Avian Migration Studies for the Beech Ridge Wind Energy Project Expansion Area Greenbrier and Nicholas Counties, West Virginia

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NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

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1.0 INTRODUCTION

Beech Ridge Energy LLC (BRE), a wholly owned subsidiary of Invenergy LLC, has developed the Beech Ridge Wind Energy Project (BRWEP) in Greenbrier and Nicholas Counties, West Virginia. The BRWEP was granted a Siting Certificate by the West Virginia Public Service Commission (PSC) on August 26, 2006, and on reconsideration, on January 11, 2007. The approval included 124 wind turbine generators (WTG) of 1.5 megawatts each for a total of 186 megawatts of generating capacity. Construction on the BRWEP began in April 2009.

On December 8, 2009, a United States District Court in the State of Maryland enjoined the construction of all but 40 centrally located WTGs (then being constructed) until further specified actions were taken, including securing an Incidental Take Permit (ITP) from the U.S. Fish and Wildlife Service (USFWS). Pursuant to a settlement agreement among the parties to the injunction proceeding, on January 26, 2010, the District Court amended its December 8, 2009 Order to allow the completion of the Project, provided a number of conditions were met including securing the ITP, and including the movement of a number of WTGs from the eastern portion of the project to the west. The amended Order also allowed the immediate completion of an additional 27 WTGs for a total of 67 WTGs. These additional WTGs were completed and brought online, together with the first 40 WTGs, between January and August 2010.

In order to comply with the portion of the Amended Order of the District Court requiring movement of certain WTGs from the eastern portion of the project to locations in the west, BRE has planned for an expansion/modification of the original project proposed to consist of up to 33 WTGs immediately west of the original footprint of the project as approved by the PSC. This expansion/modification will require review and approval by the PSC.

In connection with seeking PSC approval of the BRWEP expansion, BRE must file pre-construction avian migration studies and an avian and bat risk assessment. The original filing with the PSC occurred in 2006. This report has been prepared to comply with the PSC requirement by covering the area proposed for the project expansion and is intended to fulfill the avian migration studies requirement and supplement the results from the 2005 surveys.

1.1 Study Objectives

The principal objectives of the study to fulfill the PSC requirement were to provide site-specific information on avian use and migration though the study area that would 1) be useful in evaluating potential impacts from the proposed expansion of the BRWEP, 2) provide information useful in project planning and design to minimize potential impacts to birds to the extent practical, and 3) supplement and update the previous studies on avian use and migration in the study area.

1.2 Study Area

The BRWEP expansion area is located in Greenbrier and Nicholas counties, West Virginia, approximately 9 miles (mi; 14 kilometers [km]) northeast of Ranielle, West Virginia (Figure 1). The expansion area is located primarily along the intersection of Clear Creek Mountain, Huggins Ridge, Pollock Mountain and adjacent spur ridges located off of Beech Ridge. The proposed expansion area for the BRWEP is located immediately west of the existing project footprint (Figure 1).

The BRWEP expansion area is located within a 63,000-acre tract owned by MeadWestvaco. BRE has agreements on approximately 3,172 acres of land that comprises the project area for the expansion; however, only a portion of the project area actually host wind project facilities (Figure 2). The area of permanent project impacts in the expansion area (the land to be occupied by facilities) for up to 33 turbines, access roads, transmission line, substation and permanent meteorological towers is approximately 21 acres (Figure 2). Approximately 124 acres of temporary land cover conversion (e.g., forest removal to allow for construction) will be required for project construction.

The majority of the study area is deciduous forest habitat, with smaller inclusions of shrub-scrub, grassland, and evergreen forest vegetation types (Figure 3). The primary current land use is commercial timber production. Historic land use included timber production and coal mining activities. The resulting landscape is a mosaic of deciduous forest in various stages of growth. Avian surveys (see below) were located primarily within deciduous forest habitat, although some were located in more open areas of shrub-scrub and grassland vegetation.

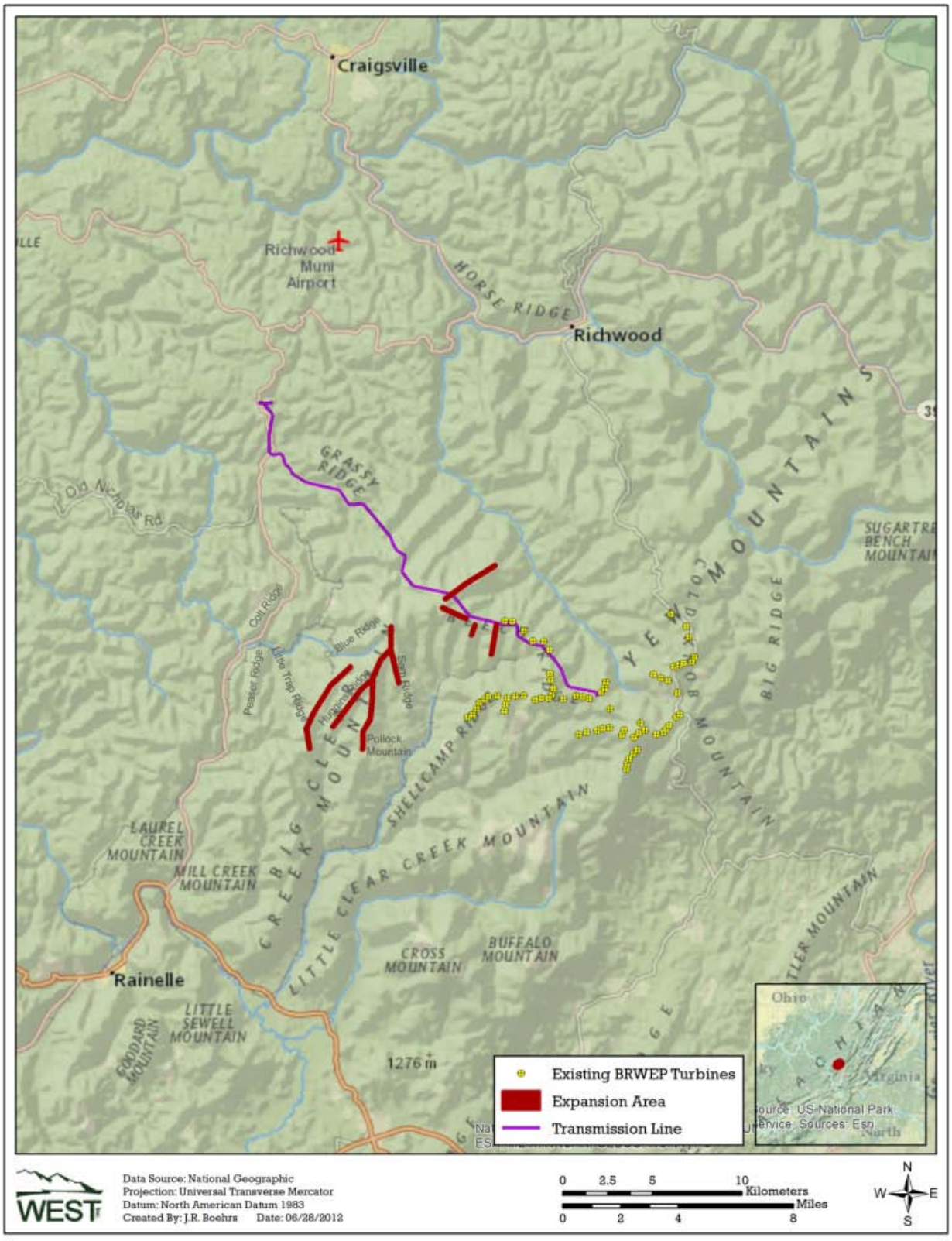

Figure 1. Location of the proposed Beech Ridge Wind Energy Project expansion area.

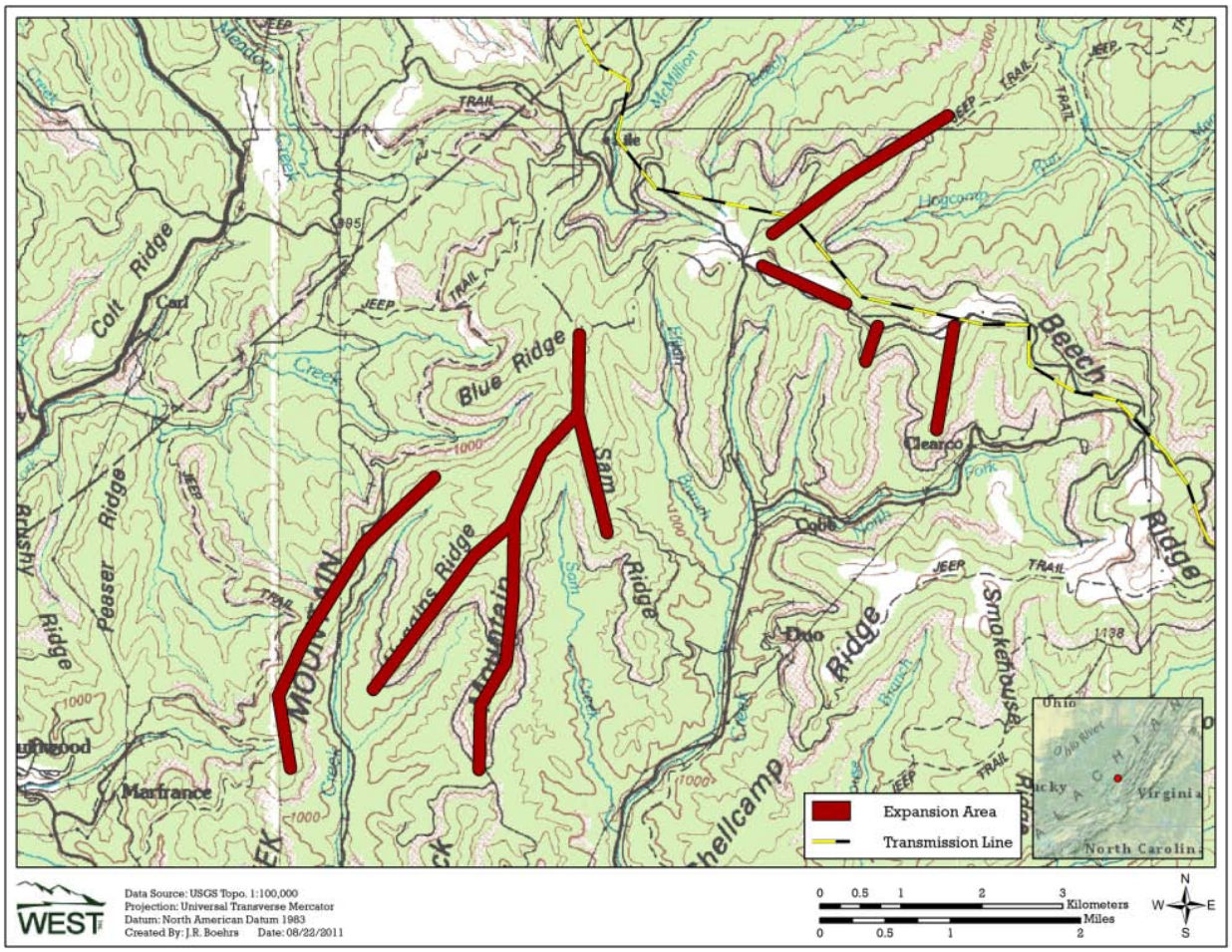

Figure 2. Proposed construction corridors for the Beech Ridge Wind Energy Project expansion area.

