine	Estimated Bird Mortality per Turbine	Survey Period Length (Days)	Search Interval	Estimator	Reference
Granite Reliable	NH	3.0	2012	3.0	2.8	189	weekly	Huso	Curry and Kerlinger. 2013. Post-construction mortality study Granite Reliable Power Wind Park, Coos County, New Hampshire, Annual Report January 2013. Prepared for Granite Reliable Power, LLC.
Groton	NH	2.0	2013	2.6	4.9	196	weekly	Shoenfeld	Stantec Consulting Services Inc. 2014. 2013 Post Construction Avian and Bat Survey Report. Prepared for Groton Wind, LLC.
			2014	3.3	3.0	190	weekly	Shoenfeld	Stantec Consulting Services Inc. 2015. 2014 Post Construction Avian and Bat Survey Report. Prepared for Groton Wind, LLC.
			2015	3.5	2.0	192	weekly	Shoenfeld	Stantec Consulting Services Inc. 2016. 2015 Post Construction Avian and Bat Survey Report. Prepared for Groton Wind, LLC.
Lempster	NH	2.0	2009	6.1	6.8	157	daily	Shoenfeld	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. 2009 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
			2010	7.1	5.3	157	weekly	Shoenfeld	Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Altona	NY	1.5	2010	6.5	1.6	173	daily	Jain	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Altona Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
				3.9	2.8		weekly	Jain	
Bliss	NY	1.5	2008	7.6	4.3	208	daily	Jain	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
				14.7	0.7		3-day	Jain	
				13.0	0.7		weekly	Jain	
			2009	8.2	4.5	215	daily	Jain	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Bliss Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
				4.5	2.9		weekly	Jain	
Chateaugay	NY	1.5	2010	3.7	2.4	173	weekly	Jain	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Chateaugay Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Clinton	NY	1.5	2008	5.5	1.4	171	daily	Jain	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009. Annual Report for the Noble Clinton Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
				4.8	3.3		3-day	Jain	
				3.8	2.5		weekly	Jain	
			2009	9.7	1.5	215	daily	Jain	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Clinton Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
				5.2	1.8		weekly	Jain	
Cohocton/ Dutch Hill	NY	2.5	2009	40.4	4.7	215	daily	Jain	Stantec Consulting Services Inc. 2010. Cohocton and Dutch Hill Wind FarmsYear 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
				13.8	2.9		weekly	Jain	
			2010	15.5	2.0	180	weekly	Jain	Stantec Consulting Services Inc. 2011. Cohocton and Dutch Hill Wind Farms Year 2 Post-Construction Monitoring Report, 2010 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
				36.1	3.2	180	daily & weekly	Jain	
			2013	8.0	4.0	100	5-day	Jain	Stantec Consulting Services Inc. 2014. Cohocton and Dutch Hill Wind Farms 2013 Post-ConstructionWildlife Monitoring Report. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Ellenburg	NY	1.5	2008	8.2	2.1	169	daily	Jain	
				6.9	1.4		3-day	Jain	

COMPARISON OF PRE-CONSTRUCTION BIRD/BAT ACTIVITY AND POST-CONSTRUCTION MORTALITY AT COMMERCIAL WIND PROJECTS IN MAINE

Site	State	Turbine Size (MW)	Year	Estimated Bat Mortality per Turbine	Estimated Bird Mortality per Turbine	Survey Period Length (Days)	Search Interval	Estimator	Reference
				4.2	1.2		weekly	Jain	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
			2009	8.0	5.7	215	daily	Jain	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Ellenburg Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
				3.7	2.3		weekly	Jain	
Hardscrabble	NY	2.0	2012	21.3	6.9	184	daily	Shoenfeld	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Ellenburg Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Howard	NY	2.1	2012	20.1	2.5	215	daily & weekly	Shoenfeld	West. 2013. 2012 Post-Construction Monitoring Studies for the Howard Wind Projgect Steuben County, New York. Prepared for Howard Wind, LLC.
			2013	4.3	0.8	185	daily & weekly	Shoenfeld	West. 2014. 2013 Post-Construction Monitoring Studies for the Howard Wind Projgect Steuben County, New York. Prepared for Howard Wind, LLC.
Maple Ridge	NY	1.7	2006	24.5	9.6	152	daily	Jain	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2006. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
				22.3	4.5	140	3-day	Jain	
				15.2	3.1	128	weekly	Jain	
			2007	10.7	3.9	199	weekly	Jain	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
			2008	8.2	3.4	209	weekly	Jain	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2008. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
			2012	12.1	NA	96	weekly	Shoenfeld	Tidhar, D., J. Ritzert, M. Sonnenberg, M. Lout, and K. Bay. 2013. 2012 Post-construction Fatality Monitoring Study for the Maple Ridge Wind Farm, Lewis County, New York. Final Report: July 12 – October 15, 2012. Prepared for EDP Renewables North America by Western EcoSystems Technology, Inc. NE/Mid-Atlantic Branch, Waterbury, Vermont.
Munnsville	NY	1.5	2008	0.7	2.2	215	weekly	Jain	Stantec Consulting Services Inc. 2009. Post-construction monitoring at the Munnsville Wind Farm, New York, 2008. Prepared for E.ON Climate and Renewables.
Steel Winds	NY	2.5	2012	6.3	4.3	161	weekly	Jain w/o area	Stantec Consulting Services Inc. 2013. Steel Winds I and II Post-Construction Monitoring Report, 2012. Prepared for First Wind Management, LLC
				6.9	8.5			Jain w/ area	
				5.8	4.0			Huso w/o area	
				6.4	7.2			Huso w/ area	
			2013	15.3	15.5	150	3-day	Huso w/ area correction	Stantec Consulting Services Inc. 2014. Steel Winds I and II Post-Construction Monitoring Report, 2013. Prepared for First Wind Management, LLC
Wethersfield	NY	1.5	2010	24.5	2.6	184	weekly	Jain	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K., Harte, A. 2011. Annual Report for the Noble Wethersfield Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Site 2-10	PA	unknown	2008	16.0	1.0	unknown	unknown	unknown	Taucher, J., T. Librandi-Mumma, and W. Capouillez. 2012. Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement Third Summary Report.
			2010	5.0	2.0	229	daily	Shoenfeld	
Site 2-14	PA	unknown	2008	7.0	7.0	229	daily	Shoenfeld	
			2009	7.0	5.0	229	daily	Shoenfeld	
Site 2-19	PA	unknown	2010	31.0	3.0	229	daily	Shoenfeld	
			2011	8.0	5.0	229	daily	Shoenfeld	
Site 2-2	PA	unknown	2008	19.0	2.0	229	daily	Shoenfeld	
			2009	13.0	4.0	229	daily	Shoenfeld	
Site 2-4	PA	unknown	2009	29.0	10.0	229	daily	Shoenfeld	
			2010	32.0	3.0	229	daily	Shoenfeld	

Site	State	Turbine Size (MW)	Year	Estimated Bat Mortality per Turbine	Estimated Bird Mortality per Turbine	Survey Period Length (Days)	Search Interval	Estimator	Reference
Site 24-1	PA	unknown	2010	59.0	4.0	229	daily	Shoenfeld	
			2011	30.0	7.0	229	daily	Shoenfeld	
Site 24-3	PA	unknown	2009	12.0	3.0	unknown	unknown	unknown	
			2010	38.0	3.0	229	daily	Shoenfeld	
			2011	19.0	3.0	229	daily	Shoenfeld	
Site 35-1	PA	unknown	2010	22.0	2.0	229	daily	Shoenfeld	
			2011	11.0	3.0	229	daily	Shoenfeld	
Site 5-5	PA	unknown	2009	13.0	1.0	unknown	unknown	unknown	
			2010	11.0	1.0	229	daily	Shoenfeld	
Site 6-1	PA	unknown	2009	28.0	2.0	229	daily	Shoenfeld	
			2010	29.0	2.0	229	daily	Shoenfeld	
Site 6-16	PA	unknown	2011	32.0	5.0	229	daily	Shoenfeld	
Site 6-3	PA	unknown	2007	30.0	2.0	229	daily	Shoenfeld	
			2008	27.0	2.0	229	daily	Shoenfeld	
Laurel Mountain	WV	1.6	2012	23.4	9.0	200	3-day	Shoenfeld	Stantec Consulting Services Inc. 2013. Fall 2011 and Spring/Summer 2012 Post-construction Monitoring Data Report for the Laurel Mountain Wind Energy Project in Randolph and Barbour Counties, West Virginia. Prepared for AES Laurel Mountain Wind, LLC.
Mount Storm	WV	2.0	2008	24.2	3.8	92	daily	Erickson et al. 2003	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
				7.8	2.4		weekly		
			2009	21.4	7.6	169	weekly		Young, D. P., K. Bay, S. Nomani, and W. L. Tidhar. 2010. NedPower Mount Storm Wind Energy Facility, post-construction avian and bat monitoring, July - October 2009. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA.
				28.6	8.7		daily		
			2010	22.4	2.8	93	daily		Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2010. Mount Storm Wind Energy Facility Post-construction Avian and Bat Monitoring, July-October 2010. Prepared for NedPower Mount Storm, LLC.
Mountaineer	WV	1.5	2003	47.5	4.0	222	2x per week	Shoenfeld	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003
Pinnacle	WV	2.4	2012	96.5	9.6	275	weekly	Huso & Dalthorp	Hein, C.D., A. Prichard, T. Mabee, M.R. Shirmacher. 2013. Avian and Bat Post-construction Monitoring at the Pinnacle Wind Farm, Mineral County, West Virginia, 2012. Prepared for Edison Mission Energy.

