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1.0 Introduction

The Bull Hill Wind Project (the project) is anticipated to affect local wildlife populations in various ways. Initially, the direct loss of habitat will 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, and possible longer-term, avoidance of the area by some species and targeted use of the project area by others, or the conversion of forested habitats to early successional habitats. Wind turbines could also pose a direct risk of fatalities if birds and bats collide with the turbines. Emerging information from post-construction studies at existing wind farms with modern turbine structures suggests that collision rates of birds are generally low, especially in comparison to other sources of avian collision-related mortality. Bat fatalities were discovered in relatively small numbers beginning in the late 1990s in conjunction with avian fatality monitoring. However, several high profile bat mortality events at wind facilities on forested ridges of the Appalachian Mountains in 2003 and 2004 raised concerns about the impacts to bats (Kunz *et al.* 2007a).

Although all wind projects have direct and indirect impacts on wildlife, steps were taken to ensure that the best information available was obtained through literature review and on-site surveys to identify possible project impacts. A review of available natural resource information in the area and ecological field investigations were conducted to characterize the habitats and wildlife use of the proposed turbine development area. This information helps characterize the habitats present in the project area, identify the predominant wildlife using the area, characterize some of the more critical resource concerns typically associated with wind energy developments, and address any site-specific concerns for the project.

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.

Consultations that were initiated with natural resource review agencies included:

- Maine Department of Conservation Maine Natural Areas Program (MNAP);
- Maine Department of Inland Fisheries and Wildlife (MDIFW); and
- U.S. Fish and Wildlife Service (USFWS).

Available databases of ecological resources and classification systems that were used during this characterization and assessment included:

- Database of Essential Habitats and Sensitive Natural Areas, as categorized by the MDIFW (http://megisims.state.me.us);
- Land Use Regulation Commission Land Use Maps (http://www.state.me.us/doc/lurc); and
- Natural Landscapes of Maine – the MNAP natural community classification system (Gawler and Cutko 2004).

Letters asked for these agencies to identify any known significant resources and/or habitats in the vicinity of the project. A response letter from MDIFW indicated that no Significant or Essential Wildlife Habitats or significant fisheries resources were known to occur in the project area (Exhibit 12B). The USFWS response indicated that the project is in the range of the Gulf of Maine Distinct Population Segment (GOM DPS), and the project is within the area designated as critical habitat for Atlantic salmon (*Salmo salar*) (74 FR 29300; June 19, 2009) (Exhibit 12B). USFWS asked that any stream crossing be documented and reported to USFWS and federal permitting or funding agencies. USFWS also identified the possible occurrence of bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) through the project area during migration.

To evaluate potential impacts to seasonally local and migrant raptors, particularly conservation concern species, MDIFW and USFWS recommended that raptor-use and migration surveys be conducted at the project during the summer and fall in 2009. 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 MDIFW. Studies included avian and bat studies, as well as nocturnal radar surveys, raptor migration surveys, aerial bald eagle nest surveys, and bat acoustic surveys, to be conducted project during the fall of 2009 and the spring of 2010. Other site-specific surveys included a review of aerial photography to characterize the predominant cover types and habitats of the project area and surrounding vicinity and wetland mapping and vernal pool surveys, which occurred in the fall of 2009 and spring of 2010. Studies were designed to address general concerns of state and federal agencies aside from critical habitat for rare, threatened or endangered species. 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.

Stantec also participated in a conference call with representatives from MDIFW and USFWS in March 2009 to discuss the protocol for aerial bald eagle nest searches. Both agencies confirmed the appropriate timing for these surveys and provided Geographic Information System data for both known bald eagle nests and rookeries of great blue heron (*Ardea herodias*), a state species of special concern, in the vicinity of the project area.

The following sections outline the regional and local landscape setting, the dominant vegetation types and wildlife species, and the significant natural resources that occur in vicinity of the project. The potential project impacts to natural resources and wildlife are discussed along with resource avoidance strategies and possible mitigation methods. These sections focus on that part of the project where wind turbines are proposed, as well as the access roads required to construct the project and maintain project operations. This project area is largely limited to the hill tops, side-slopes and access roads where turbines will be sited.

2.0 Ecological Setting of the Project Area

The project area is located in T16 MD, in Hancock County. The project is located in the Eastern Interior biophysical region of Maine. The region is characterized by gently rolling topography with elevations between 85 to 190 meters (280 to 624 feet ['']). The region contains extensive glacial stream deposits, with the state's largest example of a glaciomarine delta (Pineo Ridge) occurring in the eastern portion of the region. The region is generally undeveloped; however, there are some sparsely developed residential and agricultural areas that are mainly located south of the project area, including small residential areas in the towns of Eastbrook and Franklin as well as seasonal camps on Molasses and Spectacle Ponds. The dominant land use is commercial forestry, as well as recreational boating, fishing, hunting, and snowmobiling.

The area immediately surrounding the project area consists of a series of coastal low elevation hills around Bull Hill and Heifer Hill. At 190 meters (624') 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 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 area around the project area is almost entirely undeveloped.

Representative vegetation communities present within the area immediately surrounding the project area includes: forested uplands and wetlands, scrub-shrub wetlands, emergent wetlands, and stream systems. Forested communities are representative throughout and dominate higher elevations within the project area, while wetland systems are most common at lower elevations. Examples of these wetland communities present in the vicinity of the project area include: Oxbow Heath, Frenches Dam Meadow, and Austins Dam Heath. These communities are large, open wetland systems with narrow stream channels bordered by areas of dense ericaceous shrubs; stands and even individual dead standings trees appear to be infrequent based on initial visits to these areas. 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 region are forested, with occasional scrub-shrub and emergent wetlands associated with disturbance from timber harvesting. Streams in the region 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 within Designated Critical Habitat for the federally-listed Atlantic salmon. 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 (IWWH) or Deer Wintering Areas (DWA).

There are no MNAP-listed critically imperiled or imperiled natural communities in the project area. Additionally, no MDIFW Significant Wildlife Habitats have been mapped on either mountain. See Exhibit 12A for a detailed analysis of wetland and vernal pool resources. Several natural depressions or basins, as well as pools in old skidder tracks or previously cleared areas, hold water seasonally and may serve as breeding sites for species generally associated with vernal pools.

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 and recent land uses (i.e., forest harvesting) are probably the most significant factors affecting the type and structure of the available habitats. Field surveys conducted in 2009 indicate that the project site is characterized primarily by regenerating upland hardwood forest with pockets of emergent, scrub-shrub, and some forested wetlands. Small streams and drainages are scattered throughout the project area. The ridgeline itself consists of predominantly deep, well-drained soils on flat to moderate slopes. Small areas of mixed conifer-deciduous forest or conifer-dominated forest occur sporadically and these occur mainly in wetlands.

The project layout was designed to use existing roadways and maximize wetland avoidance and, therefore, the proposed turbines are sited in previously disturbed upland hardwood forested areas. A description of the natural communities that occur in the project area follows below.

3.1. Upland Hardwood Forest

Upland forested habitats on Bull and Heifer Hills largely fall within the Spruce-Fir-Northern Hardwoods Forest Ecosystem. This is a very common, widespread ecosystem throughout most of northern Maine (Gawler and Cutko 2005). A variety of forested natural communities can occur within this ecosystem but only one, Beech-Birch-Maple Forest, predominates in the project area.

Beech-Birch-Maple Forest is the dominant hardwood forest in the State and is ranked by MNAP as S4. It is predominant along the length of the project's turbine area, as well as along the side slopes of the hills. Common tree species include American beech, paper birch, yellow birch (*Betula alleghaniensis*), sugar maple, striped maple (*Acer pensylvanicum*), and red maple. White ash is also locally common, and red oak is an occasional component of the canopy. Canopy closure is variable and dependant on the intensity of forest harvesting practices that have occurred in the last 5 to 10 years. The majority of the project area has been heavily logged in the last five years, and the canopy in those areas is primarily open. Areas not recently affected by harvesting have a canopy that is closed with some patchy open areas, resulting in a shaded forest floor with limited herbaceous and shrub development. Common

species include evergreen wood fern, Christmas fern (*Polystichum acrostichoides*), lady fern (*Athyrium filix-femina*), bluebead lily (*Clintonia borealis*), bunchberry, wild sarsaparilla, and Canada mayflower.

Areas with open tree canopies from forest harvesting are abundant across the turbine areas. These areas typically have a canopy closure of 60 percent or less, which is atypical of this hardwood forest community. Due to the openness of the canopy, the understory in these areas, which typically includes a suite of a limited number of shade tolerant species, is more robust than usual. The understory in these areas is typically very dense and includes shrub-sized saplings of the dominant tree species such as red maple, sugar maple, and American beech; common hardwood forest understory shrubs such as beaked hazel nut (*Corylus cornuta*), striped maple, and hobblebush (*Viburnum alnifolium*), and typical open habitat species such as red raspberry (*Rubus idaeus*) and bristly blackberry (*Rubus allegheniensis*).