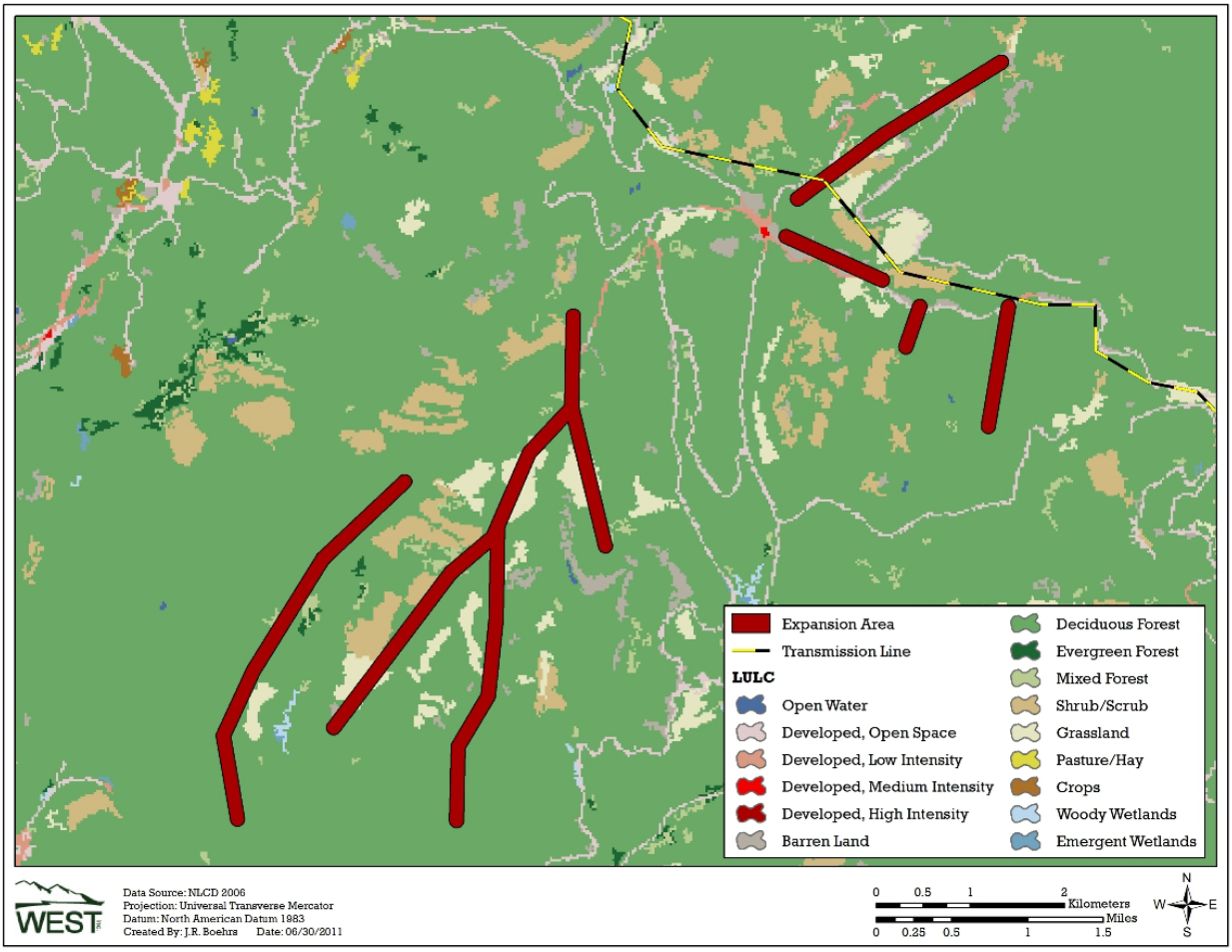

Figure 3. Land cover types within the Beech Ridge Wind Energy Project expansion area (USGS NLCD 2001).

2.0 METHODS

The avian migration studies at the BRWEP expansion area consisted of fixed-point avian surveys and raptor migration surveys during the spring and fall migration seasons. The fixed-point avian surveys were designed to collect data in areas of potential impact by development (at or near proposed turbine locations). The raptor migration surveys were designed to provide visual coverage of large areas by using point-count stations located at prominent vantage points.

2.1 Avian Surveys

Fixed-point surveys were conducted using methods used by Canterbury (2006) during previous studies at the BRWEP site. The fixed-point avian surveys were intended to provide site-specific data that could be used to calculate metrics related to species composition, such as bird diversity and species richness, and species abundance such as bird use, percent of use, and frequency of occurrence, during the migration periods primarily for passerines and other small non-passerine bird species. In addition, data were collected during the surveys on flight height to calculate the percentage of birds observed flying within the potential turbine rotor-swept height.

2.1.1 Survey Plots

Thirty-four fixed points were selected systematically to survey a spatially-representative sample of vegetation types and topography in the study area (Figure 4). Each survey plot was defined as the area within a 50-meter (m; ~164-foot [ft]) radius of the fixed point. Due to the preliminary nature of the project design for the BRWEP expansion area, there was no proposed turbine layout at the time of the surveys; therefore, fixed points were placed in and near proposed development corridors (Figure 4).

2.1.2 Survey Methods

Individual surveys were 10 minutes in duration and were conducted from approximately 30 minutes before sunrise to three hours after sunrise on any given survey day. The date, start and end time of the survey periods, and weather information (e.g., temperature, wind speed, wind direction, and cloud cover) were recorded for each survey. The survey effort was concentrated within the 50-m radius plot; however, all birds observed (seen or heard) during the survey were recorded regardless of the distance from the observer. Observations of birds beyond the 50-m radius plot were not included in the standardized analyses.

Species or best possible identification, number of observations, sex and age class (if possible), distance from the fixed point when first observed, closest distance, activity (behavior), and vegetation (habitat) were recorded for each observation. The behavior of each bird observed and the vegetation type in or over which the bird occurred were recorded for the point of first observation. For birds observed flying in the plot, approximate flight height at the point of first

observation was recorded to the nearest 5-m (~16 ft) interval. Observations made by auditory means only were noted as such.

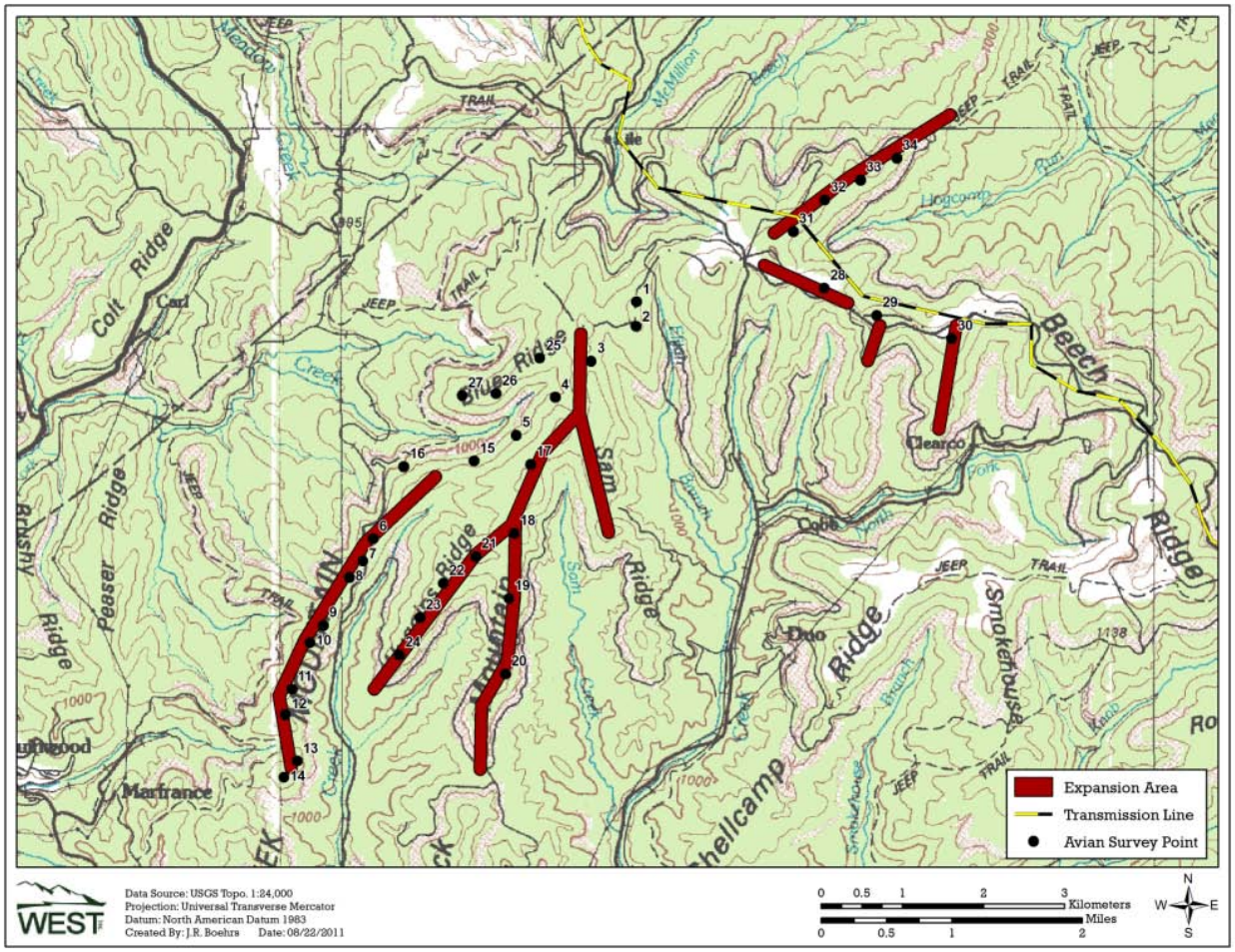

Figure 4. Avian survey points at the Beech Ridge Wind Energy Project expansion area.

2.1.3 Observation Schedule

Sampling intensity was designed to provide enough data to characterize bird diversity, species richness, bird use, percent of use, and frequency of occurrence of birds within the study area during the peak spring (April and May) and fall (September and October) migration periods for passerines. Fixed-point surveys were conducted approximately weekly at all survey stations during the study period. The observation schedule was varied by rotating the starting point on each survey day to ensure that each fixed-point was visited at different times throughout the study period.

2.2 Raptor Migration Surveys

Raptor migration surveys were conducted according to standard methods used by the Hawk Migration Association of North America (HMANA) and Hawk Watch International (HWI). The raptor migration surveys were intended to provide site-specific data on raptor composition such as species diversity and richness, and raptor abundance such as passage rate, percent of overall passage, and frequency of occurrence during the migration periods for diurnal raptors (*Accipiters*, *Buteos*, harriers, eagles, falcons), and vultures. In addition, data were collected during the surveys on flight height to calculate the percentage of raptors observed flying within the potential turbine rotor-swept height.

2.2.1 Survey Stations

Three survey stations were selected within the expansion area to survey for migrant raptors (Figure 5). The stations were established on the tops of ridges within the expansion area and in open non-forest habitats that provided maximal visibility in roughly 360^{o} around the point over long distances.

2.2.2 Survey Methods

Surveys were conducted according to methods used by the HMANA and HWI, with observers continuously scanning overhead for migrating raptors. Binoculars were frequently used throughout each survey period to aid in locating migrating raptors. The date, start and end time of the survey period, and weather information such as temperature, wind speed, wind direction, barometric pressure, percent cloud cover, precipitation, and maximum visibility estimates were recorded for each survey. Weather information was recorded using a Kestrel® 2500 pocket wind meter. Time of observation, species or best possible identification, number of observations, age and sex (if possible), and best estimation of distance from observer, flight height, and flight direction were recorded for each raptor observation. Surveys were conducted only on days when weather conditions were conducive to raptor migration (i.e., warm, clear, high pressure conditions).

2.2.3 Observation Schedule

Sampling intensity was designed to provide enough data to characterize species composition, relative abundance, and passage rates of raptors migrating within the study area during peak spring (March through May) and fall (September through November) migration periods for diurnal raptors. Surveys were conducted at all three stations approximately three times per week during the study period. Individual survey periods were one hour in duration and were conducted between approximately 0900 and 1600 each survey day to cover the peak daily period of diurnal raptor migration activity.