Exhibit 7-10

Weaver Wind Project Impacts and Risks to Small Passerine Populations (2018)

Weaver Wind Project Impacts and Risks to Small Passerine Populations

Prepared for:

Longroad Energy

133 Federal Street, Suite 1202
Boston, Massachusetts 02110

Prepared by:

Wally Erickson, Shay Howlin, and Kimberly Bay

Western EcoSystems Technology, Inc.
415 West 17th Street, Suite 200
Cheyenne, Wyoming 82001

October 15, 2018

Not for Distribution

EXECUTIVE SUMMARY

This report includes updated information to help address concerns over avian fatality impacts and risk associated with the Weaver Wind Project and adjacent Hancock and Bull Hill Projects on birds. We updated a previous evaluation of the expected impact from these projects on the regional populations of passerine species and further discuss the risk of large mortality events at wind projects.

In 2014, Erickson et al. developed bias-corrected standardized songbird fatality rates from over 116 studies across the continental US and Canada. Using species composition information from those studies, and estimates of cumulative mortality from all wind energy projects in the US and Canada, these authors concluded that wind turbine caused mortality had no measurable impact on any songbird species population. This conclusion was based on the extremely small contribution wind energy had on individual species mortality (i.e., typically <0.01% of population), and the fact that small passerines have high reproduction rates and high annual mortality (30-60%).

We demonstrated in this analysis that when considering regional population estimates and cumulative regional mortality estimates from the Weaver, Hancock and Bull Hill Projects, a similar conclusion is reached that these projects would have no measurable impact on small passerine populations regionally, even with very conservative assumptions (e.g., all mortality occurs with birds that reside in this region).

Mortality events involving large numbers of migrating nocturnal songbirds are well documented at buildings and communication towers, and are typically associated with lighting attraction. The level of mortality for defining “large” is arbitrary, but for the purpose of this discussion, we will use more than 100 carcasses found on one night at a turbine or multiple proximate turbines to be considered a large event, and more than 500 carcasses found on one night to be considered a very large event.

We are unaware of any large mortality events (>100 carcasses) of nocturnal migrants observed at wind projects since the previous evaluation. To the best of our knowledge, there have never been very large fatality events (e.g., 500 or more birds) of songbirds reported at wind turbines. The very large events that have been documented at buildings and tall guyed communication towers have almost exclusively been associated with attraction to bright, steady burning lights, poor weather and for communication towers, guy wires. With proper best management practices when it comes to on-site lighting during construction and operation, as well as taking into account the collision risk profile of a wind turbine, the potential for a very large mortality event appears extremely low. In fact, we are not even aware of any large events with wind turbines in US and Canada, despite the fact several projects have been built in areas with known high migration rates.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ii
INTRODUCTION 1
ESTIMATING IMPACTS OF WIND ENERGY ON REGIONAL SONGBIRD POPULATIONS 2
  Methods 2
  Deriving Small-Bird Fatality Rates from All-Bird Fatality Rates 4
  Results 6
REVIEW OF FATALITY RATES AT PROJECTS LOCATED IN COASTAL MIGRATORY BIRD CONCENTRATION ZONES 11
LARGE MORTALITY EVENTS AND ASSOCIATED RISK FACTORS 13
CONCLUSION 15
REFERENCES 15

LIST OF TABLES

Table 1. Fatality studies in bird conservation region 14 with publicly available data. References for each study are in Appendix A. 3
Table 2. Estimated number of fatalities per year by species for the region based on the estimate of small bird fatalities in the region (low bias adjustment) and the species composition of fatalities in the region. 7
Table 3. Estimated number of fatalities per year by species for the Weaver project based on the estimate of small bird fatalities at Bull Hill in 2013 and 2014 and Hancock in 2017 (low bias adjustment) and the species composition of fatalities at Bull Hill and Hancock. 8
Table 4. Estimated number of fatalities per year by species for the three-project area based on the estimate of small bird fatalities at Bull Hill in 2013 and 2014 and Hancock in 2017 (low bias adjustment) and the species composition of fatalities at Bull Hill and Hancock. 9
Table 5. Large bird mortality events associated with wind turbine collisions recorded in the US. 15

LIST OF FIGURES

Figure 1. Wind energy facilities used in the Regional Analysis. 4

LIST OF APPENDICES

Appendix A: References for 30 Studies Included in Regional Fatality Estimate

INTRODUCTION

This report includes updates to previous analyses of the potential impact of the Weaver Wind Project and adjacent Hancock and Bull Hill Projects, including an assessment of the potential for large fatality events for small migrating passerine species. In this paper, we evaluate the expected impact from these projects on the regional populations of passerine species.

Small passerines are the most abundant bird group in the US and Canada, as well as the most common bird fatalities from turbine collisions at wind energy facilities (Erickson et al. 2014). There are over 400 small passerine species in North America. Erickson et al. (2014) developed bias-corrected standardized songbird fatality rates from over 116 studies across the continental US and Canada. Using species composition information from those studies, and estimates of cumulative mortality from all wind energy in the US and Canada, these authors concluded that wind turbine-caused mortality had no measurable impact on any songbird species population. This conclusion was based on the extremely small contribution wind energy had on individual species mortality (i.e., typically <0.01% of population), and the fact that small passerines have high reproduction rates and high annual mortality (30-60%).

For some context, Longcore et al. (2013) concluded that more than 1% of the estimated populations for 25 species were being killed by communication towers.

We used a similar approach to look at potential impacts of wind energy on a regional and local scale in the Northeast. Using the fatality rates from wind energy reported in the region, we were able to evaluate the impacts to small passerine populations in Bird Conservation Region (BCR) 14 and for the three proximate wind energy projects of Bull Hill, Hancock, and Weaver together. BCR 14 is the Atlantic Northern Forest region, and covers all of Maine, New Brunswick, and Nova Scotia, including parts of New Hampshire, Vermont and Quebec, and the Adirondack Mountains in New York. The three proximate wind energy facilities are located in Maine and will represent a combined capacity of 157.8 megawatts (MW) when construction is completed (Bull Hill with 19 turbines each 1.8 MW, Hancock with 17 turbines each 3.0 MW, and Weaver with 22 turbines each 3.3 MW).

Impacts to small passerines were evaluated with respect to the total current installed wind energy capacity in the region as well as the capacity of the three projects when completed. Over 30 wind energy fatality studies with publicly available information were compiled to estimate an annual rate of small bird fatalities in the region. The 2013 and 2014 fatality studies at Bull Hill and the 2017 fatality study at Hancock were used as surrogates for the annual rate of small bird fatalities in the 3-project area. Fatality rates were standardized to resolve biases associated with the differing types of fatality estimator used, providing a commensurate estimator for this analysis. The local and regional fatality estimates were compared to the regional population sizes in BCR 14, following a similar approach by Erickson et al. (2014) to understand the potential biological implications of wind energy mortality in the region to small passerine species.

ESTIMATING IMPACTS OF WIND ENERGY ON REGIONAL SONGBIRD POPULATIONS

Using the fatality rates reported in the region, we were able to evaluate the impacts to small passerine populations in BCR 14 from the three proximate projects of Bull Hill, Hancock, and Weaver together.

Methods

Bird Fatality Studies

We updated the set of wind energy projects in the Erickson et al. (2014) analysis to include 24 additional fatality studies in the northeastern US. A total of 30 studies at 17 wind energy facilities were included in this analysis (Table 1, Figure 1). Several fatality studies were conducted over multiple years or at more than one phase of the wind energy facility. All studies were within the northern forest avifaunal biome.

Table 1. Fatality studies in bird conservation region 14 with publicly available data. References for each study are in Appendix A.