Early successional habitat occurs in the project area in locations that have been previously disturbed, including along road and trail edges, meteorological measurement tower clearings, and areas that have previously been heavily logged. These areas are fairly limited on the mountain. This is because, as explained above, most of the forest harvesting that has recently occurred on the mountain has included heavy selection cutting, rather than clear-cutting. Consequently, the harvested areas, while containing habitat features typical of early successional habitats such as dense shrubs and saplings, still have an intact, though sometimes quite open, canopy of mature trees and are described in the previous section.

A few areas of complete canopy removal, however, do occur and have a characteristic plant species composition. Shrubs, saplings, and wildflowers characterize some of these areas; species common to these areas include stump sprouts and saplings of some of the canopy species, pin cherry (*Prunus pensylvanica*), red raspberry, bristly blackberry, whorled aster (*Oclemena acuminata*), and rough-stemmed goldenrod (*Solidago rugosa*). In other areas of complete canopy removal, dense, regenerating softwood species, particularly red spruce, is dominant.

3.2. Wetlands

Wetlands in the project area were identified and delineated in the fall of 2009 and spring of 2010. The complete report is included as Exhibit 12A. Just over one hundred forested wetlands, streams, scrub-shrub/emergent wetlands, and vernal pools were documented in the area during those surveys. As previously noted, the landscape surrounding Bull and Heifer Hills contains an abundance of wetland habitats, including forested swamps, shrub swamps and bogs, and brooks and streams. These resources, however, occur outside of the areas that are being proposed for wind turbine development. .

Wetlands that occur on the mountain are located primarily in the low lying areas between the hills and along the existing access roads. To the extent practicable, the project will be designed to reduce potential detrimental effects to wetlands and associated habitat.

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 in 2009 and 2010.

Appendix A, Table 1 lists the wildlife species incidentally observed during extensive field surveys conducted at the project area in 2009 and 2010. This list was used to develop a matrix identifying those species documented or suspected to occur in the project area based on the habitats they would use, and the timing of that use (Appendix A Table 2). This matrix should be referred to for a more complete listing of the major taxonomic groups of wildlife anticipated to occur in the project area.

4.1. Amphibians and Reptiles

Due to the predominance of upland hardwood forest in the project area, non-breeding habitat for amphibians is common. The open canopy of these forests, however, increases the amount of sunlight

and the summer temperature in these areas, which likely limits the distribution of some species. Regardless, common amphibians in the project area likely include northern redback salamander (*Plethodon cinereus*), American toad (*Bufo americanus*), gray treefrog (*Hyla versicolor*), and wood frog (*Rana sylvatica*). These species probably occur across the ridge top of the mountain, as habitat for them is evenly distributed at this location.

Species that are less likely to occur in the project area or have a more limited distribution include the blue-spotted salamander (*Ambystoma laterale*), spotted salamander (*Ambystoma maculata*), red-spotted newt (*Notophthalmus viridescens*), dusky salamander (*Desmognathus fuscus*), two-lined salamander (*Eurycea bislineata*), spring peeper (*Pseudacris crucifer*), and green frog (*Rana clamitans*). These species and their distributions are more closely tied to their breeding pool, permanent water body, or stream habitat. Considering the locations of these types of aquatic resources within the area proposed for wind turbine development and the current level of habitat disturbance, the likelihood of these species to occur in the turbine portion of the project or be impacted by construction and operation of the project is low.

The reptile community on Bull and Heifer Hills is likely represented predominantly by snakes, including the northern redbelly snake (*Storeria occipitomaculata*), common garter snake (*Thamnophis sirtalis*), and northern ringneck snake (*Diadophis punctatus*). The open canopy and dense shrub development across much of the project area probably provides suitable habitat for these species. Turtles are unlikely to occur in most of the project development footprint due to a lack of suitable habitat. Some species, however, do travel considerable distances during nesting. It is possible that some open areas at lower elevations in the project area, such as gravel roadsides, may be used as nesting habitat by snapping turtles (*Chelydra serpentina*) and painted turtles (*Chrysemys picta*) that might inhabit the wetlands proximal to large wetland complexes in the low lying areas outside the project area.

4.2. Birds

Birds are among the most abundant and diverse wildlife communities in the region, and the project area is no exception. A variety of species are known or suspected to occur, and species common to northern hardwood forests and open upland shrub habitat are prevalent. Bird species that frequent upland hardwood 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 (*Dendroica coronata*), black-throated blue warbler (*D. caerulescens*), and black and white warbler (*Mniotilta varia*). Raptors that inhabit upland hardwoods 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*). For a list of bird species incidentally observed in the project area during environmental field surveys, refer to Appendix A Table 1.

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 could be alder flycatcher (*Empidonax alnorum*), gray catbird (*Dumetella carolinensis*), and northern waterthrush (*Parkesia noveboracensis*).

No active bald eagle nests were identified in the project area during spring aerial nest surveys (Exhibit 13C). A known bald eagle nest (MDIFW Nest #360), was located on an island in Molasses Pond approximately two miles from the southwestern-most turbine, but the nest was not active in 2010. Attempts were made to find mapped bald eagle nest locations on Spectacle Pond (MDIFW #221A/B/C), approximately two miles northwest of the turbine string on Bull Hill, Webb Pond (MDIFW Nest #511), approximately six miles from the southwestern-most turbine, Scammon Pond (MDIFW Nest #170A/B), approximately four miles from the southwestern-most turbine, and Abrams Pond (MDIFW Nest #170C), approximately four miles from the southwestern-most turbine. No nests on these ponds were identified. During surveys, 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. Two active osprey (*Pandion haliaetus*) nests were identified along the transmission line that bisects the Project area. Attempts were made to locate a reported great blue heron rookery at the south end of Scammon Pond; however, no rookery was observed. Bald eagles and osprey were observed during raptor surveys conducted at the project in 2009 and 2010.[1]

Raptor migration surveys were conducted in summer and fall 2009 and winter and spring 2010. A total of 12 species of raptor were documented in the vicinity of the project area during raptor migration surveys and some of these species could potentially breed in the 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 at the project, 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. ..

4.3. Mammals

Large mammals observed in the Project area during on-site 2009 and 2010 environmental surveys include white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), and black bear (*Ursus americanus*). Predator specie observed includes American marten (*Martes americana*). Other predators expected to occur in the Project area based on their habitat requirements include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), fisher (*Martes pennanti*), long-tailed weasel (*Mustela frenata*), and raccoon (*Procyon lotor*). Common medium-sized mammals expected to occur in the area include porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), and striped skunk (*Mephitis mephitis*).

The small mammal community is likely made up of masked shrew (*Sorex cinereus*), pygmy shrew (*Sorex hoyi*), northern short-tailed shrew (*Blarina brevicauda*), eastern chipmunk (*Tamias striatus*), 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.

Bat acoustic surveys were conducted 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 (*Eptesicus fuscus*)/silver haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), and eastern red bat (*Lasiurus borealis*)/tri-colored bat (*Pipistrellus subflavus*) guilds.

[1] In addition to fall 2009 and spring 2010 raptor surveys, Stantec also performed supplemental surveys in fall 2010. Data are currently being summarized.

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 meteorological measurement towers (met towers). For full results of acoustic surveys conducted at Bull Hill, refer to Exhibit 13C.

4.4. Significant or Sensitive Wildlife Habitats and Species

The official agency response to letters requesting information on known significant or sensitive wildlife habitats and species in the project area from MDIFW (June and July 2009) identified a DWA more than one mile southwest of the project area. The MDIFW and MDEP also identified several mapped IWWH in the vicinity of the project area. All were more than one half mile from the project area. The only known threatened or endangered species habitat in the vicinity of the project area is for Atlantic salmon in perennial streams.

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. [2] 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. In the preliminary screening report,[3] 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, 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 14 streams, 3 of which are perennial, were identified during wetland delineation surveys at the project. Additional information on the streams identified in the project area is presented in Appendix C in Exhibit 12A. A total of 53 vernal pools were identified within the project area. Eighteen of those pools were determined to be naturally occurring. Of the 18 natural vernal pools, 7 were determined to be Significant Vernal Pools by the Natural Resources Protection Act (NRPA) definition. Five pools are not naturally occurring but they meet the significance criteria of the NRPA and are more likely to be regulated by the Army Corps of Engineers. A table detailing observed amphibian breeding activity in each vernal pool is presented in Appendix C of Exhibit 12A.