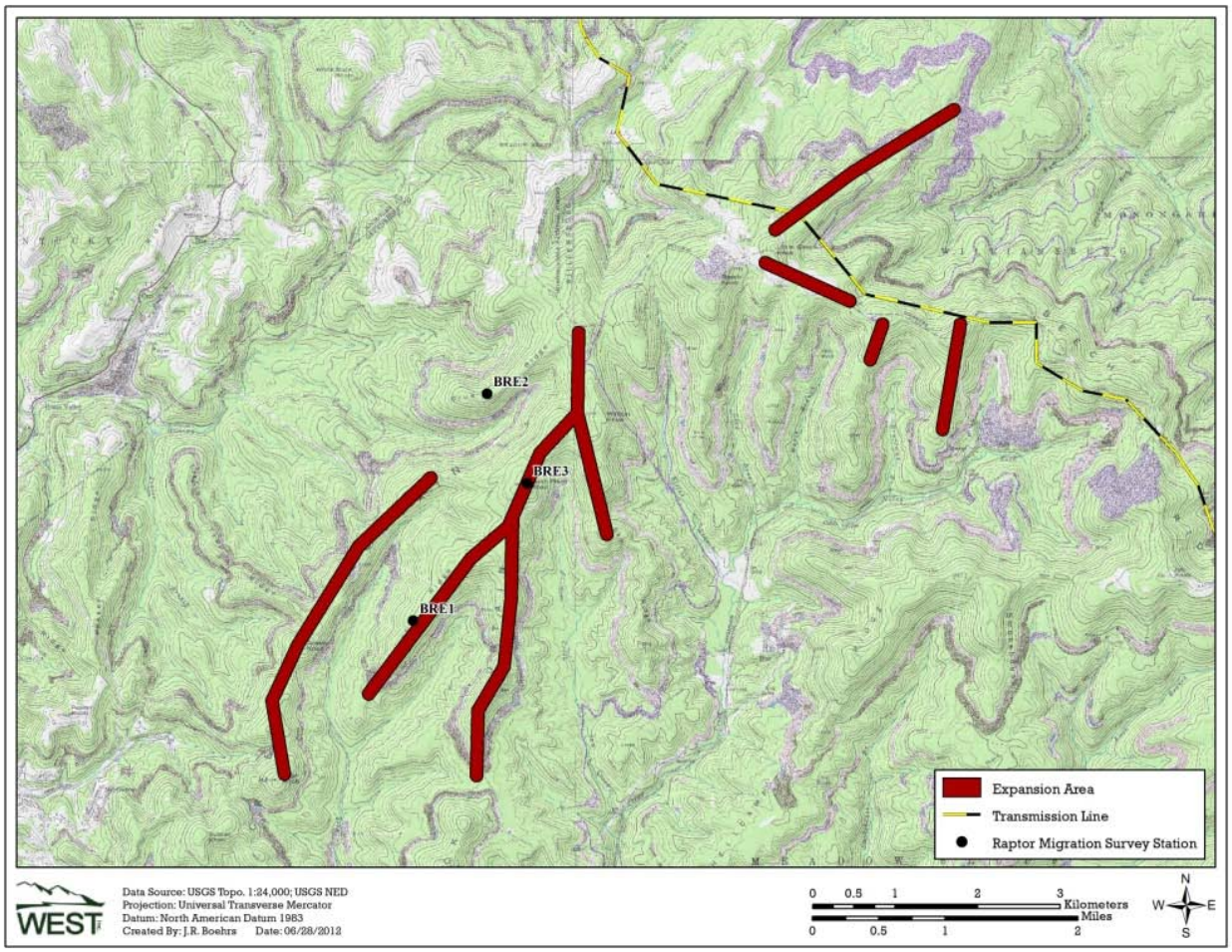

Figure 5. Raptor migration survey stations at the Beech Ridge Wind Energy Project expansion area.

2.3 Statistical Analysis

Following field surveys, observers inspected data forms for completeness, accuracy, and legibility. A Microsoft® ACCESS database was developed to store, organize, and manage survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. A sample of records from the electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. All data forms, field notebooks compiled, and electronic data files were retained for reference.

2.3.1 Avian Use Surveys

2.3.1.1 Bird Diversity and Species Richness

Bird diversity was represented by the total number of species observed. A species list with the number of groups and observations recorded was generated for the study period and included all observations of birds detected, regardless of their distance from the observer or type of observation (e.g., visual or auditory). Species richness was calculated as the average number of species observed per 10-minute survey per 50-m radius plot.

2.3.1.2 Bird Use, Percent of Use, and Frequency of Occurrence

For standardized avian use estimates, only observations of birds detected within the 50-m radius plot were used in the analysis. Mean use for a survey plot was the average number of bird observations recorded per 10-minute survey per plot. Mean use per visit was calculated as the total number of bird observations recorded within each plot averaged over all plots. A visit was defined as a complete round of surveys at all plots. To calculate overall mean use during each season, the mean use per visit was averaged over all visits during the season. Standardizing estimates of mean bird use for plots, visits, and season allow comparison between bird types and/or species, location, time, or with other studies where similar methods were used.

Percent of use was calculated as the proportion of the overall mean use that is attributable to a particular species or bird type. Frequency of occurrence was calculated as the percent of surveys in which a particular species or raptor type was observed.

2.3.1.3 Bird Flight Height Characteristics

Bird flight height metrics are often used to assess potential exposure of birds to collision risk with turbines. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH; ~44 m to 150 m [~144 ft to 492 ft] [1] above ground level) for turbines potentially used at the expansion area. The flight height recorded at the point

[1] The potential rotor-swept height was derived from a combination of two potential tower heights, either 94 m or 100 m (~308 ft to 328 ft), with 100 m (~328 ft) rotor diameter. This RSH is actually larger than either turbine so provides a conservative estimate of exposure.

of first observation of flying birds was used to calculate the percentage of birds flying within the RSH.

2.3.2 Raptor Migration Surveys

2.3.2.1 Raptor Diversity and Species Richness

Raptor diversity was represented by the total number of species observed. Species richness was calculated as the mean number of raptor species observed per survey. The unit of species richness for raptor migration surveys was just species observed per survey since the survey plot was defined by an unlimited viewshed at each station.

2.3.2.2 Passage Rate, Percent of Overall Passage, and Frequency of Occurrence

For raptor migration surveys, observations of raptors or vultures detected within an unlimited viewshed were used in the analysis. Passage rate was the number of raptor or vulture observations recorded per observer-hour[2] and was calculated by dividing the number of raptors or vultures observed during a survey by the number of hours in the survey. Passage rate per visit was calculated as the total number of raptors or vultures seen averaged over all plots. A visit was defined as a complete round of surveys at all plots. This metric allows standardized comparison between sample locations, time (hours, days, weeks, seasons), or with other studies where similar data exist. Overall passage rates for the season or entire study period was calculated by averaging across all visits. To investigate changes in passage rate over time of day, passage rate was averaged across all stations for 1-hour time blocks (e.g., 1000 – 1100 hours, 1100 – 1200 hours, etc.).

2.3.2.3 Bird Flight Height Characteristics

For observations of raptors within 800 meters (m) of the survey station[3], the approximate flight height was recorded at the point where the bird was first observed. Flight height information was used to calculate the percentage of birds observed flying within the RSH (44 to 150 m [82.0 to 492.1 ft] above ground level) for turbines potentially used at the expansion area.

3.0 RESULTS

The avian use surveys were conducted between April 8 to May 31 and September 12 to November 3, 2011. The raptor migration surveys were conducted from March 17 to May 31 and September 12 to November 29, 2011.

[2] The number of birds per observer-hour is the standard metric used during raptor migration surveys at established HMANA and HWI sites. Because raptors are counted in an unlimited viewshed around the survey station, survey plot boundaries are not used to further standardize or define use estimates.

[3] Due to the difficulty with estimating flight height when there are few reference points, flight height was not estimated for observations of birds greater than 800 m from the survey station.

3.1 Avian Surveys

Seventeen visits were completed for the avian surveys, nine of which occurred in the spring and eight in the fall. In total, 564 10-minute fixed-point avian surveys were conducted at the BRWEP expansion area.

3.1.1 Bird Diversity and Species Richness

Ninety-one species were identified throughout all the fixed-point avian surveys (Appendix A). During the surveys, 4,059 observations were made within 2,875 separate groups, defined as one or more individuals (Appendix A). Overall mean species richness was 2.72 species observed per survey per plot. Species richness was higher in the spring (3.57 species per survey per plot) than fall (1.87 species per survey per plot).

3.1.2 Bird Use, Percent of Use, and Frequency of Occurrence

Overall bird use was higher in spring than in the fall (5.20 and 4.49 bird observations per survey per plot, respectively; Table 1). Passerines accounted for the majority of bird use in either season (96.4 and 88.9 percent of bird use for spring and fall, respectively). Mean use for all other bird types was low relative to passerine use. Of non-passerine bird types, woodpeckers had the highest use in either season. Diurnal raptor use was relatively low in either season (Table 1).

Shorebirds

The only shorebird species observed was American woodcock (*Scolopax minor*), which was only observed in spring (less than 0.01 bird observations per survey per plot; Table 1). The American woodcock accounted for 0.1 percent of spring avian use and was observed during 0.4 percent of spring surveys (Table 1).

Diurnal Raptors

Diurnal raptor use was 0.01 bird observations per survey per plot in the spring and 0.06 in the fall, and composed 0.3 and 1.2 percent of overall bird use in the spring and fall, respectively (Table 1). Within the 50-m plot, diurnal raptor use in spring was attributable to three species (broad-winged hawk [*Buteo platypterus*], northern harrier [*Circus cyaneus*], and unidentified buteo), while four species accounted for all diurnal raptor use in fall (sharp-shinned hawk [*Accipiter striatus*], broad-winged hawk, red-shouldered hawk, and American kestrel [*Falco sparverius*]). Only broad-winged hawk was observed during both seasons. Diurnal raptors were observed during 1.3 percent of surveys in spring and 4.8 percent of fall surveys (Table 1).

Owls

Barred owl (*Strix varia*) was the only owl species observed, and use by this species was less than 0.01 bird observation per survey per plot in the spring; no owls were observed in the fall (Table 1). Barred owl accounted for 0.1 percent of spring bird use and was observed during 0.4 percent of spring surveys (Table 1).

Vultures

Turkey vulture (*Cathartes aura*) was the only vulture species observed, with 57 vulture observations recorded during the study, and use by this species was 0.02 bird observations per survey per plot in the spring and less than 0.01 in the fall (Table 1). Turkey vultures accounted for 0.3 percent of all bird use in the spring and 0.2 percent in the fall. Turkey vultures were observed during 1.0 percent of spring surveys and 0.4 percent of fall surveys (Table 1).

Upland Game Birds

The only upland game bird species observed was ruffed grouse (*Bonasa umbellus*), and this species was only observed in spring (0.04 bird observations per survey per plot; Table 1). Ruffed grouse accounted for 1.0 percent of spring avian use and was observed during 4.0 percent of spring surveys (Table 1).

Doves/Pigeons

Mourning dove (*Zenaida macroura*) was the only dove/pigeon species observed (Table1). Mourning dove use was 0.01 bird observations per survey per plot in the spring. Mourning doves were not observed in the fall. Mourning dove accounted for 0.3 percent of all spring bird use, and mourning doves were observed during 0.7 percent of spring surveys (Table 1).

Passerines

Passerine use was 5.01 and 3.99 birds per survey per plot in the spring and fall, respectively (Table 1). Passerines accounted for 96.4 percent of bird use in spring and 88.9 percent in fall. Passerines were observed during 79.7 percent of spring and 70.0 percent of fall surveys (Table 1). Eastern towhee was the most commonly recorded passerine during the study with 392 observations recorded (Appendix A) and had the highest mean use of all passerines in the spring (0.75 bird observations per survey per plot). Use by eastern towhee in the fall was 0.35 bird observations per survey per plot (Table 1). Eastern towhee accounted for 14.5 percent of bird use during the spring and 7.9 percent in the fall and was observed during 38.8 percent of spring surveys and 17.6 percent of fall surveys. American robin was the second most commonly recorded passerine during the study with 366 observations recorded (Appendix A) and had the highest mean use of all passerines in the fall (0.92 bird observations per survey per plot). American robin use during the spring was 0.13 bird observations per survey per plot. American robin accounted for 20.6 percent of all bird use during the fall season and just 2.6 percent in the spring, and was observed during 10.7 percent of fall surveys and 8.3 percent of spring surveys (Table 1).