Wind Energy Facility	Fatality Estimator	All-Bird Fatality Rate Estimate (MW/Year)	All-Bird Confidence Interval	Small-Bird Fatality Rate Estimate (MW/Year)
Bingham, ME (2017)	Huso	3.46	1.99, 6.24	2.80 [b]
Bull Hill, ME (2013)	Huso	6.79		5.49[a]
Bull Hill, ME (2014)	Huso	3.51		2.84[a]
Hancock, ME (2017)	Huso	1.52		1.23 [b]
Kibby, ME (2011)	Shoenfeld	0.54	0.22, 1.20	0.44[b]
Lempster, NH (2009)	Shoenfeld	3.38	1.87, 4.89	2.73 [b]
Lempster, NH (2010)	Shoenfeld	2.64	1.52, 4.58	1.65
Maple Ridge, NY (2006)	Jain	2.84		5.75
Maple Ridge, NY (2007)	Jain	2.34		1.90[b]
Maple Ridge, NY (2007-2008)	Jain	2.07		1.86
Mars Hill, ME (2007)	Jain	1.67		1.33[b]
Mars Hill, ME (2008)	Jain	1.76		1.43[b]
Noble Altona, NY (2010)	Jain	1.84		1.68
Noble Chateaugay, NY (2010)	Jain	1.66		1.34[b]
Noble Clinton, NY (2008)	Jain	1.59		1.01
Noble Clinton, NY (2009)	Jain	1.11		1.39
Noble Ellenburg, NY (2008)	Jain	0.83		0.57
Noble Ellenburg, NY (2009)	Jain	2.66		0.66
Oakfield, ME (2017)	Huso	4.23		3.42 [b]
Record Hill, ME (2012)	Huso	3.70		2.02
Record Hill, ME (2016)	Huso	2.85		2.26 [a,b]
Rollins, ME (2012)	Jain	2.9		2.35[b]
Sheffield, VT (2012)	Huso	5.27	3.68, 8.02	4.26[b]
Spruce Mountain, ME (2012)	Huso	0.75	0.61, 2.26	0.60[b]
Spruce Mountain, ME (2014)	Huso	5.03	2.70, 7.90	4.07 [b]
Stetson Mountain I, ME (2009)	Jain	2.68		2.17[b]
Stetson Mountain I, ME (2011)	Jain	1.18	1.03, 1.33	0.96[b]
Stetson Mountain I, ME (2013)	Huso	6.95		5.62[b]
Stetson Mountain II, ME (2010)	Jain	1.42	1.26, 1.58	1.15[b]
Stetson Mountain II, ME (2012)	Jain	3.37		2.73[b]

[a] Not adjusted for estimator bias.

[b] Small bird estimates calculated from all bird estimates using Erickson et al. 2014 multiplier (see Methods section).

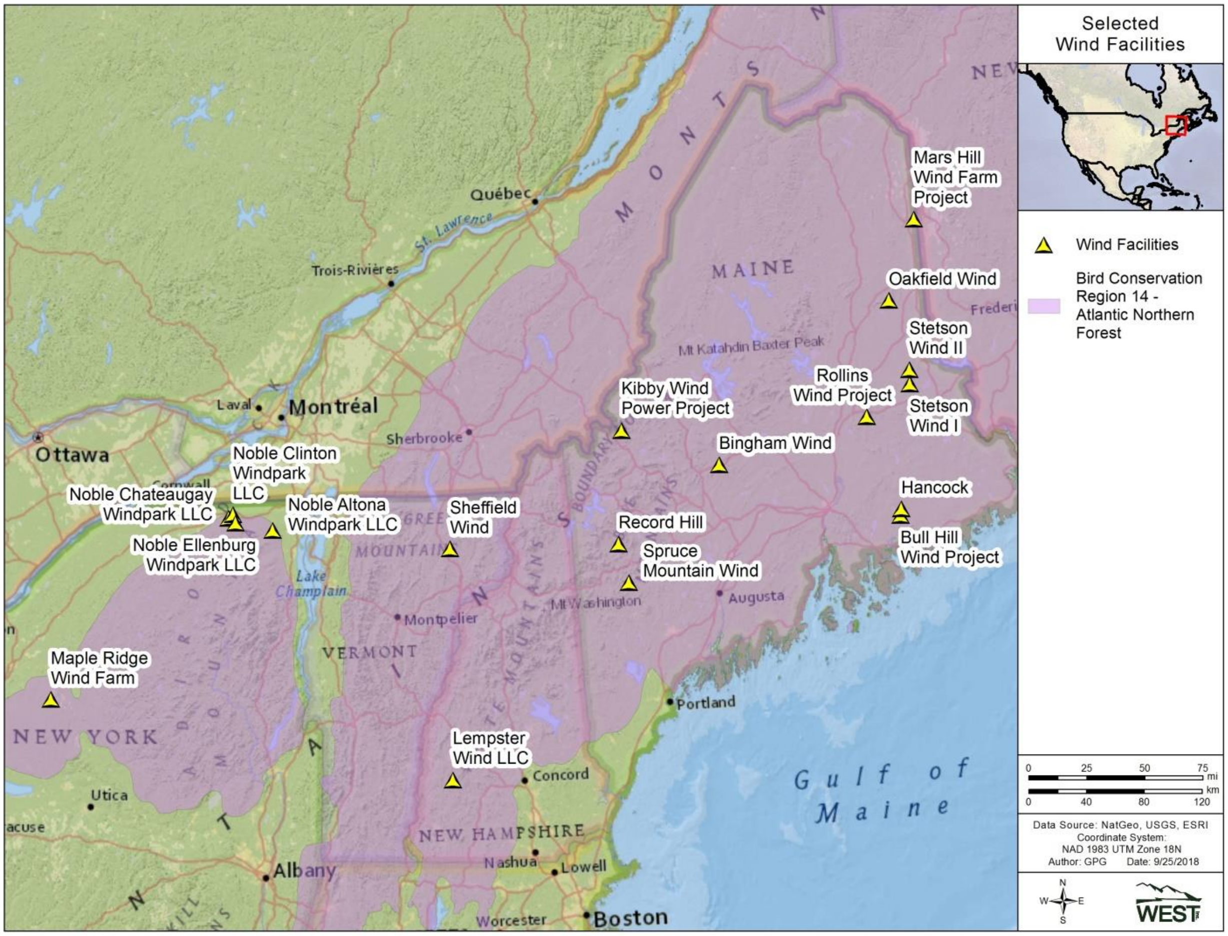


Figure 1. Wind energy facilities used in the Regional Analysis.

Estimator Types

Three fatality rate estimators were reported for the 30 studies: 16 studies used the Jain estimator (Jain 2005), 11 studies used the Huso estimator (Huso 2010), and three studies used the Shoenfeld estimator (Shoenfeld 2004). All fatality rates were estimated as the number of fatalities/MW/year. In this paper we focus on small bird fatality rates. Fatality estimates have been shown to exhibit biases that either over or underestimate the true fatality rate; see Erickson et al. (2014) for a description of differences and relative biases for the most commonly used fatality estimators.

Deriving Small-Bird Fatality Rates from All-Bird Fatality Rates

For 21 studies that did not report small-bird fatality rates, we estimated the rate from the all-bird fatality rate using the Erickson et al. (2014) multiplier for the northern forest biome. Erickson et al. (2014) estimated the multiplier to be 0.81 in this region (81% of birds found at wind turbines are estimated to be small passerines). The estimated multiplier takes into account the difference in composition of small and large bird fatalities, and the difference in small and large bird searcher efficiency and carcass removal rates.

Estimator Bias Adjustments

Small-bird fatality rates were adjusted for bias attributed to the fatality estimator used. Adjusting the bias provided a commensurate estimator that can be compared across studies, or averaged to obtain a region-wide estimate. Bias adjustments were based on a simulation study of common fatality estimators (Erickson et al. 2014). Bias adjustments from the simulation output were applied to each small-bird estimate based on the estimator type, searcher efficiency rate (low, moderate, or high), the carcass removal rate (slow, moderate, or fast), and the search interval. For 12 studies without reported searcher efficiency information and the 22 studies without reported carcass removal information, we assumed a medium searcher efficiency rate and fast carcass removal time based on biome averages reported in Erickson et al. (2014).

Bias adjustments were not available for every combination of search interval; instead, we obtained the minimum and maximum bias adjustment across the search intervals implemented during the study and across the rates of searcher efficiency change over time. The estimated small-bird fatality rate for each study was divided by each bias adjustment resulting in two fatality rates, one using the low bias adjustment and one using the high bias adjustment.

Three studies implemented the Huso estimator by excluding carcasses estimated to have died before the previous search: Bull Hill 2013, Bull Hill 2014, and Record Hill 2016. These methods reduce the bias of the estimator, and as such, the fatality rates were not adjusted for estimator bias for this analysis. The Huso estimator, as implemented for these projects, was not part of the bias simulation study by Erickson et al. (2014).