No vernal pools or perennial streams are impacted by the project.

5.0 Potential Project Impacts to Habitat and Wildlife

The construction and operation of wind turbines at Bull Hill will result in some direct and indirect impacts to local wildlife communities and their habitats. In general, the impacts could include habitat loss or conversion, disturbance effects that could result in animals avoiding the project area, habitat fragmentation, and collision-related fatalities. The following discusses the potential project impacts based

[2] 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).
[3] Stantec, Screening Analysis Results, May 21, 2009.

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.

5.1. Habitat Loss and Disturbance

The project was designed to avoid wetlands to the greatest extent possible and, therefore, the proposed turbines and associated access roads will largely occur in previously disturbed upland hardwood forest. The overall result of project construction will be the direct loss of forested upland and the conversion of some forested habitat areas to early-successional habitat.

The development of the wind farm will require the construction of turbine structures, the construction of new roads, and the placement of a power collection line adjacent to the road bed. Each wind turbine will be located in an opening averaging 1 acre in size. This opening will be graded relatively flat and, after construction, all but 0.28 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 at least 36 feet wide on the ridges for the passage of the crane needed to erect the turbines. All other roads will require a travel surface of approximately 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 project area by certain species, and the conversion of forested habitats to early successional habitats. Impacts to wildlife communities due to loss of habitat on Bull Hill, Heifer Hill and Beech Knoll are not expected to be adverse to those populations, particularly in light of the fact that the local wildlife populations already adapt to the occasional rapid changes in the distribution of habitats along the ridge from harvesting activities.

The following describes the potential disturbances to wildlife communities that are known or expected to occur within the project area.

Reptiles and Amphibians
Construction-related disturbances to amphibians include direct habitat loss and habitat modification. Clearing associated with construction could result in a dryer, warmer ground surface layer that could result in displacement of some wetland-dependent herptile species (Appendix A Table 2). However, there is minimal breeding habitat available for amphibians in the project area, and the open nature of the existing forest canopy likely limits the distribution of some wetland-dependent amphibians within the area (Appendix A Table 2). Amphibians are more diverse and abundant in low-lying, wetland habitats, which the project design largely avoids. Therefore, disturbances incurred from project construction are not expected to result in undue or adverse impacts to local populations. No state-listed rare, threatened or endangered reptiles or amphibians were observed during 2009 and 2010 environmental field surveys (Appendix A Table 1).

Construction and maintenance activities could result in loss of habitat and the displacement of reptiles from the project area. The snakes likely to occur in the area frequent variable woodlands and are generally abundant. Clearing will result in loss of habitat and cover for hunting and would influence a dryer, warmer ground surface layer. Turtles will not likely be impacted by project construction or operation. Open areas with sand or gravel substrates, occurring at lower elevations in the project area, could be used by some common species of turtles that breed in the region. Construction activities could result in temporary displacement from these areas. These species, however, take advantage of a variety of habitats and it is unlikely that local populations would be adversely impacted.

Birds
The upland hardwood forest dominating the project area provides nesting, foraging, and stop-over habitat for a number of local and migratory songbird species. Construction activities will result in some direct loss of breeding habitat of forest-interior species. The project area, however, is dominated by the most

common forest type in Maine; therefore, local and regional populations of these common species will not be adversely impacted. Additionally, if construction activities are initiated prior to the beginning of most species' breeding seasons (i.e., April to May), local birds could use alternative nest sites and would not necessarily suffer from decreased breeding success during the single season of construction activity. Sensitive species that use less common or rare habitat types would not be impacted, as such habitats do not exist within the project area. Forest-edge species and species that take advantage of early-successional habitats would benefit from increased edges and re-vegetation following construction. The new growth of grasses, shrubs, and berry producing plants at forest edges would provide such species with nesting and foraging habitat.

Many species of birds, not necessarily common to the land cover types present on-site, could occur in the project area during migration. Although most migrants would occur well above the project area during nocturnal movements, some birds could use the project area as day-time stop-over habitat. Construction of permanent roads and clearings would result in some direct loss of available stop-over habitat. The occurrence of migratory birds at any stop-over habitat varies from year to year and is influenced by weather and individual habitat preference. Also, the project area is relatively small in comparison to regionally available habitat, and adverse impacts to populations are not expected to result from the project development.

Construction activities could displace raptors that may nest in the project area. Although some nest sites potentially could be lost as a result of construction, raptors are expected to shift their home ranges slightly and are likely to breed in suitable habitat near the previous nest site. Furthermore, most species that are expected to occur in the upland hardwood habitat of the project area are regionally common. Disturbances associated with the project are not expected to result in adverse impacts to raptor populations. Raptors such as red-tailed hawks and kestrels that forage in open areas at forest edges may benefit from the increase of foraging habitat in cleared areas following construction.

Additional species of raptor occur as migrants in the vicinity of Bull Hill, Heifer Hill and Beech Knoll. These individuals use the project area for extremely short periods of time during migration and are not likely to be affected by loss or changes in habitat due to their ability to fly to alternative or adjacent stopover points

Mammals
Construction of the project could result in the loss of habitat for those mammals expected to occur in the project area, as well as displacement from the project area of those species most sensitive to human activity. For example, small-scale effects could potentially include the removal of individual roost trees used by bats. However, roost trees are not likely to occur in the project area due to recent harvesting, and additional harvesting for the project is expected to occur at a relatively minor scale and be spread out across the mountains due to the narrow, linear layout of the project. Furthermore, the regional commonness of the dominant habitat types in the project area buffers any impacts associated with the removal of canopy trees, expansion of existing roads, and creation of new roads. Undue or adverse impacts to these populations are not expected.

Significant or Sensitive Wildlife Habitat
There are two types of significant or sensitive habitat and/or wildlife communities that occur in the project area: significant vernal pools and *Wetlands of Special Significance*.

A total of 53 vernal pools were identified within the project area. Eighteen of those pools were determined to be naturally occurring. Of the 18 natural vernal pools, 7 were determined to be Significant Vernal Pools by the NRPA definition. Five pools are not naturally occurring but they meet the significance criteria of the NRPA and are more likely to be regulated by the Army Corps of Engineers.

Of the 111 wetland resources identified in the project area by on-site wetland surveys, 21 would be considered *Wetlands of Special Significance* (part of the resource protection subdistrict P-WL1) for containing significant wildlife habitat or the proximity to a stream resource (Exhibit 13A).

5.2. Collision Risk

5.2.1. Review of known avian collision risk

Birds are known to collide with tall structures, such as buildings, communications towers and wind turbines. Collisions are more likely to occur in periods of low visibility mainly at night during inclement weather. 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 farms in the United States where mortality studies have been conducted, collision risk is generally considered low relative to other sources of bird mortality. 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

The original concern that wind farm-induced fatalities could pose biologically significant impacts to bird populations arose from a few facilities located along migratory 'bottlenecks' or sites where birds were seasonally very active. A large number of hawk and eagle fatalities were observed at the Altamont Pass and Solano County Wind Resource Areas in California (Altamont Pass; Orloff and Flannery 1992, Hunt 2002). Estimates of raptor and other bird fatalities at Altamont Pass are variable. However, using more recent data, it is estimated that thousands of raptors strike turbines every year at Altamont Pass (Erickson *et al.* 2002, Sterner 2002, Smallwood and Thelander 2004, GAO 2005). In 2004 raptor mortality estimates at Altamont Pass were found to be 0.24 fatalities per turbine per year (fatalities/turbine/year) (1,296 raptor fatalities) (GAO 2005).

Further 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 (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, with blades that spin faster as wind speed increases. The turbines at these sites are also 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 United States, outside of California, has been documented to be very low. For example, 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). Several recent studies conducted in the U.S., outside of California, have documented relatively low raptor mortality with less than 50 total raptor and owl fatalities documented by over 25 studies at over 20 different locations throughout the U.S. (Appendix B Table 1 attached hereto). This compares with more than 100 raptor mortalities documented per year at Altamont Pass and overall estimates of thousands killed annually at that facility. The relatively low flight heights of raptors migrating through the 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). 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.