Other Small Bird Types

Woodpecker use was 0.12 bird observations per survey per plot in the spring and 0.24 in the fall (Table 1). Woodpeckers accounted for 2.2 percent of all bird use in the spring and 5.2 percent in the fall. Woodpeckers were observed during 9.6 percent of spring and 19.1 percent of fall surveys. The most common woodpecker species recorded was downy woodpecker (*Picoides pubescens*) with 46 observations recorded (Appendix A). Downy woodpecker use was 0.05 bird observations per survey per plot in the spring and 0.11 in the fall. Cuckoo use was less than 0.01 bird per survey in the spring and 0.04 in the fall. Cuckoos accounted for 0.1 percent and

0.8 percent of bird use in the spring and fall, respectively (Table 1). Cuckoos were observed during 0.3 percent of spring and 3.3 percent of fall surveys. Ruby-throated hummingbird (*Archilochus colubris*) was the only swift/hummingbird species observed, with an estimated use of less than 0.01 bird observations per survey per plot in both the spring and fall (Table 1). Use by ruby-throated hummingbirds accounted for 0.1 percent and 0.2 percent of bird use in the spring and fall, respectively, and they were observed during 0.3 percent of spring surveys and 0.7 percent of fall surveys (Table 1).

Table 1. Mean bird use, percent of use, and frequency of occurrence for bird types and species observed during the avian use surveys at the Beech Ridge Wind Energy Project expansion area.

	Mean Use		Percent of Use		Frequency of Occurrence	
Type / Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
Shorebirds	**<0.01**	**0**	**0.1**	**0**	**0.4**	**0**
American woodcock	<0.01	0	0.1	0	0.4	0
Raptors	**0.01**	**0.06**	**0.3**	**1.2**	**1.3**	**4.8**
sharp-shinned hawk	0	0.02	0	0.4	0	1.8
broad-winged hawk	<0.01	<0.01	0.1	0.2	0.3	0.7
red-shouldered hawk	0	0.01	0	0.2	0	1.1
unidentified Buteo	<0.01	0	0.1	0	0.7	0
northern harrier	<0.01	0	0.1	0	0.3	0
American kestrel	0	0.02	0	0.4	0	1.8
Owls	**<0.01**	**0**	**0.1**	**0**	**0.4**	**0**
barred owl	<0.01	0	0.1	0	0.4	0
Vultures	**0.02**	**<0.01**	**0.3**	**0.2**	**1.0**	**0.4**
turkey vulture	0.02	<0.01	0.3	0.2	1.0	0.4
Upland Game Birds	**0**	**0.04**	**0**	**1.0**	**0**	**4.0**
ruffed grouse	0	0.04	0	1.0	0	4.0
Doves/Pigeons	**0.01**	**0**	**0.3**	**0**	**0.7**	**0**
mourning dove	0.01	0	0.3	0	0.7	0
Passerines	**5.01**	**3.99**	**96.4**	**88.9**	**79.7**	**70.0**
alder flycatcher	<0.01	0	0.1	0	0.7	0
American crow	0	0.08	0	1.9	0	2.9
American goldfinch	0.16	0.17	3.0	3.7	10.6	10.7
American redstart	<0.01	0.03	0.2	0.7	1.0	0.7
American robin	0.13	0.92	2.6	20.6	8.3	10.7
barn swallow	<0.01	0	0.1	0	0.3	0
bay-breasted warbler	<0.01	0	0.2	0	1.0	0
Bicknell's thrush	<0.01	0	0.1	0	0.3	0
black-and-white warbler	0.15	<0.01	2.8	0.2	11.0	0.7
black-capped chickadee	0.08	0.17	1.6	3.7	5.4	10.7
black-throated blue warbler	0.02	0.12	0.3	2.6	1.6	7.4
black-throated green warbler	0.39	0.06	7.6	1.2	25.6	2.6
Blackburnian warbler	<0.01	<0.01	0.1	0.2	0.7	0.7
blackpoll warbler	<0.01	<0.01	0.1	0.1	0.3	0.4
blue-gray gnatcatcher	<0.01	<0.01	0.1	0.1	0.7	0.4
blue-headed vireo	0.19	0.10	3.7	2.1	14.7	5.9

Table 1. Mean bird use, percent of use, and frequency of occurrence for bird types and species observed during the avian use surveys at the Beech Ridge Wind Energy Project expansion area.

Type / Species	Mean Use		Percent of Use		Frequency of Occurrence	
	Spring	Fall	Spring	Fall	Spring	Fall
blue jay	0.02	0.22	0.3	4.8	1.7	19.5
brown-headed cowbird	0.06	0.14	1.2	3.1	4.0	0.7
brown thrasher	0.01	0	0.3	0	1.3	0
Canada warbler	0.02	0	0.4	0	2.3	0
Cape May warbler	0.01	<0.01	0.3	0.1	1.3	0.4
Carolina wren	0	<0.01	0	0.2	0	0.7
cedar waxwing	0.11	0.30	2.1	6.7	3.3	7.7
cerulean warbler	0.05	0.01	1.0	0.2	4.6	1.1
chestnut-sided warbler	0.43	0	8.3	0	26.5	0
chipping sparrow	<0.01	0.01	0.1	0.3	0.3	0.7
common grackle	0	0.19	0	4.3	0	0.7
common yellowthroat	0.06	0.03	1.1	0.6	4.9	1.5
common raven	<0.01	0.03	0.2	0.7	1.0	2.2
dark-eyed junco	0.21	0.44	4.1	9.7	16.1	20.6
eastern bluebird	<0.01	0.01	0.1	0.2	0.3	0.4
eastern phoebe	<0.01	0	0.1	0	0.3	0
eastern towhee	0.75	0.35	14.5	7.9	38.8	17.6
eastern wood-pewee	<0.01	0.01	0.2	0.2	1.0	0.7
European starling	0.02	0.06	0.4	1.2	1.3	0.7
field sparrow	0.09	0	1.8	0	6.8	0
golden-crowned kinglet	<0.01	0	0.1	0	0.3	0
golden-winged warbler	0.02	<0.01	0.4	0.1	2.0	0.4
gray catbird	0	<0.01	0	0.1	0	0.4
great crested flycatcher	0	<0.01	0	0.1	0	0.4
hermit thrush	0.05	0	0.9	0	3.7	0
hooded warbler	0.14	<0.01	2.6	0.1	12.7	0.4
house wren	<0.01	0	0.1	0	0.3	0
indigo bunting	0.25	<0.01	4.9	0.1	19.1	0.4
Kentucky warbler	<0.01	<0.01	0.1	0.1	0.3	0.4
least flycatcher	0.03	<0.01	0.6	0.2	2.9	0.7
magnolia warbler	0.13	0.03	2.4	0.6	8.9	2.2
mourning warbler	0.03	0	0.6	0	2.9	0
Nashville warbler	0.02	0	0.4	0	1.6	0
ovenbird	0.31	0.01	5.9	0.2	18.4	0.4
palm warbler	0.02	0.03	0.3	0.7	1.6	0.7

Table 1. Mean bird use, percent of use, and frequency of occurrence for bird types and species observed during the avian use surveys at the Beech Ridge Wind Energy Project expansion area.

	Mean Use		Percent of Use		Frequency of Occurrence	
Type / Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
red-eyed vireo	0.43	0.01	8.2	0.2	28.5	1.1
rose-breasted grosbeak	0.09	0.02	1.7	0.4	8.3	1.8
scarlet tanager	0.10	0	1.9	0	9.3	0
song sparrow	0.02	0.03	0.3	0.6	1.7	1.5
Swainson's thrush	0	<0.01	0	0.1	0	0.4
Swainson's warbler	<0.01	0	0.1	0	0.3	0
tree swallow	0	0.02	0	0.5	0	0.7
unidentified passerine	0	0.30	0	6.7	0	12.1
unidentified sparrow	0	<0.01	0	0.1	0	0.4
unidentified warbler	<0.01	0.06	0.2	1.2	0.7	3.3
veery	0.11	0	2.1	0	7.7	0
white-breasted nuthatch	0.01	0.05	0.2	1.1	1.0	4.4
white-crowned sparrow	0	<0.01	0	0.1	0	0.4
white-throated sparrow	0	<0.01	0	0.1	0	0.4
wood thrush	0.03	<0.01	0.5	0.1	2.8	0.4
worm-eating warbler	0.01	<0.01	0.2	0.1	1.0	0.4
yellow-breasted chat	<0.01	0.01	0.2	0.3	1.0	1.1
yellow-rumped warbler	0.14	0.02	2.7	0.5	12.0	1.5
yellow warbler	<0.01	0	0.1	0	0.3	0
Cuckoos	**<0.01**	**0.04**	**0.1**	**0.8**	**0.3**	**3.3**
black-billed cuckoo	0	<0.01	0	0.1	0	0.4
yellow-billed cuckoo	<0.01	0.03	0.1	0.7	0.3	2.9
Swifts/Hummingbirds	**<0.01**	**<0.01**	**0.1**	**0.2**	**0.3**	**0.7**
ruby-throated hummingbird	<0.01	<0.01	0.1	0.2	0.3	0.7
Woodpeckers	**0.12**	**0.24**	**2.2**	**5.2**	**9.6**	**19.1**
downy woodpecker	0.05	0.11	1.0	2.4	4.0	10.3
hairy woodpecker	0.03	0.06	0.6	1.4	2.3	5.9
northern flicker	0.03	0.03	0.5	0.7	2.6	3.3
pileated woodpecker	0	0.03	0	0.7	0	2.9
unidentified woodpecker	0.01	<0.01	0.2	0.1	0.8	0.4
Overall	**5.20**	**4.49**	**100**	**100**		

3.1.3 Bird Flight Height Characteristics

Overall, the number of birds observed flying was low (Table 2). During the avian surveys, 194 groups of birds were observed flying, totaling 278 observations (approximately 6.8 percent of all birds observed). Due to the vegetation type in the study area (primarily deciduous forest), the vertical viewshed was somewhat limited, but nearly all flying birds observed within the 50-m radius plot were flying below the RSH. Only 1.6 percent of flying passerines were observed within the RSH; all other flying birds were observed flying within the 50-m radius plot were below the RSH (Table 2).

Table 2. Flight height by bird type during avian use surveys at the Beech Ridge Wind Energy Project expansion area.

Bird Type	Number of Groups Flying	Number of Flying Bird Observations	Mean Flight Height (m)	Percent Flying	Percent within Flight Height Categories		
					0 - 44 m	44 - 150 m[b]	> 150 m
Shorebirds	1	2	4.00	100	100	0	0
Diurnal Raptors	2	2	14.50	10.5	100	0	0
Accipiters	0	0	0	0	0	0	0
Buteos	1	1	14.00	12.5	100	0	0
Northern harrier	1	1	15.00	100	100	0	0
Falcons	0	0	0	0	0	0	0
Owls	1	1	1.00	100	100	0	0
Vultures	3	5	11.33	71.4	100	0	0
Upland Game Birds	0	0	0	0	0	0	0
Doves/Pigeons	2	4	2.50	100	100	0	0
Large Corvids	2	2	9.50	5.9	100	0	0
Passerines	171	246	6.47	9.5	98.4	1.6	0
Cuckoos	0	0	0	0	0	0	0
Swifts/Hummingbirds	1	1	2.00	33.3	100	0	0
Woodpeckers	9	13	11.22	13.3	100	0	0
Overall	**194**	**278**	**5.68**				

[a.] The potential "rotor-swept height" for turbines likely used in the expansion area development, or 44 to 150 m (144 to 492 ft) above ground level.