Estimation of Species-Specific Numbers of Small Passerines

A regional small-bird fatality rate was estimated by averaging across the 17 wind energy facilities. For facilities with studies spanning multiple years and phases, we first averaged the small-bird fatality rate across years for a phase, and then averaged across phases. The region average small-bird fatality rate was multiplied by the number of MW in BCR 14 (2,199.75 MW) to obtain the estimated total number of small-bird fatalities in the region. Regional estimates of installed capacity were from the American Wind Energy Association (AWEA) state fact sheets for Maine, New Hampshire, Vermont, New York, and Massachusetts, updated through the second quarter of 2018 (AWEA 2018). The entire current installed capacity of Maine, New Hampshire, and Vermont was included, as well as half the installed capacity of New York and a quarter of the installed capacity in Massachusetts to align with the planned inference space of BCR 14.

The small-bird fatality rate for the 3-project area was estimated by averaging across the two Bull Hill studies and the Hancock study. This small-bird fatality rate was multiplied by the number of MW in the 3-project area (157.8 MW) to obtain the estimated total number of small-bird fatalities in the area.

Using the species composition of small-bird fatalities, we estimated the species-specific number of small passerine fatalities for the BCR 14 region and the 3-project region. The estimated total number of small-bird fatalities in the region was multiplied by the proportion of the total small passerine fatalities from the 30 studies to obtain species-specific numbers of small passerines. We also estimated species-specific numbers of small passerine fatalities in the 3-project area using the proportion of the total small passerine fatalities from the two Bull Hill studies and the Hancock study.

Estimation of Bird Population Sizes

The estimated number of regional fatalities for each species was compared to the overall population size estimated for each species. We obtained the estimates of population size for species in BCR 14 from the Population Estimates Database (Partners in Flight Science Committee 2013). The database is sponsored by Partners in Flight, a cooperative partnership of public and private organizations whose goal is to conserve bird populations in the Western Hemisphere. Database values are based on breeding bird surveys (BBS), which are annual roadside counts conducted in the same locations over multiple years by volunteers. Adjustments to the BBS estimates are made using other sources for unique landcover or insufficient BBS data (see Blancher et al. 2013). We restricted a comparison of fatality estimates relative to the population size of BCR 14 and not the larger continental populations. This analysis assumes all the fatalities associated with wind turbines were resident birds whereas many of the carcasses found likely include migrants that reside outside BCR 14 given the migration behavior of these birds.

Results

Bird Conservation Region 14 Fatality Rates

The estimate of small-bird fatalities/MW/year ranged from 0.44 to 5.75 across the 30 studies, with a mean of 2.26 small birds/MW/year. The adjusted number of small-bird fatalities/MW/year ranged from 0.40 to 7.92 across the 30 studies with the low estimator bias adjustment and ranged from 0.25 to 5.55 with the high estimator bias adjustment. The estimated average number of small-bird fatalities/MW/year with the low estimator bias adjustment was 2.40 and the estimate with the high estimator bias adjustment was 1.70 fatalities/MW/year.

Using the estimator bias adjusted fatality rates, regional estimates of small bird fatalities were 5,278 small birds per year with the low bias adjustment and 3,749 small birds per year with the high bias adjustment. Species specific numbers were estimated based on the observed distribution of fatalities for the 30 studies and the low bias adjustment (Table 2).

Table 2. Estimated number of fatalities per year by species for the region based on the estimate of small bird fatalities in the region (low bias adjustment) and the species composition of fatalities in the region.

Bird Species	Frequency in Regional Fatalities	BCR 14 Population Size	Regional Fatality Estimate	Percent of BCR 14 Population
red-eyed vireo	0.19	12,000,000	1,006	0.0084
golden-crowned kinglet	0.14	5,100,000	751	0.0147
magnolia warbler	0.08	3,600,000	432	0.0120
black-throated blue warbler	0.03	690,000	170	0.0246
ruby-crowned kinglet	0.03	1,300,000	142	0.0109
common yellowthroat	0.03	6,300,000	135	0.0021
cedar waxwing	0.02	5,200,000	128	0.0025
European starling	0.02	1,900,000	106	0.0056
ovenbird	0.02	2,100,000	106	0.0051
black-and-white warbler	0.02	1,900,000	99	0.0052
black-throated green warbler	0.02	1,900,000	99	0.0052
red-breasted nuthatch	0.02	750,000	99	0.0132
yellow-bellied sapsucker	0.02	1,300,000	99	0.0076
American redstart	0.02	4,900,000	85	0.0017
Blackburnian warbler	0.02	1,800,000	85	0.0047
northern parula	0.02	2,900,000	85	0.0029
tree swallow	0.02	1,100,000	85	0.0077
blue-headed vireo	0.01	1,800,000	71	0.0039
pine warbler	0.01	180,000	71	0.0394
bay-breasted warbler	0.01	600,000	64	0.0106
blackpoll warbler	0.01	300,000	64	0.0213
eastern kingbird	0.01	330,000	64	0.0193
yellow-rumped warbler	0.01	2,200,000	64	0.0029
brown creeper	0.01	370,000	57	0.0153
hermit thrush	0.01	1,600,000	57	0.0035
northern parula	0.01	2,900,000	57	0.0020
American robin	0.01	13,000,000	50	0.0004
chestnut-sided warbler	0.01	2,200,000	50	0.0023
Swainson's thrush	0.01	1,400,000	50	0.0035
American woodcock	0.01	0	43	Inf
song sparrow	0.01	9,500,000	43	0.0004
yellow-bellied flycatcher	0.01	400,000	43	0.0106
American goldfinch	0.01	3,300,000	35	0.0011
bobolink	0.01	590,000	35	0.0060
eastern wood-pewee	0.01	160,000	35	0.0221
white-throated sparrow	0.01	7,000,000	35	0.0005
dark-eyed junco	0.01	2,800,000	28	0.0010
scarlet tanager	0.01	120,000	28	0.0236
Tennessee warbler	0.01	300,000	28	0.0094
veery	0.01	1,500,000	28	0.0019
blue jay	<0.01	650,000	21	0.0033
downy woodpecker	<0.01	550,000	21	0.0039
hairy woodpecker	<0.01	470,000	21	0.0045
indigo bunting	<0.01	360,000	21	0.0059
northern waterthrush	<0.01	190,000	21	0.0112
purple finch	<0.01	1,000,000	21	0.0021
rose-breasted grosbeak	<0.01	230,000	21	0.0092
warbling vireo	<0.01	300,000	21	0.0071
winter wren	<0.01	1,100,000	21	0.0019

Table 2. Estimated number of fatalities per year by species for the region based on the estimate of small bird fatalities in the region (low bias adjustment) and the species composition of fatalities in the region.

Bird Species	Frequency in Regional Fatalities	BCR 14 Population Size	Regional Fatality Estimate	Percent of BCR 14 Population
black-capped chickadee	<0.01	5,100,000	14	0.0003
chimney swift	<0.01	130,000	14	0.0109
chipping sparrow	<0.01	5,700,000	14	0.0002
cliff swallow	<0.01	110,000	14	0.0129
eastern phoebe	<0.01	1,900,000	14	0.0007
least flycatcher	<0.01	1,500,000	14	0.0009
Nashville warbler	<0.01	1,800,000	14	0.0008
palm warbler	<0.01	180,000	14	0.0079
Philadelphia vireo	<0.01	300,000	14	0.0047
ruby-throated hummingbird	<0.01	1,600,000	14	0.0009
alder flycatcher	<0.01	4,600,000	7	0.0002
barn swallow	<0.01	500,000	7	0.0014
brown-headed cowbird	<0.01	460,000	7	0.0015
Canada warbler	<0.01	380,000	7	0.0019
eastern towhee	<0.01	70,000	7	0.0101
evening grosbeak	<0.01	620,000	7	0.0011
gray catbird	<0.01	1,200,000	7	0.0006
Lincoln's sparrow	<0.01	700,000	7	0.0010
northern mockingbird	<0.01	9,000	7	0.0787
prairie warbler	<0.01	16,000	7	0.0443
red-winged blackbird	<0.01	1,200,000	7	0.0006
red crossbill	<0.01	40,000	7	0.0177
savannah sparrow	<0.01	2,800,000	7	0.0003
white-breasted nuthatch	<0.01	250,000	7	0.0028
white-crowned sparrow	<0.01	0	7	Migrant only
white-winged crossbill	<0.01	300,000	7	0.0024
Wilson's warbler	<0.01	110,000	7	0.0064
yellow-throated vireo	<0.01	16,000	7	0.0443
yellow warbler	<0.01	2,100,000	7	0.0003

Weaver Project Area Fatality Rates

Using the estimated average number of small-bird fatalities/MW/year at Bull Hill and Hancock presented above, species specific numbers were estimated based on the observed species distribution of fatalities at Bull Hill and Hancock and the proposed capacity of the Weaver project (Table 3).

Table 3. Estimated number of fatalities per year by species for the Weaver project based on the estimate of small bird fatalities at Bull Hill in 2013 and 2014 and Hancock in 2017 (low bias adjustment) and the species composition of fatalities at Bull Hill and Hancock.