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). A wide variety of songbird species have been found during mortality surveys but, to date, no large fatality events, as have been occasionally observed at tall communications towers, have been reported. In a review of studies conducted at 15 land-based facilities in 12 different states, Erickson *et al.* (2001) concluded that, on average, 1 to 2 birds, (primarily songbirds) are killed per turbine per year outside of California. Publicly available results of more recent studies at 18 wind projects in the United States estimate fatality rates between 5.67 to 6.31 birds/turbine/year to 0 birds/turbine/year (Appendix B Table 2 attached hereto). Using comparable methodologies, avian fatality monitoring in 2007 and 2008 at the Mars Hill Wind Project estimated 0.44 to 1.04 bird fatalities/turbine/year and 2.4 to 2.65 birds/turbine per year, respectively; fatality monitoring in 2009 at the Stetson Wind Project estimated 4.03 bird fatalities/turbine/year.[4]

Lighting

The lighting of tall structures may increase the risk that tall structures pose to night-migrating birds and bats. Lighting is believed to act as an attractant to birds, which have been observed circling around lit structures until they collapse from exhaustion or collide with the structures or their support systems (such as guy wires). The structure, as well as the type, location, number of lights, and pulse frequency of the lighting are important factors in the potential for a lit structure to be a risk to night migrants. Tall radio towers pose the greatest risk to night-migrants for several reasons. First, they are typically 333-671 meters (1,000' to 2,200') tall, which extends well into the altitude zone in which most migrants fly, as documented in numerous radar surveys. Second, the Federal Aviation Administration (FAA) lighting standards for these very tall towers require a series of lights (up to 12 sets of lights along the length of the tower) that include both flashing beacons (L-864) and steady burning (L-810) lights. This requirement places the lights at the same altitude at which birds are flying. Third, the steady burning L-810 lights create a constant illumination of the tower, which further increases the potential for attraction. Finally, the dense array of guy wires surrounding each tower present a high collision risk for any birds that are drawn into the area lighted by the towers.

A new FAA Advisory Circular on Obstruction Marking and Lighting (USDOT AC 70/7460-1K, Effective 2/1/07) provides guidelines on the lighting requirements of wind turbines and wind farms. The requirements for wind turbines indicate that the lighting is unlikely to be a significant attractant to night-migrating birds. Lighting is limited to a single flashing red L-864 light placed on the turbine nacelle, which is typically located approximately 84 meters (275') above the ground and well below the height at which most migrants fly. Importantly, only one turbine is required to be lit for every linear half-mile of turbine string, and all lit turbines should flash simultaneously, when possible. The result of these greatly reduced lighting requirements is a reduction of the overall number of lights and the total time during which turbines are lit. The placement of lights well below the height at which birds prefer to migrate also indicates a very low risk for lighting to attract birds to the turbines. Mortality studies conducted in 2007 at the Mars Hill Wind Project found no relationship to avian mortality and turbine lighting, however at the Stetson Wind Project in 2009, there was a significantly higher mortality of birds, bats, and birds and bats combined at turbines lit with FAA lighting.

5.2.2. Potential risk of avian collision at the Bull Hill Wind Project

The potential risk of avian collision with power lines at the project does not exist since the project has been designed with an underground collection system. This system complies with the Avian Power Line Interaction Committee's (APLIC) Suggested Practices for Avian Protection on Power Lines: The State of

[4] Results of the Stetson study are likely influenced by the proportion of avian carcasses found at turbine number 1 which is lit by FAA lighting and is situated next to a lit operations and maintenance building. When excluding data from turbine 1, the average number of fatalities at lit turbines at the Stetson project was 2.4

the Art in 2006 and APLIC's Manual for Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. These manuals were developed to mitigate and avoid avian collision and electrocution with overhead electrical lines.

Different taxonomic groups of birds exhibit different habitat use and flight behaviors and, consequently, the level of risk of birds colliding with the proposed turbines is expected to vary among groups. For example, since most songbirds migrate at night, this species group is considered more at risk of collision than raptors and other birds that typically migrate during the day. Therefore, in order to assess the risk of bird collisions, it is necessary to consider these groups individually. The following describes the risk of collision of birds that could come into the vicinity of the proposed turbines. The information below is based on the environmental field surveys conducted in 2009 and 2010.

Songbirds

Stantec conducted nocturnal radar studies to characterize nocturnal migration activity in the project area in fall 2009 and spring 2010. Marine surveillance radar, similar to that described by Cooper et al. (1991), was used during field data collection. Radar surveys were conducted on 20 nights between September 1 and October 15 in fall 2009 and on 20 nights between April 29 and May 24 in spring 2010. The radar was located on the summit of Bull Hill at an elevation of approximately 188 m (616') 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 was 387 ± 21 for the entire spring survey period. Nightly passage rates varied from 188 ± 30 to 1500 ± 209 t/km/hr in fall 2009 and between 43 ± 16 t/km/hr to 879 ± 76 t/km/hr in spring 2010. Mean flight direction through the Project area for the fall season was 260 ± 66° and 48 ± 49° for the spring season. The seasonal mean flight height of targets in fall 2009 was 356 ± 9 m above the radar site and 217 ± 8 m above the radar site in spring 2010. Nightly flight heights ranged from 208 ± 9 m to 558 ± 22 m in fall 2009 and from 100 ± 10 m to 358 ± 53 m in spring 2010. The percent of targets observed flying below 145 m was 14 percent for the entire fall 2009 season and was 38 percent for the entire spring 2010 season.

In terms of passage rates, the mean passage rate of 614 t/km/hr at the project in fall 2009 is on the higher end of the range of results from these other studies (91 to 620 t/km/hr); it is typical for fall passage rates to be higher than spring passage rates as fall migrants include juveniles born that year and older birds who may die during migration or over the winter and therefore would not migrate in spring. 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 excellent 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 and Boldt 2001). 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 results of these other radar studies suggest that the vast majority of nocturnal migrants fly at altitudes well above the rotor swept zone of the proposed turbines (see Appendix A Table 5 of Exhibit 12C for a review of seasonal radar migration surveys from other publicly available wind projects); however, the seasonal average flight height for spring (217 ± 8 m) is on the low end of the range of flight heights recorded at other wind projects in the east (210 m to 552 m in spring). The estimated percent below turbine height during spring 2010 radar surveys at the project was 38 percent for the season. The percent below turbine height at other publicly available wind projects in the eastern United States during spring ranges from 3 to 26 percent. It is important to note that the percent of targets detected below turbine height does not correlate with post-construction mortality events; in other words, this calculation is not an appropriate measure of post-construction risk. Nevertheless, First Wind has committed to perform at least one year of post-construction mortality surveys to identify the level of project impact on migratory

species (Exhibit 19). An adaptive management plan will be developed in close coordination with state agencies should significant impacts to migratory species occur as a result of the project).

Water birds and waterfowl
Similar to raptors, very few waterfowl or water birds have been found during mortality surveys at existing wind farms, despite characteristic flocking behaviors and activity during nocturnal and crepuscular periods that would seem to put these birds at a greater risk of collision. Water bird mortality at wind developments has accounted for approximately five percent of the reported mortality at wind facilities in the United States (Erickson *et al.* 2002).

Although suitable habitat is not available for water birds or waterfowl on Bull Hill, Heifer Hill and Beech Knoll, there may be flyovers of some species such as mallard and wood duck, as well as water birds such as great blue heron, because these species use lakes, wetlands, and streams in the surrounding landscape. Large flocks of Canada geese were observed during diurnal migration surveys at the project. However, they were routinely observed flying high far west of the project area. Based on the available information from other facilities and on-site habitat observations, the risk of fatalities to waterfowl and water birds to collide with the proposed wind turbines is very low.

Raptors
Raptor migration surveys were conducted in summer 2009 on six survey days between August 1 and August 27, in fall 2009 on 12 survey days between September 2 to October 14, in winter on three survey days (March 19, March 25 and April 6), and in spring 2010 on 12 survey days between April 21 and May 23. The purpose of the raptor surveys was to sample use and migration activity at central and prominent locations within the project area. The specific goal of summer surveys was to characterize bald eagle activity in the vicinity of the Project during the late-fledging period. Other raptor activity was documented as well. The objectives of surveys during both the summer and fall were to document the species that occur in the vicinity of the Project, and the specific flights heights, flight path locations and other flight behaviors of raptors within or in the vicinity of the Project. Therefore, summer and winter surveys were conducted from Sparrow Hill and spring and fall surveys were conducted from Bull Hill.

A total of 24 raptor observations were made in summer 2009, 124 in fall 2009, and 55 in winter and spring 2010, combined. Passage rates were 0.52 raptor observations/hour in summer 2009, 1.43 raptors/hour in fall 2009, and 0.53 raptors/hour in spring 2010. Raptor passage rates at the project were considerably lower than those at nearby Hawk Migration Association of North America sites during the same seasons (Appendix C Table 5 of Exhibit 12C, both reports). In summer 2009, 4 percent of total raptor observations were in the project area, 48 percent were observed in the project area in fall 2009, and 27 percent were observed in the project area in spring 2010. Of these birds, 4 percent were documented flying at heights below 145 m for at least a portion of their flight in summer 2009, 98 percent were documented flying at heights below 145 m in fall 2009, and 100 percent were documented flying at heights below 145 m in spring 2010. The relatively low flight height of raptors at the project may be influenced by the site's topography, which consists of low-elevation hills rather than ridgelines.