3.2 Raptor Migration Surveys

Raptor migration surveys were conducted at the three stations, three times weekly, within the BRWEP expansion area. Each station was surveyed 68 or 69 times, for a total of 206 raptor migration surveys (Table 3). Mean passage rate (number of raptor observations recorded per observer-hour) across all species within the area varied from 3.50 to 4.91 raptor observations recorded per observer-hour and averaged 3.98 raptor observations recorded per observer-hour (Table 3; Table 4).

Table 3. Summary of raptor passage rate and species richness during the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

Station	Number of Surveys	Number of Species	Mean Use	Number of Species per Survey
1	69	11	4.02	1.64
2	68	12	4.91	1.84
3	69	10	3.50	1.38
Overall	**206**	**15**	**3.98**	**1.59**

3.2.1 Raptor Diversity and Species Richness

In total, 1,109 raptors of 15 species were recorded during raptor migration surveys (Table 4). Eleven raptor species were recorded during the spring and 13 during the fall. Diurnal raptors, excluding vultures, accounted for 37.2 percent of all birds observed (Table 4). Turkey vultures were the most commonly recorded species, accounting for approximately 62.6 percent of all birds recorded (Table 4). Average species richness was 1.59 species per survey.

Table 4. Total number of groups and observations for each raptor type and species observed during the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

	Spring		Fall		Total	
Type / Species	**Groups**	**Observations**	**Groups**	**Observations**	**Groups**	**Observations**
Diurnal Raptors	**141**	**176**	**166**	**236**	**307**	**412**
Accipiters	*16*	*17*	*15*	*17*	*31*	*34*
Cooper's hawk	2	3	5	5	7	8
sharp-shinned hawk	14	14	10	12	24	26
Buteos	*116*	*145*	*126*	*193*	*242*	*338*
broad-winged hawk	38	47	33	80	71	127
red-shouldered hawk	60	71	26	30	86	101
red-tailed hawk	18	27	66	82	84	109
rough-legged hawk	0	0	1	1	1	1
Eagles	*2*	*6*	*7*	*7*	*9*	*13*
bald eagle	0	0	2	2	2	2
golden eagle	2	6	4	4	6	10
unidentified eagle	0	0	1	1	1	1
Falcons	*3*	*4*	*16*	*17*	*19*	*21*
American kestrel	1	1	13	13	14	14
merlin	2	3	3	4	5	7
Other Raptors	*4*	*4*	*2*	*2*	*6*	*6*
northern harrier	4	4	0	0	4	4
osprey	0	0	2	2	2	2
Owls	**2**	**2**	**0**	**0**	**2**	**2**
barred owl	2	2	0	0	2	2
Vultures	**224**	**483**	**119**	**212**	**343**	**695**
black vulture	0	0	1	1	1	1
turkey vulture	224	483	118	211	342	694
Overall	**367**	**661**	**285**	**448**	**652**	**1,109**

3.2.2 Passage Rate, Percent of Overall Passage, and Frequency of Occurrence

For all stations and all species combined (diurnal raptors, owls, and vultures), mean passage rate was 4.88 bird observations recorded per observer-hour in the spring and 2.99 bird observations recorded per observer-hour in the fall (Table 5). During the spring, mean passage rate was highest at station RM2 with 6.82 bird observations recorded per observer-hour, followed by RM1 with 4.86 bird observations recorded per observer-hour, and RM3 with 4.36 bird observations recorded per observer-hour (Table 6). For the fall, passage rate was highest at station RM1 with 3.26 bird observations recorded per observer-hour, followed by RM2 with 3.21 bird observations recorded per observer-hour, and RM3 with 2.72 bird observations recorded per observer-hour (Table 6).

Diurnal Raptors

Mean diurnal raptor passage rate within the study area was 1.25 raptor observations recorded per observer-hour in the spring and 1.47 in the fall (Table 5). Spring diurnal raptor passage rate among stations ranged from 0.65 raptor observations recorded per observer-hour at station RM3 to 1.87 at station RM2, while fall raptor passage rate use ranged from 1.71 raptor observations recorded per observer-hour at station RM2 to 1.37 at station RM1 (Table 6). Diurnal raptors composed 25.7 percent of the overall passage rate in the spring and 49.1 percent of the passage rate in the fall (Table 5). Diurnal raptors were observed during 61.7 percent of spring surveys and 64.9 percent of fall surveys (Table 5).

The bulk of the diurnal raptor passage was from *Buteos*; overall mean *Buteo* passage rate was 1.08 *Buteo* observations recorded per observer-hour in spring and 1.23 in fall. *Buteos* were observed during 55.4 percent of spring surveys and 52.3 percent of fall surveys (Table 5). Broad-winged hawk and red-shouldered hawk had the highest passage rate of any raptors in the spring (0.40 and 0.47 hawk observations recorded per observer-hour, respectively), and broad-winged hawk and red-tailed hawk had the highest passage rate for diurnal raptors in fall (0.51 and 0.54 hawk observations recorded per observer-hour respectively; Table 5). Excluding broad-winged hawks, red-shouldered hawks, and red-tailed hawks, use by other diurnal raptor subtypes was relatively low. Combined, *Accipiters,* northern harrier, eagles, and falcons accounted for five to 10 percent of the total passage during the spring and fall (Table 5) and accounted for five to 10 percent of the passage at any station during either season (Table 6).

Owls

Two barred owls were observed during spring raptor migration surveys (Table 4), resulting in a passage rate of 0.01 owl observations recorded per observer-hour; no owls were observed during the fall surveys (Table 5). Barred owls accounted for 0.2 percent of overall spring passage and were observed during 2.1 percent of spring surveys (Table 5). Barred owls were only observed at station RM2 (Table 6).

Vultures

Turkey vulture was the most common species observed during the raptor migration surveys (Table 4). Spring vulture passage rate was 3.62 vulture observations recorded per observer-hour, and fall passage rate was 1.52 vulture observations recorded per observer-hour (Table 5). Turkey vultures composed 74.1 percent of overall spring passage and 50.7 percent of fall passage, and turkey vultures were recorded during 70.8 percent of spring surveys and 42.3 percent of fall surveys. In the spring, most turkey vulture passage was recorded at station RM2 (4.92 vulture observations recorded per observer-hour), while in the fall, most passage was recorded at station RM1 (1.88 vulture observations recorded per observer-hour).

Table 5. Passage rate, percent of passage rate, and frequency of occurrence for each raptor type and species observed during the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

	Mean Passage Rate		Percent of Passage Rate		Frequency of Occurrence	
Type / Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
Diurnal Raptors	**1.25**	**1.47**	**25.7**	**49.1**	**61.7**	**64.9**
Accipiters	0.09	0.11	1.9	3.8	15.0	13.5
Cooper's hawk	0.03	0.02	0.6	0.8	3.3	4.5
sharp-shinned hawk	0.06	0.09	1.3	3.1	11.7	9.9
Buteos	1.08	1.23	22.1	41.1	55.4	52.3
broad-winged hawk	0.40	0.51	8.2	16.9	26.3	15.3
red-shouldered hawk	0.47	0.19	9.7	6.2	35.4	17.1
red-tailed hawk	0.21	0.54	4.2	17.9	13.8	33.3
rough-legged hawk	0	<0.01	0	0.2	0	0.9
Eagles	0.05	0.03	1.0	1.1	2.5	5.4
bald eagle	0	<0.01	0	0.3	0	0.9
golden eagle	0.05	0.02	1.0	0.6	2.5	3.6
unidentified eagle	0	<0.01	0	0.2	0	0.9
Falcons	0.02	0.09	0.4	2.9	2.9	13.5
American kestrel	<0.01	0.06	0.1	2.0	1.3	11.3
merlin	0.01	0.03	0.3	0.8	1.7	2.3
Other Raptors	*0.02*	*<0.01*	*0.3*	*0.3*	*3.3*	*1.8*
northern harrier	0.02	0	0.3	0	3.3	0
osprey	0	<0.01	0	0.3	0	1.8
Owls	**0.01**	**0**	**0.2**	**0**	**2.1**	**0**
barred owl	0.01	0	0.2	0	2.1	0
Vultures	**3.62**	**1.52**	**74.1**	**50.9**	**70.8**	**42.3**
black vulture	0	<0.01	0	0.2	0	0.9
turkey vulture	3.62	1.52	74.1	50.7	70.8	42.3
Overall	**4.88**	**2.99**	**100**	**100**		

Table 6. Passage rate, percent of overall passage, and frequency of occurrence for each raptor type observed during the raptor migration surveys by survey station at the Beech Ridge Wind Energy Project expansion area.

	Passage Rate		Percent of Overall Passage		Frequency of Occurrence	
Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
			Station RM1			
Diurnal Raptors	**1.28**	**1.37**	**26.4**	**42.1**	**66.7**	**61.1**
Accipiters	*0.09*	*0.01*	*1.9*	*0.4*	*18.2*	*2.8*
Buteos	*1.04*	*1.27*	*21.5*	*39.1*	*54.5*	*55.6*
Northern harrier	*0.03*	*0*	*0.6*	*0*	*6.1*	*0*
Eagles	*0.11*	*0*	*2.3*	*0*	*6.1*	*0*
Falcons	*0*	*0.08*	*0*	*2.6*	*0*	*13.9*
Vultures	**3.58**	**1.88**	**73.6**	**57.9**	**69.7**	**50**
Overall	**4.86**	**3.26**	**100**	**100**		
			Station RM2			
Diurnal Raptors	**1.87**	**1.71**	**27.4**	**53.3**	**75**	**63.9**
Accipiters	*0.15*	*0.16*	*2.2*	*4.9*	*21.9*	*19.4*
Buteos	*1.69*	*1.36*	*24.7*	*42.4*	*71.9*	*55.6*
Eagles	*0*	*0.06*	*0*	*1.7*	*0*	*8.3*
Falcons	*0.03*	*0.11*	*0.5*	*3.5*	*3.1*	*13.9*
Osprey	*0*	*0.03*	*0*	*0.9*	*0*	*5.6*
Owls	**0.03**	**0**	**0.5**	**0**	**6.2**	**0**
Vultures	**4.92**	**1.50**	**72.1**	**46.7**	**84.4**	**38.9**
Overall	**6.82**	**3.21**	**100**	**100**		
			Station RM3			
Diurnal Raptors	**0.65**	**1.39**	**14.9**	**51.5**	**51.5**	**66.7**
Accipiters	*0.03*	*0.14*	*0.7*	*5.1*	*6.1*	*13.9*
Buteos	*0.56*	*1.16*	*12.8*	*42.8*	*45.5*	*50.0*
Northern Harrier	*0.03*	*0*	*0.7*	*0*	*6.1*	*0*
Eagles	*0*	*0.04*	*0*	*1.5*	*0*	*8.3*
Falcons	*0.03*	*0.06*	*0.7*	*2.1*	*6.1*	*11.1*
Vultures	**3.71**	**1.31**	**85.1**	**48.5**	**66.7**	**41.7**
Overall	**4.36**	**2.71**	**100**	**100**		

3.2.3 Temporal Passage Rate

Temporal activity was variable throughout each season for both diurnal raptors and vultures (Figures 6a and 6b). In spring, the number of diurnal raptors observed per survey day ranged from zero on several survey days to 16 on May 10, while the number of turkey vultures ranged from zero on several days to 38, 41, and 34 vultures on April 7, April 24, and May 22, respectively (Figure 6a). In fall, 17 or fewer raptors were observed on all survey days except September 22, when 51 diurnal raptors were observed (Figure 6b). The number of turkey vultures ranged from zero to 15 in the fall, except on October 23 (21 observations) and November 2 (19 observations; Figure 6b). On a daily basis, overall passage rate peaked in the early afternoon at 1300 hours, but remained relatively high from 1100 to 1700 hours (Figure 7). This trend was similar for diurnal raptors and vultures, with passage rate peaking at 1100 and 1300 hours (Figure 7).