Bird Species	Frequency in Fatalities	BCR 14 Population Size	Weaver Fatality Estimate	Percent of BCR 14 Population
red-eyed vireo	0.38	12,000,000	82	0.0007
golden-crowned kinglet	0.10	5,100,000	22	0.0004
pine warbler	0.07	180,000	14	0.0080

Table 3. Estimated number of fatalities per year by species for the Weaver project based on the estimate of small bird fatalities at Bull Hill in 2013 and 2014 and Hancock in 2017 (low bias adjustment) and the species composition of fatalities at Bull Hill and Hancock.

Bird Species	Frequency in Fatalities	BCR 14 Population Size	Weaver Fatality Estimate	Percent of BCR 14 Population
black-and-white warbler	0.06	1,900,000	12	0.0006
northern parula	0.06	2,900,000	12	0.0004
common yellowthroat	0.03	6,300,000	7	0.0001
magnolia warbler	0.03	3,600,000	7	0.0002
bay-breasted warbler	0.02	600,000	5	0.0008
black-throated green warbler	0.02	1,900,000	5	0.0003
northern waterthrush	0.02	190,000	5	0.0025
yellow-rumped warbler	0.02	2,200,000	5	0.0002
American redstart	0.01	4,900,000	2	0.0000
black-throated blue warbler	0.01	690,000	2	0.0003
Blackburnian warbler	0.01	1,800,000	2	0.0001
blackpoll warbler	0.01	300,000	2	0.0008
blue-headed vireo	0.01	1,800,000	2	0.0001
cedar waxwing	0.01	5,200,000	2	0.0000
chestnut-sided warbler	0.01	2,200,000	2	0.0001
ovenbird	0.01	2,100,000	2	0.0001
palm warbler	0.01	180,000	2	0.0013
ruby-crowned kinglet	0.01	1,300,000	2	0.0002
song sparrow	0.01	9,500,000	2	0.0000
Swainson's thrush	0.01	1,400,000	2	0.0002
tree swallow	0.01	1,100,000	2	0.0002
Veery	0.01	1,500,000	2	0.0002
yellow-bellied flycatcher	0.01	400,000	2	0.0006
yellow-bellied sapsucker	0.01	13,00,000	2	0.0002
Total		**72,540,000**	**208**	

Three-Project Area Fatality Rates

The estimated average number of small-bird fatalities/MW/year at Bull Hill and Hancock was 2.70 small birds/MW/year. The estimated average number of small-bird fatalities/MW/year with the low estimator bias adjustment was 2.95 and the estimate with the high estimator bias adjustment was 2.50 fatalities/MW/year. Using this fatality rate, the estimate of small bird fatalities in the 3-project area was 465 small birds per year with the low bias adjustment and 394 small birds per year with the high bias adjustment. Species specific numbers were estimated based on the observed species distribution of fatalities at Bull Hill and Hancock (Table 4).

Table 4. Estimated number of fatalities per year by species for the three-project area based on the estimate of small bird fatalities at Bull Hill in 2013 and 2014 and Hancock in 2017 (low bias adjustment) and the species composition of fatalities at Bull Hill and Hancock.

Bird Species	Frequency in Fatalities	BCR 14 Population Size	3-Project Fatality Estimate	Percent of BCR 14 Population
red-eyed vireo	0.38	12,000,000	178	0.0015
golden-crowned kinglet	0.10	5,100,000	47	0.0009
pine warbler	0.07	180,000	31	0.0174
black-and-white warbler	0.06	1,900,000	26	0.0014

Table 4. Estimated number of fatalities per year by species for the three-project area based on the estimate of small bird fatalities at Bull Hill in 2013 and 2014 and Hancock in 2017 (low bias adjustment) and the species composition of fatalities at Bull Hill and Hancock.

Bird Species	Frequency in Fatalities	BCR 14 Population Size	3-Project Fatality Estimate	Percent of BCR 14 Population
northern parula	0.06	2,900,000	26	0.0009
common yellowthroat	0.03	6,300,000	16	0.0002
magnolia warbler	0.03	3,600,000	16	0.0004
bay-breasted warbler	0.02	600,000	10	0.0017
black-throated green warbler	0.02	1,900,000	10	0.0006
northern waterthrush	0.02	190,000	10	0.0055
yellow-rumped warbler	0.02	2,200,000	10	0.0005
American redstart	0.01	4,900,000	5	0.0001
black-throated blue warbler	0.01	690,000	5	0.0008
Blackburnian warbler	0.01	1,800,000	5	0.0003
blackpoll warbler	0.01	300,000	5	0.0017
blue-headed vireo	0.01	1,800,000	5	0.0003
cedar waxwing	0.01	5,200,000	5	0.0001
chestnut-sided warbler	0.01	2,200,000	5	0.0002
ovenbird	0.01	2,100,000	5	0.0002
palm warbler	0.01	180,000	5	0.0029
ruby-crowned kinglet	0.01	1,300,000	5	0.0004
song sparrow	0.01	9,500,000	5	0.0001
Swainson's thrush	0.01	1,400,000	5	0.0004
tree swallow	0.01	1,100,000	5	0.0005
veery	0.01	1,500,000	5	0.0003
yellow-bellied flycatcher	0.01	400,000	5	0.0013
yellow-bellied sapsucker	0.01	1,300,000	5	0.0004
Total		**142,931,000**	**460**	

Effects on Bird Populations

The regional impact of mortality due to collisions with wind turbines on bird populations was extremely low relative to the size of the BCR 14 population. Most of these species are migratory and may reside in areas outside BCR 14, so this analysis is likely conservative (i.e., overestimate). The highest impact was to an estimated 0.08% of the northern mockingbird (*Mimus polyglottos*) population (seven fatalities in a population of 9,000). Prairie warblers (*Setophaga discolor*) and yellow-throated vireos (*Vireo flavifrons*) had an estimated impact to 0.04% of the population (seven fatalities in a population of 16,000), and pine warblers (*S. pinus*) had an estimated impact to 0.04% of the population (71 fatalities in a population of 180,000). All other species impacted in the region were less than 0.025% of the population. Red-eyed vireos (*V. olivaceus*) had an estimated impact to 0.008% of the population (1,006 fatalities in a population of 12,000,000).

The 3-project impact of mortality due to collisions with wind turbines on bird populations was extremely low relative to the size of the BCR 14 population. Across the species found, the highest impact was an estimated 0.02% of the pine warbler population (31 fatalities in a population of 180,000). All other species impacted in the 3-project area were less than 0.01% of the population. Red-eyed vireos had an estimated impact to 0.002% of the population (178 fatalities in a population of 12,000,000).

The Weaver project impact of mortality due to collisions with wind turbines on bird populations was also extremely low relative to the size of the BCR 14 population. Across the species found, the highest impact was an estimated 0.01% of the pine warbler population (14 fatalities in a population of 180,000). All other species impacted in the 3-project area were less than 0.01% of the population. Red-eyed vireos had an estimated impact to 0.001% of the population (82 fatalities in a population of 12,000,000).

While large events appear unlikely at wind projects with proper lighting best management practices, if such an event occurred during the life of a project (e.g., 500 carcasses during one event), the impacts to populations would again likely still be negligible. Such events at communication towers typically involve multiple species and given the BCR population sizes, 500 carcasses across multiple species would still likely be a very low percentage of any of the populations.

REVIEW OF FATALITY RATES AT PROJECTS LOCATED IN COASTAL MIGRATORY BIRD CONCENTRATION ZONES

WEST also examined the fatality rates in publicly available post-construction studies for projects located within similar broad landscape settings as the Bull Hill, Hancock, and Weaver projects; namely coastal plain or Great Lakes shorelines that may act as major bird migration concentration zones. All these projects were located much closer to the coast than Weaver, which is 18 miles from the coast. This included using preliminary bird fatality rate estimates derived from post-construction fatality monitoring that has been conducted at two commercial wind energy facilities along the Texas Gulf Coast that have been previously discussed and three wind projects located adjacent to the Great Lakes. The Gulf Wind and Penascal Wind projects are located between 2.0 and 12.0 miles (mi; 3.2 and 19.3 kilometers [km]) west of the coastal Laguna Madre National Wildlife Refuge in Kenedy County, Texas. These projects are located in the Central Flyway, one of North America's most significant concentration zones for migrating birds. The Great Lakes projects are also within a major migratory area where stopover or landing options for nocturnally migrating birds may be focused or constrained, resulting in higher bird concentrations.

At the two Texas Gulf coastal wind energy facilities (totaling 687 MW) studied by Erickson (2010), the initial data for the entire Spring 2010 documented 300 avian fatalities, including nocturnally migrating birds such as yellow-breasted chat (*Icteria virens*), red-eyed vireo, white-eyed vireo (*Vireo griseus*), and American redstart (*Setophaga ruticilla*). This information was gathered using both human searchers and dogs to conduct daily fatality searches at 14 turbines at each project site during the spring and fall migration periods. No large bird mortality events (>100 carcasses) were documented during this survey period (Erickson 2010) and the preliminary bird mortality levels were consistent with studies at other wind farms located in non-coastal areas. This is relevant to the Weaver, Bull Hill and Hancock projects in that, while levels of avian use – particularly nocturnal migrant use – and the overall risk profile of the two coastal Texas projects was expected to be high, studies of the site did not demonstrate elevated risk to migrating songbirds.