A total of 12 species of raptor were documented in the vicinity of the project area in 2009 and 2010. During fall 2009 raptor migration surveys, one state-listed endangered species, peregrine falcon, was observed in the project area. The falcon was flying over tree canopy, approximately 15 meters above ground, moving northwest over Bull Hill. Two state species of special concern were observed during the fall surveys—bald eagle and northern harrier. Two state species of special concern were observed in winter and spring 2010: six bald eagle 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 observations were made during the spring surveys. One observation of northern harrier occurred within the Project area. For full results of raptor migration surveys conducted at Bull Hill, see Exhibit 12C.

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 Vestas 1.8 turbines to be used 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. Owls primarily forage during nocturnal and crepuscular periods. Some raptors engage in elaborate courtship aerial displays. Despite these behaviors, mortality surveys at existing wind farms, outside of the California facilities that observed high fatalities due to local circumstances, have indicated low raptor mortality. This trend of low raptor mortality is expected at the project.

Summary of Avian Collision Risk at Bull Hill

Fatality rates from other projects can be used to determine a possible level of impact at the proposed project. The rates observed at other facilities can be considered comparable to a proposed wind farm if those projects are representative of the site being assessed (i.e., in the same region with similar landscape and project design characteristics). Relative mortality estimates from post-construction monitoring conducted at the Mars Hill Wind Project in Maine, Stetson Wind Project in Maine, and Lempster Wind Project in New Hampshire, were low; for raptors, only one owl fatality was found at Mars Hill in two years of post-construction monitoring (one red-tailed hawk was found at Stetson in 2009 however this fatality was the results of electrocution of the bird which perched on a riser pole of the electrical collection system; Appendix B Table 1). For birds and bats, a total of 27 bats and 36 birds (0.43-4.4 bats/turbine/year [bats/t/yr] and 0.44-2.5 birds/turbine/year [birds/t/yr]), were found in two years of monitoring at Mars Hill, 5 bats and 30 birds (2.11 bats/t/yr and 4.03 birds/t/yr) were found in one year of monitoring at Stetson Mountain I, 14 bats and 11 birds (2.48 bats/t/yr and 2.14 birds/t/yr) were found in one year of monitoring at Stetson Mountain II, and 10 bats and 9 birds (0.58 bats/t/spring and 5.51 bats/t/fall; 0.80 birds/t/spring and 5.95 birds/t/fall) were found during daily searches conducted between April 20 and June 1 and July 15 and October 31, 2009 at Lempster (Appendix B Table 2). As mortality rates are typically described as fatalities per turbine per year, the overall mortality expected at a given project is proportional to the size (i.e., number of turbines) of the proposed wind farm. The project would include 19 turbines. This is fairly small compared to most wind projects already operating in the eastern United States.

5.2.3. Risk of Bat Collisions with Turbine Structures

5.2.3.1 Review of Known Bat Collision Risk

Acoustic surveys were conducted at Bull Hill between July 14 and November 4 in fall 2009 and were redeployed on April 15 and operated until July 14 in spring 2010. The object of acoustic surveys were (1) to document bat activity patterns 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. Six Anabat® acoustic bat detectors were deployed in the project area; two detectors were deployed on the Little Bull Hill meteorological 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.

During the fall 2009 survey period, a total 4,657 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. During the spring survey period, a total of 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. Of those calls that were identified to species guild, bats of the Genus *Myotis* were the most abundant bats documented during both the fall 2009 acoustic survey and the spring 2010 acoustic surveys. Other bat guilds that were documented include big brown/silver haired bat, hoary bat, and eastern red bat/tri-colored bat guilds. Tree detectors in both seasons recorded more *Myotis* calls

than the met tower detectors. For full results of acoustic surveys conducted at Bull Hill, refer to Exhibit 12C.

Wind projects have been cited as a potential threat to migrating bats for a number of years, and emerging evidence suggests that migratory bats could be at a greater risk of collision than birds. 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 earlier studies and similar studies have raised concerns that bat mortality associated with wind 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 United States (Kunz et al. 2007b), with most fatalities occurring during what is generally considered the fall migration period (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. Two post-construction surveys conducted at wind projects in Maine estimated far lower bat mortality rates than those documented at projects in the East and in other regions of the United States: post-construction 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; monitoring at the Stetson Mountain I Wind Project in 2009 estimated 2.11 bat fatalities/turbine/year; and monitoring at the Stetson Mountain II Wind Project in 2010 estimated 2.48 bat fatalities/turbine/year (Appendix B Table 2). While bat collision rates in Maine have been lower than those documented elsewhere in the East and in other regions of the United States, little is known about the migration patterns and numbers of migratory bats in Maine 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 United States, only approximately 11 species have been found during mortality searches (Arnett *et al* 2008).

5.2.3.2 Potential risk of bat collision at the Bull Hill Wind Project

The late-summer and fall 2009 and spring and summer 2010 bat surveys at the project indicated that some species of bats that are considered at risk of collision are present in the area. However, the activity of bats detected at the project was considered at the low end of the range found at other forest edge detector sites in the Northeast in fall 2009, and comparable to other detector sites in the Northeast, including Mars Hill, Lempster and Stetson wind projects, during spring seasons (see Exhibit 13C for a review of the bat surveys conducted in that project area). As stated above, factors that contribute to levels of risk of bat mortality are unknown, therefore inferences made regarding levels of potential risk of bat collision at the project cannot be made at this time. First Wind has committed to perform at least one year of post-construction mortality surveys to identify the level of project impact on migratory bat and bird species.

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Appendix A
Incidental Wildlife Observations and Wildlife Habitat Use Matrix

Appendix A Table 1. Wildlife Species Incidentally Observed during 2009 and 2010 Field Surveys at the Bull Hill Wind Project.

Common Name	Scientific Name	Regulated Status
Birds		
Acadian flycatcher	*Empidonax virescens*	
American crow	*Corvus brachyrhynchos*	
American goldfinch	*Carduelis tristis*	
American kestrel	*Falco sparverius*	
American redstart	*Setophaga ruticilla*	State Special Concern
American robin	*Turdus migratorius*	
American woodcock	*Scolopax minor*	
Bald eagle	*Haliaeetus leucocephalus*	State Special Concern
Baltimore oriole	*Icterus galbula*	
barn swallow	*Hirundo rustica*	
black and white warbler	*Mniotilta varia*	State Special Concern
black-capped chickadee	*Poecile atricapilla*	
black-throated blue warbler	*Dendroica fusca*	
black-throated green warbler	*Dendroica virens*	
blue jay	*Cyanocitta cristata*	
blue-headed vireo	*Vireo solitarius*	
broad-winged hawk	*Buteo platypterus*	
brown creeper	*Certhia americana*	
Canada goose	*Branta canadensis*	
cedar waxwing	*Bombycilla cedrorum*	
chestnut-sided warbler	*Dendroica pensylvanica*	State Special Concern
common loon	*Gavia immer*	
common raven	*Corvus corax*	
common yellowthroat	*GeoThlypis trichas*	
Cooper's hawk	*Accipiter cooperii*	
dark-eyed junco	*Junco hyemalis*	
downy woodpecker	*Picoides pubescens*	
eastern phoebe	*Sayornis phoebe*	
golden-crowned kinglet	*Regulus satrapa*	
great blue heron	*Ardea herodias*	State Special Concern
hairy woodpecker	*Picoides villosus*	
hermit thrush	*Catharus guttatus*	
herring gull	*Larus argentatus*	
house finch	*Carpodacus mexicanus*	
merlin	*Falco columbarius*	
mourning dove	*Zenaida macroura*	
yellow-rumped warbler	*Dendroica coronata*	
northern flicker	*Colaptes auratus*	
northern goshawk	*Accipiter gentilis*	
northern harrier	*Circus cyaneus*	State Special Concern
osprey	*Pandion haliaetus*	
ovenbird	*Seiurus aurocapillus*	
palm warbler	*Dendroica palmarum*	
pileated woodpecker	*Dryocopus pileatus*	
pine warbler	*Dendroica pinus*	
purple finch	*Carpodacus purpureus*	
red-tailed hawk	*Buteo jamaicensis*	
ruby-crowned kinglet	*Regulus calendula*	
ruby-throated hummingbird	*Archilochus colubris*	
ruffed grouse	*Bonasa umbellus*	
sharp-shinned hawk	*Accipiter striatus*	
song sparrow	*Melospiza melodia*	
turkey vulture	*Cathartes aura*	
white-breasted nuthatch	*Sitta carolinensis*	
white-throated sparrow	*Zonotrichia albicollis*	State Special Concern
wild turkey	*Meleagris gallopavo*	
winter wren	*Troglodytes hiemalis*	
yellow-bellied sapsucker	*Sphyrapicus varius*	
Mammals		
American marten	*Martes americana*	
black bear	*Ursus americanus*	
moose	*Alces alces*	
red squirrel	*Tamiasciurus hudsonicus*	
snowshoe hare	*Lepus americanus*	
white-tailed deer	*Odocoileus virginianus*	
Amphibians		
American toad	*Lithobates catesbeiana*	
green frog	*Lithobates clamitans*	
spotted salamander	*Ambystoma maculata*	
wood frog	*Lithobates sylvatica*	
blue-spotted salamander	*Ambystoma laterale*	State Special Concern
Invertebrates		
caddis fly (cigar tube)	Order: Trichoptera Family: Phryganeidae	
caddis fly (log cabin)	Order: Trichoptera Family: Limnephilidae	
predaceous diving beetle	Order: Coleoptera Family: Dytiscidae	