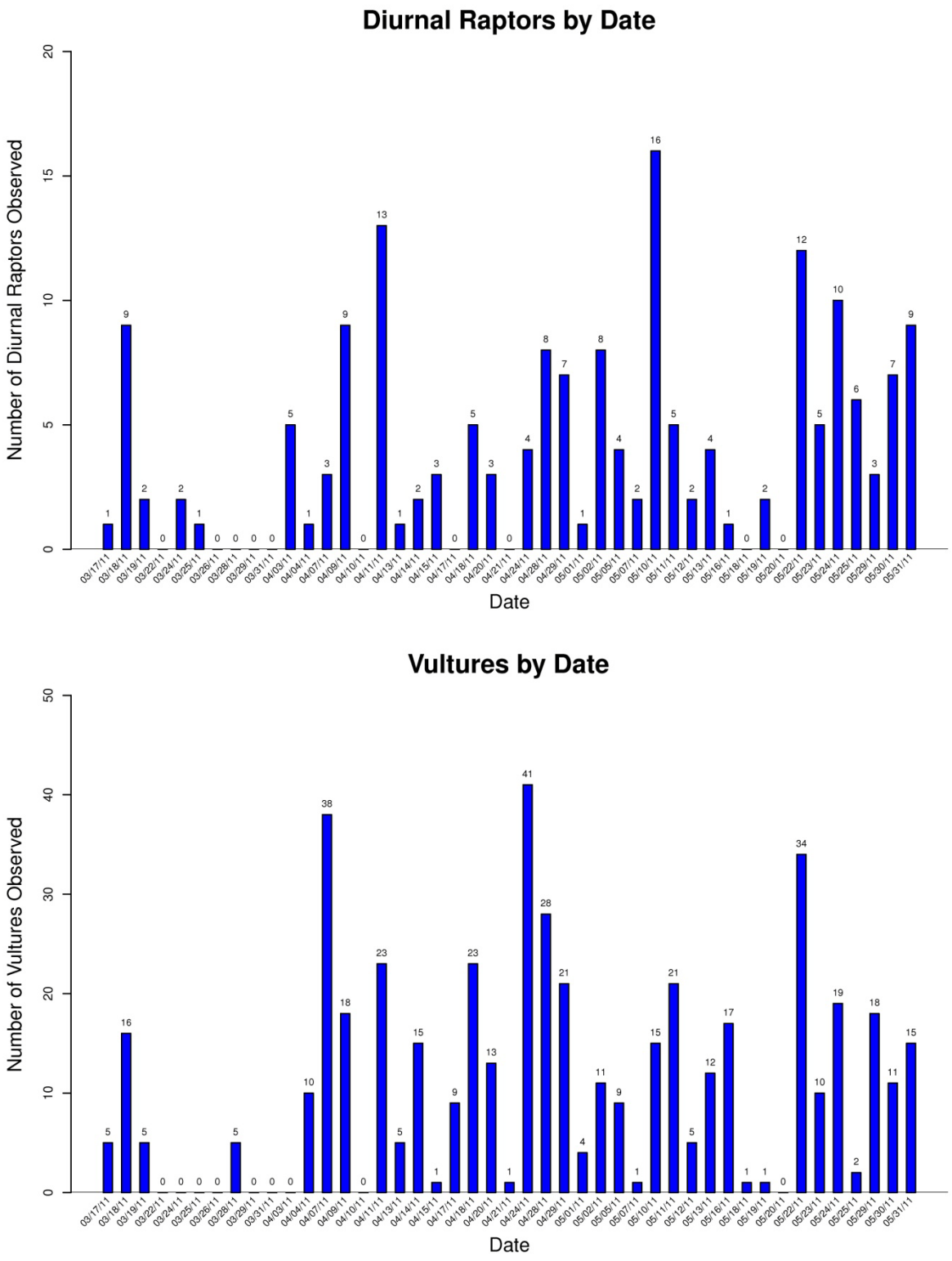

Figure 6a. Number of raptor and vulture observations recorded by survey day during the spring raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

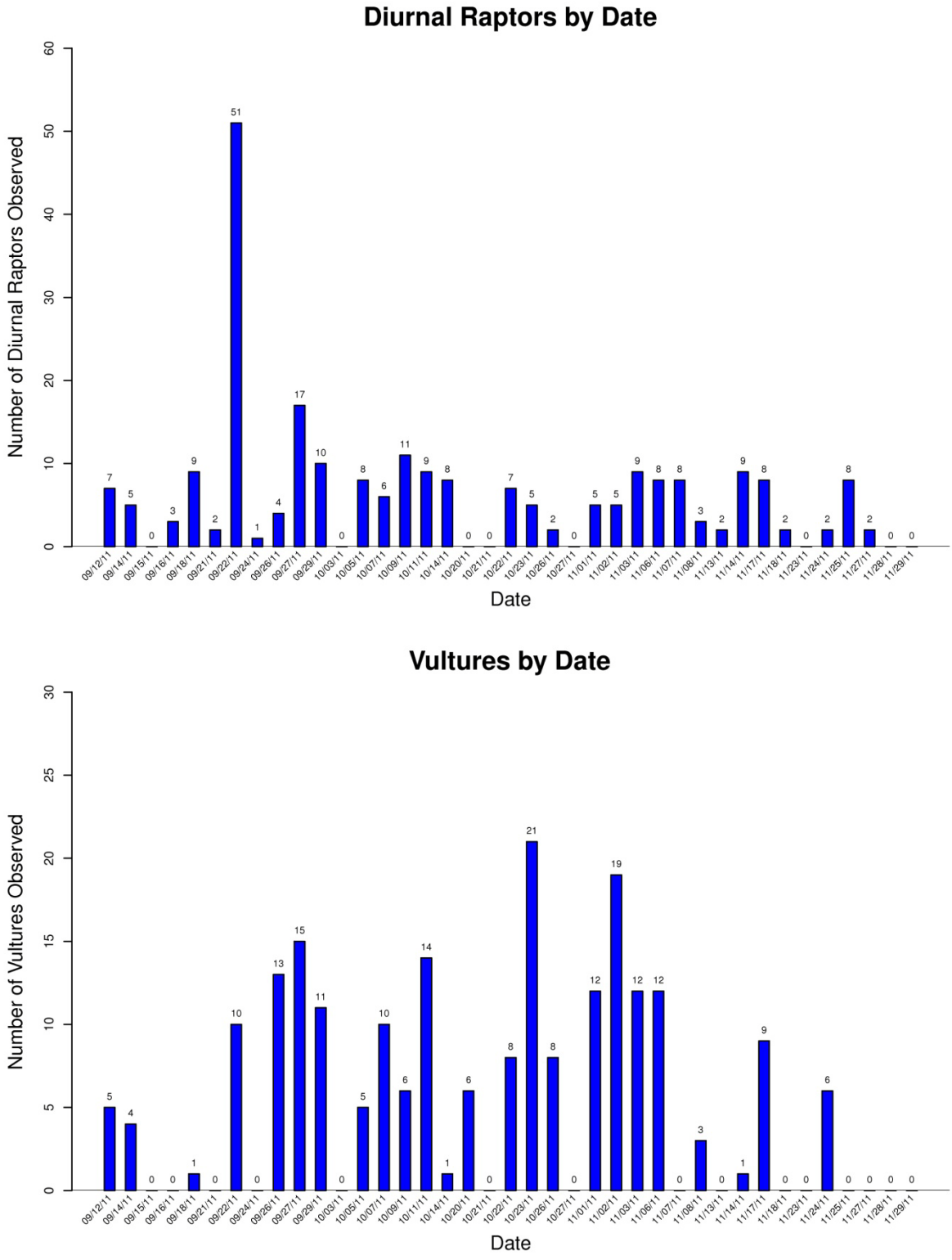

Figure 6b. Number of raptor and vulture observations recorded by survey day during the fall raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

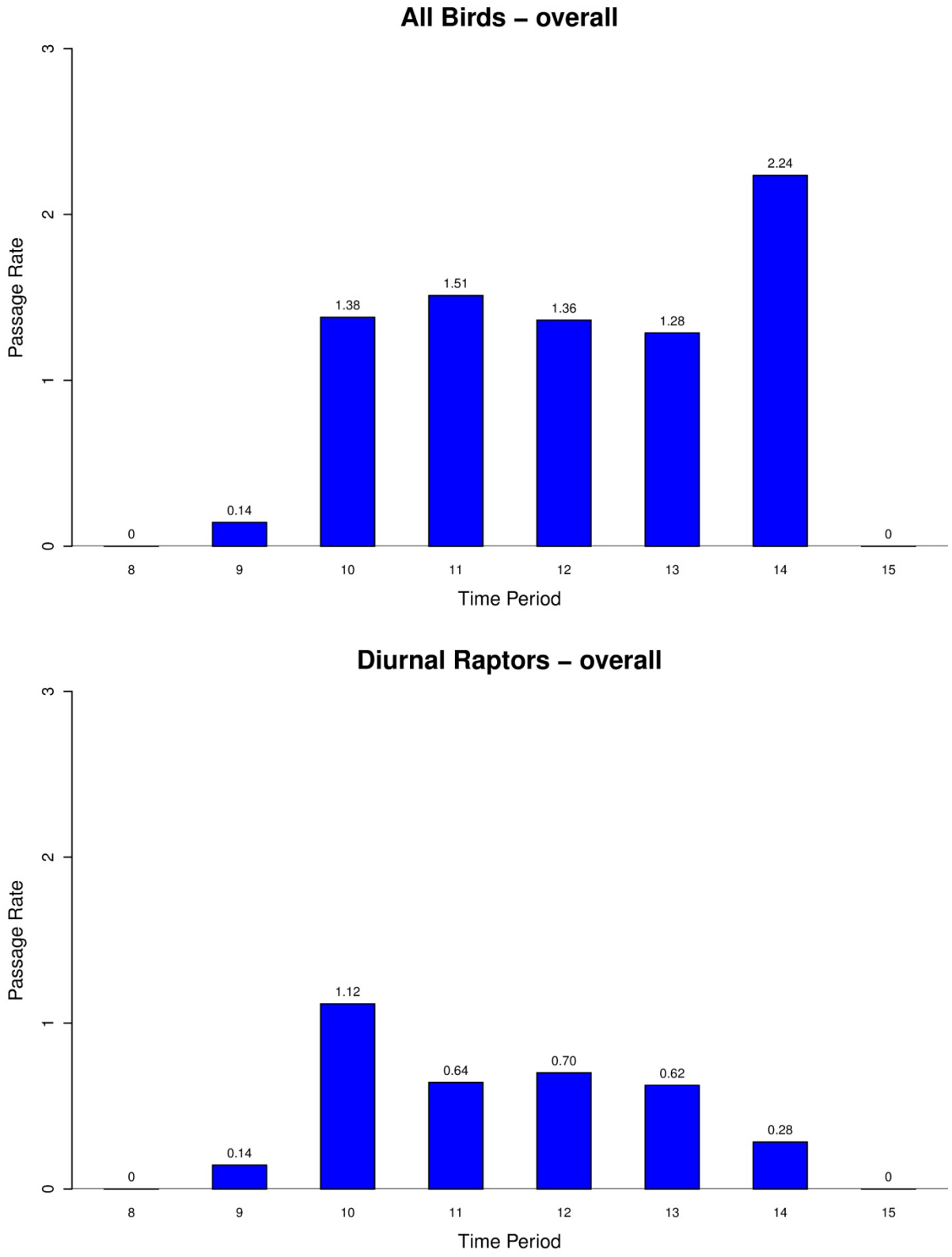

Figure 7. Mean passage rate by time of day (hour) for the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

3.2.4 Flight Height Characteristics

For diurnal raptors, approximately 25% of raptor observations were recorded flying in the RSH, based on the flight height recorded at point of first observation for observations with 800 m of the station (Table 7). For *Buteos*, the most common diurnal raptor subtype, 28.5 percent were observed flying within the RSH. Fewer than 25 *Buteo* observations were recorded within an 800-m radius of the survey station for each other raptor subtypes, which limits the utility of the flight height analysis to characterize exposure to turbines for those raptor subtypes. For example, the small sample size may not be representative of the true flight height distribution for these subtypes or species. About 19 percent of flying vulture observations were recorded within the RSH (Table 7).