Studies along the Great Lakes had similar results. The Prince Wind Power Project is a 126-wind turbine project located 1-2 mi (2-3 km) from the Lake Superior shoreline near Sault Ste. Marie, Ontario. Given its location near the lakeshore to the south of Goulais Bay, this site would appear a likely site were migratory bird movements might concentrate – particularly passerines moving south during the fall migration (Diehl et al. 2003). The results of three years of intensive post-construction mortality monitoring at this site resulted in adjusted bird mortality estimates of 0.54 to 2.15 birds per turbine per study year (Natural Resource Solutions 2009). These estimates were adjusted for searcher efficiency and scavenger removal, these estimates are similar to reported totals for other wind power projects well away from the Great Lakes or distinct migration zones, including open agricultural lands. The Prince Wind Power Project studies focused on spring and fall migration (as well as the summer periods); however, there was no documentation of any large passerine mortality events over the course of the surveys – surveys that included monitoring at all of the turbines 3-5 times per week in 2008 and monitoring at 1/3 of the turbines 2-5 times a week in 2006 and 2007 (Natural Resource Solutions 2009).

Similar mortality studies were conducted at the Wolfe Island Wind Plant, a project that includes 86 utility-scale wind turbines located on Wolfe Island in Lake Ontario near the headwaters of the Saint Lawrence River in Ontario. Given its coastal location on the northeast side of Lake Ontario, this appears to be another location where one might expect to see concentrated migratory bird movements. However, the results of a full year (July 2009 through June 2010) of post-construction monitoring (1-2 turbine searches per week) at all of the turbines at the site resulted in adjusted mortality estimates of 13.38 birds per turbine per year, or 5.82 birds per MW per year (Stantec Ltd. 2010, 2011). Though higher than average, this estimate remains within the range reported at other wind projects. As with the other studies examined, there were no large mortality events documented in this survey, including during the migratory period.

Howe et al. (2002) studied bird mortality at 31 wind turbines located on a peninsula within five mi (eight km) of Lake Michigan in northern Kewaunee County, Wisconsin – at a site where the proximity of the Green Bay to the west and the main body of Lake Michigan to the east might be expected to concentrate bird migratory movement and stopover use. Nevertheless, the study resulted in adjusted fatality rates of 1.29 birds per turbine per year. No large mortality events were documented in this survey, including during the migratory period.

Although the survey protocols and fatality estimation techniques vary for each of these studies, these estimated fatality rates are similar to, or slightly lower than, average bird fatality rates that have been estimated in the US as a whole (Strickland et al. 2011, Loss et al. 2013, Erickson et al. 2014). None of these estimates would indicate project-level impacts that would be of concern to local or regional populations of the species recorded as fatalities.

LARGE MORTALITY EVENTS AND ASSOCIATED RISK FACTORS

Current research indicates that mortality of nocturnally migrating birds at wind farms in the US is widely distributed across time and space and not occurring in concentrated or large scale mortality events, though levels are generally higher during migratory seasons of the year, and nights of inclement weather during peak migration periods are known to result in higher mortality levels at structures. In this section, we discuss what is known about risk factors associated with large fatality events at various structure types and review the relatively small fatality events that have been associated with wind energy facilities.

In most studies conducted to date, inclement weather has been associated with large-scale mortality events that have occurred at structures such as communication towers (Manville 2000; Kerlinger 2000; Longcore et al. 2012, 2013), as well as at street lights, lighthouses, water towers, oil and gas flaming operations, ski lifts, and other lit structures. In addition, large-scale fatality events have been reported at natural gas compressor stations equipped with bright flood lights. These events usually occur in inclement weather when navigational cues are obscured. As a result, birds are attracted to the lights of facilities and structures, become disoriented and remain in the lighted zone where they circle the structures at risk of death from exhaustion, collision with the tower and its guy wires, and collisions with each other (Gauthreaux and Belser 2006).

A few examples of these large events are provided below. At one oil flare stack in Alberta, 1,393 dead birds comprising 24 species of passerines were found over a 2-day period in May 1980 (Bjorge 1987). Over a 3-day period in October 1964, Case et al. (1965) searched several buildings in Florida and recovered 4,707 dead birds, most of which were passerines. Also in Florida, Maehr et al. (1983) searched the base of four smokestacks over a 2-day period in September and recovered 1,265 dead passerines. The authors estimated that 5,000 birds might have collided with the structures during this period. In the fall of 1970, 707 dead birds were documented below the Empire State Building in New York (Bagg 1971). From October 5-8, 1954, 9,495 dead birds (mostly passerines) were found at 25 tall buildings in the eastern and southern US following a cold front during fall migration, and it was estimated that 106,804 birds were actually killed (Johnston and Haines 1957).

Several long-term studies have documented the chronic nature of collision mortality associated with some buildings (Erickson et al. 2001). Over a 3-year period in Toronto, Ontario, Ogden (1996) counted 5,454 dead birds at 54 tall glass buildings and estimated that 733 birds (mostly passerines) were killed per building per year. Following nights with inclement weather conditions, Taylor and Kershner (1986) searched one building in Florida from 1970 to 1981 and documented 5,046 avian fatalities comprised of 62 species, the majority of which were passerines. Two smokestacks in Citrus County, Florida were searched five times per week from 1982 to 1986, and 2,301 dead birds were found (Maehr and Smith 1988). From this, the authors estimated that 541.4 birds were killed per year. Fatalities included 50 species, most of which were neotropical migrant passerines. Daily searches of two smokestacks in Ontario, Canada over a 4-year period yielded 8,531 dead birds. Again, most of these were passerines (Weir 1976).

Fortunately, recent studies have demonstrated that avian collisions with manmade structures can be reduced dramatically with the adoption of certain lighting regimes that do not attract birds (Gehring et al. 2009, Kerlinger et al. 2010, Patterson 2012). The primary recommendations are minimizing lighting, downward case lighting, and for Federal Aviation Administration lighting using short duration pulsating lights. Additionally, most birds that die after being attracted to communication towers by lighting are killed when they collide with the guy wires that support those towers; erecting towers that are self-supporting can serve to reduce this risk.

The five largest nightly bird mortality events yet recorded where birds collided with turbines at wind energy facilities in the US were of 52 birds (Stantec 2015), 33 birds (Kerns and Kerlinger 2004), 30 birds (Young et al. 2012), 28 birds (Stantec 2015), and 14 birds (Johnson et al. 2002; Table 5). None of these events are anywhere near the magnitude of large events that have occurred at guyed communication towers or some tall buildings. In one case, 314 birds collided at a wind facility substation and battery storage facility where the lighting was left on.[1]

The first and fourth events were at the same facility on consecutive nights, characterized by fog, overcast, and low wind conditions. The second event was also associated with light attraction from substation lighting during overcast conditions, although fatalities occurred from collisions with both substation equipment and three of the turbines nearest the substation. The third event occurred at the NedPower Mount Storm Wind Energy Facility, 30 bird carcasses were reported from a single turbine (Young et al. 2012). This event was likely caused by fog and lights in the turbine nacelle that were unintentionally left on at nighttime.

The fifth event occurred in the Buffalo Ridge area of southwestern Minnesota in an agricultural setting, and it was believed to have been associated with a thunderstorm.

[1] This event, which was documented on the morning of October 3, 2011, was actually associated with a nearby battery energy storage system and substation and not the wind turbines (Peterson 2011). These fatalities were likely to have occurred sometime during the previous three nights. More fatality searches were conducted over the next two weeks with a total of 484 bird carcasses representing 29 species recovered. These fatalities did not result from wind turbine collisions, but from lighting at the electrical substation and battery storage facility during a night with heavy migration activity and overcast conditions.

Table 5. Large bird mortality events associated with wind turbine collisions recorded in the US.

Project	Date	# carcasses	Believed Cause
Record Hill, ME	Sept 30, 2014	52 carcasses during one night, 80 carcasses found over two nights	Thick fog and low cloud cover
Mountaineer, WV	May 23, 2003	33 fatalities	Combination of heavy fog and the presence of several sodium vapor lights
Mount Storm, WV	Sept 25, 2011	30 carcasses	Nacelle light unintentionally left on and fog
Record Hill, ME	Oct 1, 2014	28 carcasses	Thick fog and low cloud cover
Buffalo Ridge, MN	May 17, 1999	14 carcasses (11 warblers, two flycatchers, one vireo) were found underneath two adjacent turbines in the P3 wind plant.	A severe thunderstorm the previous night may have forced these birds to fly at lower than normal altitudes while migrating.