Appendix A Table 2. Species Matrix for the Bull Hill Project

Scientific Name	Common Name	Special Habitat Requirements	Relative Abundance in Project Area	Status: Maine	Status: Federal	Habitats: Beech-Birch-Maple Forest	Habitats: Harvested Hardwood Forests	Habitats: Spruce-Northern Hardwood Forest	Habitats: Forested Wetlands	Habitats: Forested Streams	Habitats: Vernal Pools
Amphibians											
Ambystoma laterale	Blue-spotted Salamander	Wooded swamps, ponds or vernal pools for breeding	U			Y				B	B
Ambystoma maculatum	Spotted salamander	Mesic woods, semi-permanent water for breeding	U			Y	Y			B	B
Notophthalmus viridescens	Red-spotted newt	Water with aquatic vegetation for adults	U			Y	Y	Y		B	B
Desmognathus fuscus	Northern dusky salamander	Permanent or intermittent streams or seeps in	U			Y		Y		Y	
Plethodon cinereus	Northern redback salamander	Wide variety of terrestrial habitats, mostly forested	A			Y	Y	Y			
Eurycea bislineata	Northern two-lined salamander	Wide variety of habitats, including streams, floodplains, and swamps	C			Y				Y	
Bufo a. americanus	Eastern American toad	Moist upland woods	A			Y	Y	Y		B	B
Pseudacris crucifer	Northern spring peeper	Wetlands with emergent vegetation for breeding	U			Y		Y		B	B
Hyla versicolor	Gray treefrog	Seeps, aquatic sites for breeding	C			Y	Y	Y		B	B
Rana clamitans	Green frog	Riparian habitat	U							Y	B
Rana sylvatica	Wood frog	Vernal woodland pools	A			Y		Y		B	B
Reptiles											
Chelydra serpentina	Common snapping turtle	Aquatic habitat; sandy, gravely soil	U							Y	
Chrysemys picta	Painted turtle	Aquatic habitats with open water and basking	U							Y	B
Storeria occipitomaculata	Northern redbelly snake	Moist woods, hillsides with surface debris	C			Y	Y	Y	Y		
Thamnophis sirtalis	Eastern garter snake	Moist areas, forest edges, stream edges, swamps	A			Y	Y	Y	Y	B	B
Diadophis punctatus	Northern ringneck snake	Mesic areas with abundant cover	U			Y	Y	Y		Y	
Birds											
Cathartes aura	Turkey vulture	Forest openings, fields, large dead tree trunks	U			B	B	B			
Accipiter striatus	Sharp-shinned hawk	Extensive, undisturbed open mixed woodlands	U					Y	Y		
Accipiter cooperii	Cooper's hawk	Undisturbed forests	R	T		B		B	B		
Accipiter gentilis	Northern goshawk	Extensive, mature mixed woods	U			B		B	B		
Buteo platypterus	Broad-winged hawk	Extensive woodlands with roads or clearings	U			B	B	B	B		
Buteo jamaicensis	Red-tailed hawk	Mature forest-field ecotone	C			Y	Y	Y	Y		
Bonasa umbellus	Ruffed grouse	Fallen logs amidst dense saplings	C			Y	Y	Y	Y	Y	
Scolopax minor	American woodcock	Moist soils, small clearings and dense swales	U			B	B	B		B	
Zenaida macroura	Mourning dove	Open land with bare ground	A			Y	Y	Y			
Coccyzus erythropthalmus	Black-billed cuckoo	Low, dense thickets	U			B	B	B			
Bubo virginianus	Great horned owl	Large abandoned hawk nests, large tree cavities	C			Y	Y	Y	Y		
Strix varia	Barred owl	Cool, damp lowlands, cavity trees >20" dbh	C			Y	Y	Y	Y		
Aegolius acadicus	Northern saw-whet owl	Cavity trees >12" dbh	C			Y		Y			
Caprimulgus vociferus	Whip-poor-will	Immature forests, woodlands, shrub areas, large	U	SC		B	B	B			
Archilochus colubris	Ruby-throated hummingbird	Tubular flowers, especially red	C			B	B	B		B	
Sphyrapicus varius	Yellow-bellied sapsucker	Cavity trees with >10" dbh	C			B	B	B			
Picoides pubescens	Downy woodpecker	Trees, limbs with decay column >6" dbh	C			Y	Y	Y	Y		
Picoides villosus	Hairy woodpecker	Trees, limbs with decay column >10" dbh	C			Y	Y	Y	Y		
Colaptes auratus	Northern flicker	Open areas, trees with heart rot	C			B	B	B			
Dryocopus pileatus	Pileated woodpecker	Mature trees >20" dbh with decay	C			Y	Y	Y			
Contopus virens	Eastern wood-pewee	Open deciduous and mixed forests, forest edge	U			B	B	B			
Empidonax alnorum	Alder flycatcher	Thickets, low shrubs, clearings	U				B			B	
Empidonax minimus	Least flycatcher	Open deciduous and mixed forests, forest edge	C			B	B	B			
Sayornis phoebe	Eastern phoebe	Exposed, streamside perches, sheltered ledges for	C			B	B	B			
Myiarchus crinitus	Great crested flycatcher	Mature cavity trees, deciduous forest edge	C			B	B	B			
Vireo solitarius	Blue-headed vireo	Mixed or predominantly coniferous forests	C					B	B		
Vireo olivaceus	Red-eyed vireo	Deciduous forests with continuous canopy	C			B	B	B			
Cyanocitta cristata	Blue jay	Variety of rural to urban habitats	A			Y	Y	Y	Y		
Corvus brachyrhynchos	American crow	Variety of rural to suburban habitats, open areas	A			Y	Y	Y	Y		
Corvus corax	Common raven	Cliffs and outcrops in rural areas	U			Y	Y	Y	Y		
Poecile atricapillus	Black-capped chickadee	Cavity trees >4" dbh	A			Y	Y	Y	Y		
Sitta canadensis	Red-breasted nuthatch	Cavity trees in mixed or coniferous woods	C				Y	Y	Y		
Sitta carolinensis	White-breasted nuthatch	Cavity trees in hardwoods or mixed woods	C			Y	Y	Y			
Certhia americana	Brown creeper	Woodland trees with sloughing or loose bark	C			Y	Y	Y	Y		
Troglodytes hiemalis	Winter wren	Conifer forests near water, often in ravines and swamps	U				B	B	B		
Regulus satrapa	Golden-crowned kinglet	Conifer and mixed conifer-hardwood forests	U				Y	Y	Y		
Catharus fuscescens	Veery	Moist woodlands with understory	C			B		B			
Catharus guttatus	Hermit thrush	Coniferous woodlands with dense understory	C					B			
Hylocichla mustelina	Wood thrush	Cool, moist, mature deciduous or mixed forests	C			B		B			
Turdus migratorius	American robin	Lawns, fields, agricultural areas, forest openings	A			B	B	B			
Dumetella carolinensis	Gray catbird	Shrubs, thickets in open country	C			B	B				
Bombycilla cedrorum	Cedar waxwing	Early successional forests, berry producing trees,	C			Y	Y	Y	Y		