Table 7. Flight height characteristics of birds observed during the raptor migration surveys[a] at the Beech Ridge Wind Energy Project expansion area.

Species/Type	Number of Groups Flying	Number of Flying Bird Observations	Mean Flight Height (m)	Median Flight Height (m)	Percent Within Rotor-Swept Height[b]
Diurnal Raptors	**137**	**183**	**37.26**	**25**	**25.1**
Accipiters	22	24	26.41	23	16.7
Buteos	95	137	42.53	30	28.5
Northern harrier	1	1	40	40	0
Eagles	2	2	60	60	50.0
Falcons	17	19	19.06	13	10.5
Vultures	**155**	**315**	**33.88**	**20**	**19.4**

[a] Limited to observations within 800 m of the survey station
[b] RSH=potential rotor-swept heights for turbine blades, or 44 to 150 m (144 to 492 ft) above ground level.

3.3 Sensitive Species Observations

Several observations of sensitive or rare species were recorded during the avian surveys or raptor migration surveys (Table 8). Two species federally protected under the Bald and Golden Eagle Protect Act (BGEPA) were observed, primarily during raptor migration surveys: golden eagle (11 observations) and bald eagle (two observations). The bald eagle is also listed as a state imperiled species by the West Virginia Department of Natural Resources (www.wvdnr.gov/wildlife/endangered.shtm). Two additional state imperiled species (golden winged warbler [10 observations] and osprey [two observations] and three state critically imperiled species (Nashville warbler [six observations], northern harrier [five observations], and white-throated sparrow [one individual]) were observed within the study area. Five state species of concern were recorded throughout surveys, of which four were observed during avian surveys: Blackburnian warbler (four observations), alder flycatcher (three observations), Swainson's thrush (one individual), and Swainson's warbler (one individual); and one during raptor migration surveys: black vulture (one individual; Table 8).

Table 8. Summary of sensitive species observed during avian surveys and raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

		Avian Use Surveys		Raptor Migration Surveys		Total	
Species	Status	Groups	Observations	Groups	Observations	Groups	Observations
golden eagle	EA	1	1	6	10	7	11
golden-winged warbler	S2	10	10	0	0	10	10
Nashville warbler	S1	5	6	0	0	5	6
Northern harrier	S1	1	1	4	4	5	5
Blackburnian warbler	S3	4	4	0	0	4	4
alder flycatcher	S3	3	3	0	0	3	3
bald eagle	S2, EA	0	0	2	2	2	2
osprey	S2	0	0	2	2	2	2
black vulture	S3	0	0	1	1	1	1
Swainson's thrush	S3	1	1	0	0	1	1
Swainson's warbler	S3	1	1	0	0	1	1
white-throated sparrow	S1	1	1	0	0	1	1

EA = Bald and Golden Eagle Protection Act.
S1= West Virginia State critically imperiled and/or extremely rare species (less than five known occurrences; West Virginia DNR 2003)
S2= West Virginia State imperiled or rare species (five to 20 known occurrences)
S3= West Virginia State species of concern (21 to 100 known occurrences)

4.0 DISCUSSION

The principal objectives of the study to fulfill the PSC requirement were to provide site-specific information on avian use and migration though the study area that would; (1) be useful in evaluating potential impacts from the proposed expansion of the BRWEP, (2) provide information useful in project planning and design to minimize potential impacts to birds to the extent practical, and (3) supplement and update the previous studies on avian use and migration in the study area.

The entire expansion area was not originally included in the PSC application but is located immediately adjacent to the existing BRWEP where land cover is predominately deciduous forest interspersed with inclusions of shrub/scrub; grassland, and reclaimed mined areas due to current and past land uses (see Figure 3). Canterbury (2006) described the land cover of the BRWEP as deciduous forest of varying age structure due to timber harvest, prior mining activity, and reclamation management. There are no detectable differences between the expansion area and the existing project in terms of vegetation, land cover, or topography based on land cover types (Canterbury USGS NLCD 2001). Because of the common land cover, topography, and vegetation characteristics throughout the expansion area and surrounding region, the expansion area does not provide unique habitat characters that would be expected to concentrate migrating birds or raptors. Raptors and songbirds will be present during migration seasons, and raptors may utilize updrafts associated with the area ridge lines, however, the expansion area is not likely to experience or concentrate use by migrating birds greater than surrounding areas.

To investigate potential impact from the proposed expansion of the BRWEP, standardized bird surveys were conducted during the spring and fall migration periods. Exposure to project infrastructure is affected by how much a species utilizes an area (use), as well as how often use

occurs (frequency of occurrence). The surveys were designed to collect data on bird species composition, species richness, bird use, and frequency of occurrence in the study area that is useful for characterizing the bird community and potential exposure or risk to the proposed development. Use and percent of use provide relative measures of species exposure to the proposed project compared to other species. Percent of use was calculated as the proportion of overall use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. Frequency of occurrence provides a relative measure of how often a species is observed in the study area compared to other species.

4.1 Avian Surveys

To help estimate potential impacts from the proposed expansion of the BRWEP relative to the original facility, avian use surveys were conducted and compared to the previous avian studies at BRWEP (Canterbury 2006). The intent was to evaluate similarities or differences in the expansion area and whether changes in bird use, species composition and relative abundance had occurred over time. Diurnal avian point counts surveys are reliable and repeatable methods for estimating the relative abundance and spatial and temporal use by birds, and in particular for small birds such as passerines and other songbirds. Fixed-point avian surveys were conducted in 2005 at the BRWEP project site (Canterbury 2006) and again in 2011 throughout the expansion area (this study). Survey and analytical methods were conducted in the same fashion during both studies which allowed comparison of results between the study years.

When comparing the fixed-point avian surveys between 2005 and 2011, the overall use estimates by bird types and sub-groups were similar. For example, while use by individual species was somewhat more variable, overall mean use by passerines in spring 2005 was 4.29 bird observations per 10-minute survey per 50-m radius plot and for this study, mean passerine use was 5.01 bird observations per 10-minute survey per 50-m radius plot. In the fall 2005, means use by all passerines was 3.69 bird observations per survey per plot and in 2011 was 4.0 bird observations per survey per plot. Seventy-nine species of passerines were observed during the 2005 study and 69 passerine species were observed in 2011. In both years, eight of the ten most common species based on use estimates were the same: eastern towhee, American robin, dark-eyed-junco, cedar waxwing, black-throated green warbler, red-eyed vireo, blue jay, and American crow. These eight species made up over 30% of all bird use recorded during each study year.

Eight of the 21 state species of concern (http://www.wvdnr.gov/Wildlife/RareSpecList.shtm) detected in 2005 were detected during 2011 surveys: Alder flycatcher, Blackburnian warbler, golden-winged warbler, Northern harrier, osprey, Swainson's thrush, sharp-shinned hawk, and black vulture. State species of concern detected in 2005 but not detected during the 2011 study period included: northern waterthrush, vesper sparrow, yellow-rumped warbler, yellow-bellied flycatcher, Cooper's Hawk, Northern goshawk, red-headed woodpecker, yellow-bellied sapsucker, black-billed cuckoo, brown creeper; common nighthawk, and northern saw-whet owl

(Canturbury 2006). One currently listed species of concern that was observed during 2005 surveys, but not listed during that time, and recorded again in 2011 was white-throated sparrow.

In general, avian use and species composition recorded in 2005 studies were similar to that recorded for the BRWEP expansion area. Use estimates for the most common species and the different bird types were similar between the years, although the decrease in the number of sensitive species observed in 2011 compared to 2005 suggests potential changes in abundance of some species.

4.2 Raptor Migration Surveys

Results from the raptor migration surveys were similar between 2005 and 2011 in terms of species composition but different in terms of passage rate due to the observation of large numbers of broad-winged hawks migrating through in 2005 (Canterbury 2006). Overall spring diurnal raptor passage rate in 2005 was 1.01 raptor observations recorded per observer-hour and in 2011 was 1.25 raptor observations recorded per observer-hour. Overall fall diurnal raptor use was 6.85 raptor observations recorded per observer-hour in 2005 and 1.47 raptor observations recorded per observer-hour in 2011. The high use estimate in 2005 was driven by 481 observations of broad-winged hawks recorded over the fall study period (Canterbury 2006). Overall species composition was similar between 2005 and 2011, although Canterbury recorded three species of owl during the raptor migration surveys (eastern screech owl, great-horned owl, and barred owl; Canterbury 2006) compared to only one species in 2011 (barred owl).

To investigate the uniqueness of the expansion area compared to regional raptor migration, data from established hawk watch sites in the same geographic region as the BRWEP was gathered. The number of raptor observations recorded per observer-hour, vultures excluded, were compiled from the Hawk Watch HMANA (2010) public website and compared to raptor migration through the expansion area (Appendix B). Belmont Valley Hawk Watch Site, Virginia is located 113 miles (181.9 km) west of the Site, near Charlottesville, Virginia. Allegheny Front Hawk Watch Site, Pennsylvania is located 168 miles (270.4 km) north-east of the Site, near Central City, Pennsylvania, and Washington Monument State Park Hawk Watch Site, Maryland is located 185 miles (297.7 km) north-east of the Site, near Boonsboro, Maryland.

When averaged across the survey dates, to calculate a metric comparable to other established hawk watch sites, the overall average number of raptor observations recorded per observer-hour at the expansion area was lower than the averages seen at other established sites (Appendix B). For each survey date, the overall raptor passage rate within the expansion area appears to be comparable to or lower than raptor passage rate recorded at the other evaluated Hawk Watch sites on the same date; although the average number of raptors observed was variable from one site to the next on some dates (Appendix B).

When comparing raptor migration overall, based on the total survey effort at each site from March through May and September through November, raptor passage rates appeared to be much lower at BRWEP expansion area (2.00 raptor observations recorded per observer-hour) compared to the three other Hawk Watch sites in the same geographic region, ranging from

23.26 to 33.34 raptor observations recorded per observer-hour (Table 9). Based on the survey results, raptors migrated through the BRWEP expansion area in much lower numbers during the migration seasons when compared to other sites representative of the region (Table 9). In general, based on the study results, the BRWEP expansion area does not receive higher raptor migration traffic when compared to the other regional sites (Table 9, Appendix B).

Table 9. Diurnal raptor passage rate (number of raptors observed per observer-hour) at the Beech Ridge Wind Energy Project expansion area and four other established hawk watch sites for the study period.

Site	Total Observer Hours	Total Diurnal Migrant Observations	Passage Rate
Beech Ridge expansion area, WV	205.50	412	2.00
Belmont Valley, VA	75.25	1,750	23.26
Allegheny Front, PA	601.33	12,689	21.10
Washington Monument State Park, MD	379.25	12,645	33.34

4.3 Conclusions

Results of the avian surveys and raptor migration surveys suggest that there are no unique or extraordinary concentrations or bird use features within the BRWEP expansion study area, and overall the results were typical of bird communities in the eastern Appalachian Mountain deciduous forest habitat as evidenced by the previous site surveys (Canterbury 2006). In general, results of the surveys do not suggest that development of the expansion area would have greater impacts than other wind developments in the region or expose any unusual or unique bird communities to impact risk from the development.

5.0 REFERENCES

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Appendix A:
Summary of observations and groups recorded at the Beech Ridge Wind Energy Project Expansion Area by species and bird type for avian use surveys from April 8 to May 31, 2011 & September 12, to November 3, 2011.