CONCLUSION

With best management practices in place for lighting, the risk of large mortality events appears very low for the Weaver project, as well as the two projects considered nearby. No large mortality events have been reported due to collisions with wind turbines at any wind farm in North America, with the exception of a few events associated with inappropriate lighting and collision with non-turbine structures. Even in the event of a very large (500-1,000 bird) event, the impact on bird species populations is still negligible.

Based on similar methods used by Longcore et al. (2012) and Erickson et al. (2014), avian fatality from the Weaver, Bull Hill, and Hancock Wind Projects are predicted to be very small and effectively immeasurable on regional small passerine populations and this conclusion is similar to the conclusion reached previously (Erickson et al. 2015). In addition, the cumulative impacts of all wind projects in BCR 14 also have an effectively immeasurable effect on the regional populations.

REFERENCES

American Wind Energy Association (AWEA). 2018. U.S. Wind Energy State Facts. Accessed August 29, 2018. Available online at: http://www.awea.org/resources/statefactsheets.aspx?itemnumber =890&&navItemNumber=5067

Bagg, A. M. 1971. The Changing Seasons. American Birds 25(1): 16-23.

Bjorge, R. R. 1987. Birds kill at an oil industry flare stack in northwest Alberta. The Canadian Field-Naturalist 101: 346-350.

Blancher, P. J., K. V. Rosenberg, A. O. Panjabi, B. Altman, A. R. Couturier, W. E. Thogmartin, and the Partners in Flight Science Committee. 2013. Handbook to the Partners in Flight Population Estimates Database. Version: 2.0. Partners in Flight (PIF) Technical Series No. 6. Available online at: http://www.partnersinflight.org/pubs/ts/

Case, L. D., H. Cruickshank, A. E. Ellis, and W. F. White. 1965. Weather causes heavy bird mortality. Florida Naturalist 38(1): 29-30.

Diehl, R. H., R. P. Larkin, and J. E. Black. 2003. Radar Observations of Bird Migration over the Great Lakes. The Auk 120(2): 278-290.

Erickson, W. P. 2010. Texas Gulf Coast Avian and Bat Fatality and Curtailment Approaches. Presented at the National Wind Coordinating Collaborative (NWCC) Wildlife and Wind Research Meeting VIII, October 19-21, 2010, Lakewood, Colorado. Available online at: http://nationalwind.org/wp-content/uploads/assets/research_meetings/Research_Meeting_VIII_Proceedings1.pdf

Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Bird Collision Mortality in the United States. National Wind Coordinating Collaborative (NWCC) Publication and Resource Document. Prepared for the NWCC by WEST, Inc., Cheyenne, Wyoming. August 2001.

Erickson, W. P., K. J. Bay, and S. Howlin. 2015. Weaver wind project impacts and risks to small passerine populations. Prepared for SunEdison, Portland, Maine. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. July 13, 2015.

Erickson, W. P., M. M. Wolfe, K. J. Bay, D. H. Johnson, and J. L. Gehring. 2014. A Comprehensive Analysis of Small Passerine Fatalities from Collisions with Turbines at Wind Energy Facilities. PLoS ONE 9(9): e107491. doi: 10.1371/journal.pone.0107491.

Gauthreaux, S.A. Jr. and C. G. Belser. 2006. Effects of Artificial Night Lighting on Migratory Birds. Pp. 67-93. In: C. Rich and T. Longcore, eds. Ecological Consequences of Artificial Night Lighting. Island Press, Washington, D.C.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2009. Communication Towers, Lights, and Birds: Successful Methods of Reducing the Frequency of Avian Collisions. Ecological Applications 19(2): 505-514.

Howe, R. W., W. Evans, and A. T. Wolf. 2002. Effects of Wind Turbines on Birds and Bats in Northeastern Wisconsin. Prepared by University of Wisconsin-Green Bay, for Wisconsin Public Service Corporation and Madison Gas and Electric Company, Madison, Wisconsin. November 21, 2002. 104 pp.

Huso, M. 2010. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22(3): 318-329. doi: 10.1002/env.1052.

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002. Collision Mortality of Local and Migrant Birds at a Large-Scale Wind-Power Development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30(3): 879-887.

Johnston, D. W. and T. P. Haines. 1957. Analysis of mass bird mortality in October, 1954. The Auk 74: 447-458.

Kerlinger, P. 2000. Avian Mortality at Communication Towers: A Review of the Recent Literature, Research, and Methodology. US Fish and Wildlife Service, Office of Migratory Bird Management. March 2000.

Kerlinger, P., J. L. Gehring, W. P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. Wilson Journal of Ornithology 122(4): 744-754.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collision Fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D. G. Bert, L. M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M. L. Avery, R. L. Crawford, A.M. Manville, II, E. R. Travis, and D. Drake. 2012. An Estimate of Avian Mortality at Communication Towers in the United States and Canada. PLoS ONE 7(4): e34025. doi: 10.1371/journal.pone.0034025.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D. G. Bert, L. M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M. L. Avery, R. L. Crawford, A.M. Manville, II, E. R. Travis, and D. Drake. 2013. Avian Mortality at Communication Towers in the United States and Canada: Which Species, How Many, and Where? Biological Conservation 158: 410-419.

Loss, S. R., T. Will, and P. P. Marra. 2013. Estimates of Bird Collision Mortality at Wind Facilities in the Contiguous United States. Biological Conservation 168: 201-209.

Maehr, D. S. and J. Q. Smith. 1988. Bird casualties at a central Florida power plant: 1982-1986. Florida Field Naturalist 16: 57-80

Maehr, D. S., A. G. Spratt, and D. K. Voigts. 1983. Bird casualties at a central Florida power plant. Florida Field Naturalist 11(3): 45-68.

Manville, A. 2000. Avian Mortality at Communication Towers: Background and Overview. Pp. In: W. R. Evans and A. M. Manville, II, eds. Proceedings of the Workshop on Avian Mortality at Communication Towers; 1-5

National Geographic Society (National Geographic). 2018. World Maps. Digital topographic map. PDF topographic map quads. Accessed March 8, 2018. Available online: http://www.natgeomaps.com/trail-maps/pdf-quads

Natural Resource Solutions Inc. (NRSI). 2009. 2006, 2007 and 2008 Bird and Bat Mortality Monitoring, Prince Wind Power Project. Project No. 821, D. Stephenson, Senior Biologist. Prepared for Brookfield Renewable Power, Gatineau, Quebec. Prepared by NSRI, Waterloo, Ontario. May 5, 2009.

North American Datum (NAD). 1983. Nad83 Geodetic Datum.

Ogden, L. J. E. 1996. Collision course: The hazards of lighted structures and windows to migrating birds. Toronto, Ontario: World Wildlife Fund Canada and the Fatal Light Awareness Program; 46 p.

Partners in Flight Science Committee. 2013. Population Estimates Database. Version 2013. Accessed June 4, 2015. Available online at: http://rmbo.org/pifpopestimates

Patterson, J.W. Jr. 2012. Evaluation of New Obstruction Lighting Techniques to Reduce Avian Fatalities. DOT/FAA/TC-TN12/9. National Technical Information Services (NTIS), Springfield, Virginia.

Peterson, T. 2011. Bird Mortality Event at Laurel Mountain Substation. Prepared for US Fish and Wildlife Service (USFWS) Elkins, West Virginia. Prepared by Stantec Consulting Services, Inc

Shoenfeld, P. 2004. Suggestions Regarding Avian Mortality Extrapolation. Technical memo provided to FPL Energy. West Virginia Highlands Conservancy, HC70, Box 553, Davis, West Virginia, 26260.

Stantec Consulting Ltd. (Stantec Ltd.). 2010. Wolfe Island Ecopower Centre Post-Construction Followup Plan. Bird and Bat Resources Monitoring Report No. 2: July - December 2009. File No. 160960494. Prepared for TransAlta Corporation's wholly owned subsidiary, Canadian Renewable Energy Corporation. Prepared by Stantec Ltd., Guelph, Ontario. May 2010.

Stantec Consulting Ltd. (Stantec Ltd.). 2011. Wolfe Island Wind Plant Post-Construction Follow-up Plan. Bird and Bat Resources Monitoring Report No. 3: January - June 2010. File No. 160960494. Prepared for TransAlta Corporation's wholly owned subsidiary, Canadian Renewable Energy Corporation. Prepared by Stantec Consulting Ltd., Guelph, Ontario. January 2011.

Stantec Consulting, Inc. (Stantec). 2015. Bull Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Bull Hill Wind Project, Hancock County, Maine. Prepared for Blue Sky East, LLC, and First Wind, Portland, Maine. Prepared by Stantec, Topsham, Maine.