Vermivora peregrina	Tennessee warbler	Brushy, semi open habitat in coniferous or mixed	U					B	B		
Vermivora ruficapilla	Nashville warbler	Scattered trees interspersed with brush	C			B		B	B		
Parula americana	Northern parula	The lichen *Usnea* for nesting	C			B		B	B		
Dendroica petechia	Yellow warbler	Scattered small trees or dense brush	A			B	B			B	
Dendroica pensylvanica	Chestnut-sided warbler	Brush at wood margins, hardwood seedling stands	A			B	B	B			
Dendroica tigrina	Cape May warbler	Young conifers	U					B	B		
Dendroica caerulescens	Black-throated blue warbler	Hardwoods with well-developed understory	C					B			
Dendroica coronata	Yellow-rumped warbler	Coniferous trees, bayberry thickets	A				B	B	B		
Dendroica virens	Black-throated green warbler	Coniferous forests, mixed woodlands	C			B		B	B		
Dendroica fusca	Blackburnian warbler	Coniferous forests, mixed woodlands	U					B	B		
Mniotilta varia	Black-and-white warbler	Deciduous or mixed conifer-hardwood forests	C			B	B	B	B		
Setophaga ruticilla	American redstart	Deciduous forest and shrub habitats	A			B	B	B	B		
Seiurus aurocapillus	Ovenbird	Deciduous or mixed conifer-hardwood forests	C			B	B	B	B		
Seiurus noveboracensis	Northern waterthrush	Cool, shaded, wet ground with shallow pools	U							B	B
Oporornis philadelphia	Mourning warbler	Stands of dense saplings and shrubs, disturbed second growth	U			B	B	B			
Geothlypis trichas	Common yellowthroat	Shrublands, dense forest edges, regenerating fields	C			B	B	B		B	
Wilsonia canadensis	Canada warbler	Dense vegetation along streams and wet areas within woodlands	U			B	B	B			
Piranga olivacea	Scarlet tanager	Mature deciduous and mixed conifer-hardwood forests	C			B	B	B			
Spizella arborea	American tree sparrow	Shrublands and forest edges during winter	C				W				
Spizella passerina	Chipping sparrow	Fields and lawns in close proximity to trees (often	C				B				
Melospiza melodia	Song sparrow	Wet areas with brushy vegetation	A				B				
Zonotrichia albicollis	White-throated sparrow	Shrublands and dense forest edges	C			B	B	B	B		
Junco hyemalis	Dark-eyed junco	Mature conifer forests (often eastern hemlock)	C				Y	Y	Y		
Pheucticus ludovicianus	Rose-breasted grosbeak	Forest-field ecotones, thickets, sapling stands	C			B	B	B			
Molothrus ater	Brown-headed cowbird	Open fields, mowed grassy areas, low trees	A			B	B	B			
Icterus galbula	Baltimore oriole	Tall scattered deciduous trees	C			B	B	B			
Carduelis tristis	American goldfinch	Open, weedy fields with scattered small trees	A			Y	Y	Y	Y		
Coccothraustes vespertinus	Evening grosbeak	Spruce and fir forest	U					W	W		
Mammals											
Sorex cinereus	Masked shrew	Damp woodlands, ground cover	U			Y	Y	Y		Y	
Sorex fumeus	Smokey shrew	Loose damp leaf litter	U			Y		Y		Y	
Sorex hoyi	Pygmy shrew	Moist leaf litter, damp soils, riparian areas	U			Y		Y	Y	Y	
Blarina brevicauda	Northern short-tailed shrew	Low vegetation, damp, loose leaf litter	A			Y	Y	Y	Y	Y	
Myotis lucifugus	Little brown myotis	Dark, warm sites for maternity colonies	U			B	B	B	B	B	
Lasionycteris noctivagans	Silver-haired bat	Dead trees with loose bark; streams	U	SC		B	B	B	B	B	
Pipistrellus subflavus	Eastern tri-colored bat	Warm, draft-free, damp sites for hibernation, open woodlands	U	SC		B	B	B		B	
Lasiurus borealis	Red bat	Deciduous trees on forest edges for roosting	U	SC		B	B	B		B	
Lasiurus cinereus	Hoary bat	Edges of coniferous forests	U	SC			B	B	B		
Lepus americanus	Snowshoe hare	Dense brushy or softwood cover	C			Y	Y	Y	Y	Y	
Tamias striatus	Eastern chipmunk	Open, deciduous forests and edges	C			Y	Y	Y	Y		
Sciurus carolinensis	Eastern gray squirrel	Tall trees for dens or leaf nests	C			Y	Y	Y			
Tamiasciurus hudsonicus	Red squirrel	Woodlands with mature trees	C				Y	Y	Y		
Glaucomys sabrinus	Northern flying squirrel	Mature trees with cavities, arboreal lichens	U			Y	Y	Y			
Peromyscus maniculatus	Deer mouse	Northern hardwoods or coniferous forests	C			Y	Y	Y	Y		
Clethrionomys gapperi	Southern red-backed vole	Springs, brooks, seeps, debris or slash cover	C					Y	Y	Y	
Microtis pennsylvanicus	Meadow vole	Herbaceous vegetation, loose organic soils	A				Y			Y	
Synaptomys cooperi	Southern bog lemming	Deciduous or mixed conifer-hardwood forests	U			Y	Y	Y		Y	
Napaeozapus insignis	Woodland jumping mouse	Moist, cool woodland, loose soils	U			Y	Y			Y	
Erethizon dorsatum	Porcupine	Rock ledges or tree dens, northern hardwoods	U			Y	Y	Y			
Canis latrans	Coyote	Forests, forest edges, agricultural land	U			Y	Y	Y	Y	Y	
Vulpes vulpes	Red fox	Forests, forest edges, agricultural land	U			Y	Y	Y		Y	
Urocyon cinereoargenteus	Gray fox	Hollow logs, tree cavities, rock crevices	U			Y	Y	Y		Y	
Ursus americanus	Black bear	Fallen trees, hollow logs, rock ledges, slash piles, northern hardwoods, mixed forests	U			Y	Y	Y	Y	Y	
Procyon lotor	Raccoon	Hollow trees	C			Y	Y			Y	
Martes pennanti	Fisher	Coniferous and mixed conifer-hardwood forests, adequate den sites	U			Y		Y	W	W	
Mustela erminea	Ermine	Dense brushy cover	U			Y	Y	Y	Y	Y	
Mustela frenata	Long-tailed weasel	Diversity of forested and partially forested habitats and edges	U			Y	Y		Y	Y	
Mephitis mephitis	Striped skunk	Agricultural areas, open habitats, often in suburban	C			Y	Y	Y	Y	Y	
Lynx rufus	Bobcat	Rock ledges, under windfalls, hollow logs	U	SC		Y	Y	Y		Y	
Odocoileus virginianus	White-tailed deer	Softwood yarding cover in winter	C			Y	Y	Y	Y	Y	
Alces alces	Moose	Wetlands preferred in the summer for insect relief and aquatic vegetation	C			Y	Y	Y	Y	Y	
			Amphibians (11)			10	5	7	0	10	8
			Reptiles (5)			3	3	3	2	4	2
			Birds (70)			52	53	63	34	7	1
			Mammals (34)			28	28	28	18	25	0
			Total (120)			93	89	101	54	46	11