Strickland, M. D., E. B. Arnett, W. P. Erickson, D. H. Johnson, G. D. Johnson, M. L. Morrison, J. A. Shaffer, and W. Warren-Hicks. 2011. Comprehensive Guide to Studying Wind Energy/Wildlife Interactions. Prepared for the National Wind Coordinating Collaborative (NWCC), Washington, D.C., USA. June 2011. Available online at: http://www.batsandwind.org/pdf/Comprehensive_Guide_to_Studying_Wind_Energy_Wildlife_Interactions_2011.pdf

Taylor, W. K. and M. A. Kershner. 1986. Migrant birds killed at the Vehicle Assembly Building (VAB), John F. Kennedy Space Center. Journal of Field Ornithology 57: 142-154.

US Geological Survey (USGS). 2018. USGS Topographic Maps. Accessed January 17, 2018. Information online: https://nationalmap.gov/ustopo/index.html

Weir, R. D. 1976. Annotated bibliography of bird kills at manmade obstacles: a review of the state of the art and solutions. Canadian Wildlife Services, Ontario Region, Ottawa.

Young, D.P., Jr., S. Nomani, Z. Courage, and K. Bay. 2012. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 27, 2012.

Appendix A: References for 30 Studies Included in Regional Fatality Estimate

Bigham, ME (2017)

TRC. 2017. Bingham Wind Project: Post-Construction Bird and Bat Fatality Monitoring Report, Year 1 (2017). Prepared for Novatus Energy, LLC, New York, New York. Prepared by TRC, Scarborough, Maine. December 2017.

Bull Hill, ME (2013)

Stantec Consulting, Inc. (Stantec). 2014. Bull Hill Wind Project Year 1 Post-Construction Wildlife Monitoring Report, 2013. Bull Hill Wind Project, Hancock County, Maine. Prepared for Blue Sky East, LLC, and First Wind, Portland, Maine. Prepared by Stantec, Topsham, Maine. February 2014.

Bull Hill, ME (2014)

Stantec Consulting, Inc. (Stantec). 2015. Bull Hill Wind Project Year 2 Post-Construction Wildlife Monitoring Report, 2014. Bull Hill Wind Project, Hancock County, Maine. Prepared for Blue Sky East, LLC, and First Wind, Portland, Maine. Prepared by Stantec, Topsham, Maine.

Hancock, ME (2017)

TRC. 2017. Hancock Wind Project: Post-Construction Bird and Bat Fatality Monitoring Report, Year 1 (2017). Prepared for Novatus Energy, LLC, New York, New York. Prepared by TRC, Scarborough, Maine. December 2017.

Kibby, ME (2011)

Stantec Consulting, Inc. (Stantec). 2012. 2011 Post-Construction Monitoring Report, Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc., North Walpole, New Hampshire. Prepared by Stantec, Topsham, Maine. March 2012.

Lempster, NH (2009)

Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project, Iberdrola Renewables. Prepared for Lempster Wind, LLC, Lempster Wind Technical Advisory Committee, and Iberdrola Renewables, Inc. Prepared by Western EcoSystems Technology Inc.

Lempster, NH (2010)

Tidhar, D., W. L. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for the Lempster Wind Project, Lempster, New Hampshire. Prepared for Iberdrola Renewables, Inc. and the Lempster Wind Technical Committee. Prepared by Western EcoSystems Technology, Inc.

Maple Ridge, NY (2006)

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final Report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Maple Ridge, NY (2007)

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study - 2007. Final report prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study. May 6, 2009.

Maple Ridge, NY (2007-2008)

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, and M. Lehman. 2009. Maple Ridge Wind Power Avian and Bat Fatality Study Report - 2008. Annual Report for the Maple Ridge Wind Power Project, Post-construction Bird and Bat Fatality Study - 2008. Prepared for Iberdrola Renewables, Inc, Horizon Energy, and the Technical Advisory Committee (TAC) for the Maple Ridge Project Study. Prepared by Curry and Kerlinger, LLC. May 14, 2009.

Mars Hill, ME (2007)

Stantec Consulting, Inc. (Stantec). 2008. 2007 Spring, Summer, and Fall Post-Construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Prepared for UPC Wind Management, LLC, Cumberland, Maine. Prepared by Stantec (formerly Woodlot Alternatives, Inc.), Topsham, Maine. January 2008.

Mars Hill, ME (2008)

Stantec Consulting, Inc. (Stantec). 2009. Post-Construction Monitoring at the Mars Hill Wind Farm, Maine - Year 2, 2008. Prepared for First Wind Management, LLC, Portland, Maine. Prepared by Stantec Consulting, Topsham, Maine. January 2009.

Noble Altona, NY (2010)

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011. Annual Report for the Noble Altona Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Noble Chateaugay, NY (2010)

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011. Annual Report for the Noble Chateaugay Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Noble Clinton, NY (2008)

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009. Annual Report for the Noble Clinton Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Noble Clinton, NY (2009)

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010. Annual Report for the Noble Clinton Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 9, 2010.

Noble Ellenburg, NY (2008)

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Noble Ellenburg, NY (2009)

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010. Annual Report for the Noble Ellenburg Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 14, 2010.

Oakfield, ME (2017)

TRC. 2018. Oakfield Wind Project: Post-Construction Bird and Bat Fatality Monitoring Report, Year 2 (2017). Prepared for Novatus Energy, LLC, New York, New York. Prepared by TRC, Scarborough, Maine. January 2018.

Record Hill, ME (2012)

Stantec Consulting, Inc. (Stantec). 2013. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind LLC, Lyme, New Hampshire. Prepared by Stantec Consulting, Topsham, Maine. March 2013. Available online at: http://www.maine.gov/dep/ftp/WindPowerProjectFiles/PostConstructionMonitoring/RH%202012%20PCM%20Report_031313.pdf

Record Hill, ME (2016)

Stantec Consulting Services Inc. (Stantec). 2017. Final Post-Construction Monitoring Report, Year 3, Record Hill Wind Project. Prepared for Record Hill Wind LLC, Lyme, New Hampshire. Prepared by Stantec, Topsham, Maine. March 16, 2017.

Rollins, ME (2012)

Stantec Consulting, Inc. (Stantec). 2013. Rollins Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, Portland, Maine. Prepared by Stantec, Topsham, Maine. March 2013.

Sheffield, VT (2012)

Martin, C., E. Arnett, and M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont. 2012 Annual Report. Department of Natural Resources Management, Texas Tech University, Lubbock, Texas. Prepared for Bat Conservation International and First Wind. March 25, 2013.

Spruce Mountain, ME (2012)

Tetra Tech. 2013. Spruce Mountain Wind Project Post-Construction Bird and Bat Fatality and Raptor Monitoring: Year 1 Annual Report. Prepared for Patriot Renewables. Prepared by Tetra Tech, Portland, Maine. May 2013. Available online at: http://www.maine.gov/dep/ftp/WindPowerProjectFiles/PostConstructionMonitoring/SMW%202012%20post%20consturction%20monitoring%20report.pdf

Spruce Mountain, ME (2014)

Tetra Tech, Inc. (Tetra Tech). 2015. Post-Construction Monitoring Report 2014: Spruce Mountain Wind Project, Woodstock, Maine. Final. Prepared for Patriot Renewables and Spruce Mountain Wind. Prepared by Tetra Tech, Portland, Maine. February 2015.

Stetson Mountain I, ME (2009)

Stantec Consulting, Inc. (Stantec). 2009. Stetson I Mountain Wind Project: Year 1 Post-Construction Monitoring Report, 2009 for the Stetson Mountain Wind Project in Penobscot and Washington Counties, Maine. Prepared for First Wind Management, LLC. Portland, Maine. Prepared by Stantec, Topsham, Maine. December 2009.

Stetson Mountain I, ME (2011)

Normandeau Associates, Inc. 2011. Year 3 Post- Construction Avian and Bat Casualty Monitoring at the Stetson I Wind Farm, T8 R4 NBPP, Maine. Prepared for First Wind Energy, LLC, Portland, Maine. Prepared by Normandeau Associates, Inc., Falmouth, Maine. December 2011.

Stetson Mountain I, ME (2013)

Stantec Consulting, Inc. (Stantec). 2014. Stetson I Wind Project 2013 Post-Construction Wildlife Monitoring Report, Year 5. Stetson I Wind Project, Washington County, Maine. Prepared for First Wind, Portland, Maine. Prepared by Stantec Consulting, Topsham, Maine. February 2014.

Stetson Mountain II, ME (2010)

Normandeau Associates, Inc. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring Study, T8 R4 NBPP, Maine. Prepared for First Wind, LLC, Portland, Maine. Prepared by Normandeau Associates, Inc., Falmouth, Maine. December 2, 2010.

Stetson Mountain II, ME (2012)

Stantec Consulting, Inc. (Stantec). 2013. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, Portland, Maine. Prepared by Stantec Consulting, Topsham, Maine. March 2013.