Relative Abundance
A - Abundant
C - Common
U - Uncommon
R - Rare

Status
E - Endangered
T - Threatened
SC- Special Concern

Season of Use
B - Breeding Season
M - Migration
W - Wintering
Y - Year round

Appendix B
Publicly Available Post-Construction Results

Appendix B Table 1. Available raptor and owl mortality data reported at wind farms in the U.S. (outside of California) from 1994-2009

Location	Habitat Type (# Turbines)	Study period	Search Interval	Number of fatalities and species	Dates of carcass discovery	Reference
Bliss NY	agricultural, woodland (67/100.5)	April 21 - Nov 14, 2008	8 daily, 8 every 3-days, 7 every 7-days	3 red-tailed hawk, 1 sharp-shinned hawk	n/a	Jain *et al.* 2009d
Casselman, PA	forested ridge, agricultural, reclaimed mine (23/34.5)	April 19 - Nov 15, 2008	10 daily	0	n/a	Arnett *et al.* 2009
Clinton, NY	agricultural, woodland (67)	2008	8 daily, 8 every 3-days, 7 every 7-days	1 broad-winged hawk	May	Jain *et al.* 2009b
Cohocton and Dutch Hill, NY	agricultural (50)	2009	5 daily, 12 weekly	1 sharp-shinned hawk	7/8/2009	Stantec 2010a
Ellenburg, NY	agricultural, woodland (54)	2008	6 daily, 6 every 3-days, 6 every 7-days	1 broad-winged hawk	June	Jain *et al.* 2009c
Jersey Atlantic, NJ	wetland/wastewater treatment (5/7.5)	1/1 - 8/31/2009	3 days/week	1 osprey	8/18/2009	NJ Audubon Society, 2009
Lempster, NH	forested ridgeline (12)	2009*	4 daily	0	n/a	Tidhar 2009
Maple Ridge, NY	woodland, agricultural grassland (120)	2006	10 every 3 days, 30 7 days, 10 daily	1 American kestrel	7/6/2006	Jain *et al* . 2007
Maple Ridge, NY	woodland, agricultural grassland (195)	2007	64 weekly	1 American kestrel, 5 red-tailed hawk	red-tailed hawk (1 found 8/07, 2 found 9/07) // (1 sharp-shinned hawk and 2 red-tailed hawk dates not reported)	Jain *et al.* 2008
Maple Ridge, NY	woodland, grassland, agricultural (120)	2008	64 weekly	1 American kestrel, 2 sharp-shinned hawk, 1 Cooper's hawk	n/a	Jain *et al.* 2009a
Mars Hill, ME	forested ridgeline (28)	2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	0	n/a	Stantec 2008
Mars Hill, ME	forested ridgeline (28)	2008	28 of 28 weekly, seasonal dog searches	1 barred owl	4/11/2008	Stantec 2009a
Massachusetts Maritime Academy Turbine, Massachusetts	coastal (1/0.66)	24 April - 30 November, 2006	4-12 searches/week	1 osprey	n/a	Vlietstra 2008
Massachusetts Maritime Academy Turbine, Massachusetts	coastal (1/0.66)	15 April - 30 November, 2007	3-5 searches/week	0	n/a	Vlietstra 2008
Meyersdale, PA	forested ridgeline (20/30)	2 August - 13 September, 2004	10 daily, 10 weekly	0	n/a	Arnett *et al.* 2005
Munnsville, NY	agricultural (23)	2008	12 weely	2 red-tailed hawk	7/16 and 8/14	Stantec 2009b
Searsburg, VT	forested ridge (11)	1997	11 total (4 per search) 2-6 days per month	0	n/a	Kerlinger 2002
Somerset County, PA	agricultural grassland (8)	2000	n/a	0	n/a	Kerlinger 2006
Stetson, ME	forested ridgeline (38)	2009	19 weekly	1 red-tailed hawk**	7/27/2009	Stantec 2010a

Appendix B Table 2. 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 total BAT fatalities/turbine /year (total)	# BIRDS found during surveys (incidental)	Estimated total BIRD fatalities/turbine /year (total)	Reference
Buffalo Ridge, Minnesota	agricultural grassland (73)	April 1994 - Dec 1995	30-50 weekly	n/a	n/a	7	0.33-0.66 fatalities/t/yr (36 total)	Osborn *et al*. 2000
Buffalo Ridge, Minnesota (Phase 3)	agricultural grassland (138)	15 March - 15 November, 1999	30 every 14 days	n/a	n/a	20	4.45/t/yr (613)	Johnson *et al.* 2002
Buffalo Ridge, Minnesota	agricultural grassland (281)	15 June - 15 September, 2001 and 2002	83 of 103 bi-weekly	151	1.30-3.02/t/yr (364-849)	n/a	n/a	Johnson and Strickland 2004
Searsburg, Vermont	forested (11)	30 June - 18 October, 1997	11 total (4 per search) 2 to 6 days per month	0	n/a	0	n/a	Kerlinger 2002
Kewaunee County, Wisconsin	agricultural (31)	1999 - 2001	n/a	n/a	1.16-4.26/t/yr (36-132)	25	1.29/t/yr (40)	Sagrillo 2003, Sagrillo 2007
Somerset County, Pennsylvania	agricultural (8)	2000 (12 months)	n/a	0	n/a	0	n/a	Kerlinger 2006
Mountaineer, West Virginia	forested ridgeline (44)	4 April - 11 Nov, 2003	2x per week	475	47.53/t/yr (2092)	69*	4.04/t/yr (178 + 33 due to substation lighting)	Kerns and Kerlinger, 2004
Mountaineer, West Virginia	forested ridgeline (44)	31 July- 11 September, 2004	22 daily, 22 weekly	398 (68)	38/t/yr (1364-1980)	15 (n/a)	n/a	Arnett 2005
Myersdale, Pennsylvania	forested ridgeline (20)	2 August - 13 September, 2004	10 daily, 10 weekly	262 (37)	25/t/yr (400-660)	13 (4)	n/a	Arnett 2005
Top of Iowa, Iowa	agricultural (89)	24 March- 10 December, 2004	26 every 3-days	44 (n/a)	10.17/t/yr (905)	5 (n/a)	0.9/t/yr (80 total)	Koford et al. 2005
Buffalo Mtn, Tennessee	reclaimed mine on ridge (18)	April - December, 2005	18 of 18 every week, every 2 weeks, or every 2-5 days	243 (14)	63.9/t/yr (1,149)	9 (2)	1.8/t/yr (111.6 total)	Fiedler *et al.* 2007
Maple Ridge, New York	woodland, grassland, agricultural (120)	June 17 - November 15, 2006	10 every 3-days, 30 7-days, 10 daily	326 (58)	11.39-20.31/t/yr (1367-2437.2)	123 (15)	3.10-9.48/t/yr (372-1138 total)	Jain *et al*. 2007
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 30 - November 14, 2007	64 weekly	202 (81)	15.54-18.53/t/yr (3030-3614)	64 (32)	5.67-6.31/t/yr (1106-1230)	Jain *et al.* 2008
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 15 - November 9, 2008	64 weekly	140 (76)	8.18 - 8.92/t/yr (1595-1739)	74 (23)	3.42-3.76/t/yr (667-733)	Jain *et al.* 2009a
Mars Hill, Maine	forested ridgeline (28)	23 April- 3 June, 15 July-23 Sept 2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	22 (2)	0.43/t/yr-4.4/t/yr (12.1-122.5)	19 (3)	0.44-2.5/t/yr (26.8-69.2 total)	Stantec 2008
Mars Hill, Maine	forested ridgeline (28)	19 April- 6 June, 15 July-8 Oct 2008	28 of 28 weekly, seasonal dog searches	5	0.17/t/yr-0.68/t/yr (5-19)	17(4)	2.4/t/yr-2.65/t/yr (57-74)	Stantec 2009a
Munnsville, New York	agricultural and forested uplands	April 15-November 15, 2008	12 of 23 weekly, seasonal dog searches	9 (1)	0.70-2.90/t/yr	7 (3)	1.71-2.22/t/yr (39.2-51.12)	Stantec 2009b
Mount Storm, West Virginia	forested ridgeline (82)	July 18-October 17 2008	18 weekly, 9 daily	182 (27)	7.76-24.21/t/yr (636-1985)	29 (8)	2.41-3.81/t/yr (198-312)	Young *et al.* 2009
Clinton, New York	agricultural, woodland (67)	April 26 to October 13, 2008	8 daily, 8 every 3-days, 7 every 7-days	39 (14)	3.76-5.45/t/yr (252-365)	14 (9)	1.43-2.48 small birds/t/yr (96 -166); 0.88 med-large birds/t/yr (59)	Jain et al. 2009b
Ellenburg, New York	agricultural, woodland (54)	April 28 to October 13, 2008	6 daily, 6 every 3-days, 6 every 7-days	34 (25)	3.37-6.59/t/yr (226-441)	12 (10)	0.92-1.10 small birds/t/yr (62-74); 0.77 med-large birds/t/yr (51)	Jain et al. 2009c
Bliss, New York	agricultural, woodland (67)	April 21 - Nov 14, 2008	8 daily, 8 every 3-days, 7 every 7-days	74 (15)	7.58-14.66/t/yr (508-983)	20 (7)	0.74-4.04 small birds/t/yr (50-271); 0.25-0.66 med-large birds/t/yr (17-44)	Jain et al. 2009d
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31	4 daily	10 (2)	0.58/t/spring (7); 5.51/t/fall (66)	9 (4)	0.80/t/spring (10); 5.95/t/fall (71)	Tidhar 2010
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 15 - Nov 15, 2009	5 daily, 12 weekly	62 (7)	13.8-40.4/t/yr (804-2002)	15 (3)	2.9-4.7/t/yr (147-235)	Stantec 2010b
Stetson Mountain I, Maine	forested ridgeline (38)	April 20 to Oct 21, 2009	19 weekly	5 (0)	2.11/t/yr (80)	30 (9)	4.03/t/yr (153)	Stantec 2010a
Stetson Mountain II, Maine	forested ridgeline (17)	April 19 to Oct 15, 2010	17 weekly	14	2.48/t/yr (42.12)	11	2.14/t/yr (36.41)	Normandeau Associates, 2010 preliminary estimates, unpubl. data

*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.