		Spring		Fall		Total	
Type / Species	Scientific Name	Groups	Observations	Groups	Observations	Groups	Observations
Shorebirds		**2**	**3**	**0**	**0**	**2**	**3**
American woodcock	*Scolopax minor*	2	3	0	0	2	3
Diurnal Raptors		**23**	**24**	**24**	**24**	**47**	**48**
Accipiters		*2*	*2*	*5*	*5*	*7*	*7*
sharp-shinned hawk	*Accipiter striatus*	2	2	5	5	7	7
Buteos		*19*	*20*	*13*	*13*	*32*	*33*
broad-winged hawk	*Buteo platypterus*	4	5	3	3	7	8
red-shouldered hawk	*Buteo lineatus*	13	13	8	8	21	21
red-tailed hawk	*Buteo jamaicensis*	0	0	2	2	2	2
unidentified *Buteo*		2	2	0	0	2	2
Northern Harrier		*1*	*1*	*0*	*0*	*1*	*1*
northern harrier	*Circus cyaneus*	1	1	0	0	1	1
Eagles		*1*	*1*	*0*	*0*	*1*	*1*
golden eagle	*Aquila chrysaetos*	1	1	0	0	1	1
Falcons		*0*	*0*	*6*	*6*	*6*	*6*
American kestrel	*Falco sparverius*	0	0	6	6	6	6
Owls		**1**	**1**	**0**	**0**	**1**	**1**
barred owl	*Strix varia*	1	1	0	0	1	1
Vultures		**20**	**47**	**7**	**10**	**27**	**57**
turkey vulture	*Cathartes aura*	20	47	7	10	27	57
Upland Game Birds		**21**	**21**	**11**	**12**	**32**	**33**
ruffed grouse	*Bonasa umbellus*	16	16	11	12	27	28
wild turkey	*Meleagris gallopavo*	5	5	0	0	5	5
Doves/Pigeons		**7**	**10**	**0**	**0**	**7**	**10**
mourning dove	*Zenaida macroura*	7	10	0	0	7	10
Large Corvids		**66**	**71**	**107**	**153**	**173**	**224**
American crow	*Corvus brachyrhynchos*	25	27	62	98	87	125
common raven	*Corvus corax*	41	44	45	55	86	99
Passerines		**1,860**	**2,298**	**564**	**1,213**	**2,424**	**3,511**
alder flycatcher	*Empidonax alnorum*	3	3	0	0	3	3
American goldfinch	*Carduelis tristis*	53	70	33	50	86	120
American redstart	*Setophaga ruticilla*	3	3	2	8	5	11
American robin	*Turdus migratorius*	71	91	53	275	124	366
barn swallow	*Hirundo rustica*	2	6	0	0	2	6
bay-breasted warbler	*Dendroica castanea*	4	4	0	0	4	4
Bicknell's thrush	*Catharus bicknelli*	1	1	0	0	1	1
black-and-white warbler	*Mniotilta varia*	57	64	2	2	59	66
black-capped chickadee	*Poecile atricapilla*	31	42	33	46	64	88
black-throated blue warbler	*Dendroica caerulescens*	7	7	24	32	31	39
black-throated green warb.	*Dendroica virens*	133	160	7	15	140	175
Blackburnian warbler	*Dendroica fusca*	2	2	2	2	4	4
blackpoll warbler	*Dendroica striata*	1	1	1	1	2	2
blue-gray gnatcatcher	*Polioptila caerulea*	2	2	1	1	3	3
blue-headed vireo	*Vireo solitaries*	83	93	23	28	106	121
blue jay	*Cyanocitta cristata*	17	52	85	92	102	144
brown-headed cowbird	*Molothrus ater*	21	30	3	38	24	68

Appendix A:
Summary of observations and groups recorded at the Beech Ridge Wind Energy Project Expansion Area by species and bird type for avian use surveys from April 8 to May 31, 2011 & September 12, to November 3, 2011.

		Spring		Fall		Total	
Type / Species	Scientific Name	Groups	Observations	Groups	Observations	Groups	Observations
brown thrasher	*Toxostoma rufum*	8	8	0	0	8	8
Canada warbler	*Wilsonia canadensis*	7	7	0	0	7	7
Cape May warbler	*Dendroica tigrina*	6	6	1	1	7	7
Carolina wren	*Thryothorus ludovicianus*	0	0	4	4	4	4
cedar waxwing	*Bombycilla cedrorum*	20	68	25	111	45	179
cerulean warbler	*Dendroica cerulean*	16	17	3	3	19	20
chestnut-sided warbler	*Dendroica pensylvanica*	142	168	0	0	142	168
chipping sparrow	*Spizella passerine*	4	4	2	4	6	8
common grackle	*Quiscalus quiscula*	0	0	2	52	2	52
common yellowthroat	*Geothlypis trichas*	42	45	4	7	46	52
dark-eyed junco	*Junco hyemalis*	91	104	62	119	153	223
eastern bluebird	*Sialia sialis*	1	1	2	4	3	5
eastern phoebe	*Sayornis phoebe*	1	1	0	0	1	1
eastern towhee	*Pipilo erythrophthalmus*	208	292	62	100	270	392
eastern wood-pewee	*Contopus virens*	10	10	2	3	12	13
European starling	*Sturnus vulgaris*	9	12	2	15	11	27
field sparrow	*Spizella pusilla*	33	41	0	0	33	41
golden-crowned kinglet	*Regulus satrapa*	2	2	0	0	2	2
golden-winged warbler	*Vermivora chrysoptera*	9	9	1	1	10	10
gray catbird	*Dumetella carolinensis*	0	0	1	1	1	1
great crested flycatcher	*Myiarchus crinitus*	0	0	1	1	1	1
hermit thrush	*Catharus guttatus*	20	23	0	0	20	23
hooded warbler	*Wilsonia citrine*	62	62	1	1	63	63
house wren	*Troglodytes aedon*	1	1	0	0	1	1
indigo bunting	*Passerina cyanea*	83	91	2	2	85	93
Kentucky warbler	*Oporornis formosus*	1	1	1	1	2	2
least flycatcher	*Empidonax minimus*	15	15	2	2	17	17
magnolia warbler	*Dendroica magnolia*	40	46	8	9	48	55
mourning warbler	*Oporornis philadelphia*	10	10	0	0	10	10
Nashville warbler	*Vermivora ruficapilla*	5	6	0	0	5	6
ovenbird	*Seiurus aurocapillus*	140	184	1	3	141	187
palm warbler	*Dendroica palmarum*	6	6	5	8	11	14
prairie warbler	*Dendroica discolor*	1	1	0	0	1	1
red-breasted nuthatch	*Sitta canadensis*	1	1	0	0	1	1
red-eyed vireo	*Vireo olivaceus*	117	148	3	3	120	151
rose-breasted grosbeak	*Pheucticus ludovicianus*	63	65	5	5	68	70
scarlet tanager	*Piranga olivacea*	44	45	0	0	44	45
song sparrow	*Melospiza melodia*	7	8	5	7	12	15
Swainson's thrush	*Catharus ustulatus*	0	0	1	1	1	1
Swainson's warbler	*Limnothlypis swainsonii*	1	1	0	0	1	1
tree swallow	*Tachycineta bicolor*	0	0	2	6	2	6
tufted titmouse	*Baeolophus bicolor*	1	1	2	2	3	3
unidentified passerine		0	0	47	101	47	101
unidentified sparrow		0	0	1	1	1	1
unidentified warbler		3	4	9	15	12	19
veery	*Catharus fuscescens*	58	66	0	0	58	66
white-breasted nuthatch	*Sitta carolinensis*	7	7	15	16	22	23

Appendix A:
Summary of observations and groups recorded at the Beech Ridge Wind Energy Project Expansion Area by species and bird type for avian use surveys from April 8 to May 31, 2011 & September 12, to November 3, 2011.

		Spring		Fall		Total	
Type / Species	**Scientific Name**	**Groups**	**Observations**	**Groups**	**Observations**	**Groups**	**Observations**
white-crowned sparrow	*Zonotrichia leucophrys*	0	0	1	1	1	1
white-throated sparrow	*Zonotrichia albicollis*	0	0	1	1	1	1
winter wren	*Troglodytes troglodytes*	2	2	0	0	2	2
wood thrush	*Hylocichla mustelina*	20	21	1	1	21	22
worm-eating warbler	*Helmitheros vermivorus*	6	6	1	1	7	7
yellow-breasted chat	*Icteria virens*	3	3	3	4	6	7
yellow-rumped warbler	*Dendroica coronate*	42	47	4	6	46	53
yellow warbler	*Dendroica petechia*	1	1	0	0	1	1
Cuckoos		**2**	**2**	**14**	**14**	**16**	**16**
black-billed cuckoo	*Coccyzus erythropthalmus*	0	0	2	2	2	2
yellow-billed cuckoo	*Coccyzus americanus*	2	2	12	12	14	14
Swifts/Hummingbirds		**1**	**1**	**2**	**2**	**3**	**3**
ruby-throated hummingbird	*Archilochus colubris*	1	1	2	2	3	3
Woodpeckers		**65**	**74**	**78**	**79**	**143**	**153**
downy woodpecker	*Picoides pubescens*	14	17	29	29	43	46
hairy woodpecker	*Picoides villosus*	13	15	17	18	30	33
northern flicker	*Colaptes auratus*	13	14	11	11	24	25
pileated woodpecker	*Dryocopus pileatus*	22	24	20	20	42	44
unidentified woodpecker		3	4	1	1	4	5
Overall		**2,068**	**2,552**	**807**	**1,507**	**2,875**	**4,059**

[a] Regardless of distance from observer.

Appendix B:
Average number of raptor observations recorded per observer-hour by date at the Beech Ridge Wind Energy Project expansion area and four other established hawk watch sites in the Appalachian Mountain Region.

Date	Beech Ridge Expansion, WV	Belmont Valley, VA	Allegheny Front, PA	Washington Monument State Park, MD
3/17/2011	0.50	NS	1.29	2.67
3/18/2011	4.50	NS	1.06	NS
3/19/2011	1.00	NS	2.67	NS
3/22/2011	0	2.40	0.50	9.00
3/24/2011	0.67	1.0	0.33	0
3/25/2011	1.00	4.80	NS	2.00
3/26/2011	0	5.00	1.60	3.27
3/28/2011	0	0.44	0.67	NS
3/29/2011	0	NS	0.27	3.00
3/31/2011	0	NS	NS	NS
4/3/2011	5.00	NS	0.86	10.53
4/4/2011	0.50	NS	4.40	8.44
4/7/2011	1.00	2.86	4.89	2.67
4/9/2011	3.00	NS	NS	NS
4/10/2011	0	2.11	28.10	4.42
4/11/2011	4.33	NS	3.86	55.50
4/13/2011	1.00	NS	NS	NS
4/14/2011	1.00	NS	5.56	5.74
4/15/2011	3.00	NS	25.38	18.40
4/17/2011	0	5.40	1.54	5.88
4/18/2011	1.68	20.53	7.20	18.00
4/20/2011	1.00	4.67	0.53	65.91
4/21/2011	0	1.00	3.33	0.86
4/24/2011	1.19	11.00	1.71	8.00
4/28/2011	2.67	4.00	1.25	5.33
4/29/2011	2.33	1.60	NS	4.25
5/1/2011	0.33	NS	1.07	NS
5/2/2011	4.00	NS	6.73	3.43
5/5/2011	1.33	NS	0	NS
5/7/2011	2.00	2.18	0	0.86
5/10/2011	5.33	NS	NS	NS
5/11/2011	1.67	0.40	NS	NS
5/12/2011	1.00	NS	NS	NS
5/13/2011	4.00	NS	NS	NS
5/16/2011	0.50	NS	NS	NS
5/18/2011	0	NS	NS	NS
5/19/2011	1.00	NS	NS	NS
5/20/2011	0	NS	NS	NS
5/22/2011	4.00	1.00	NS	NS
5/23/2011	2.50	4.00	NS	NS
5/24/2011	3.33	NS	NS	NS
5/25/2011	5.81	NS	NS	NS
5/29/2011	1.00	NS	NS	NS
5/30/2011	2.33	NS	NS	NS
5/31/2011	3.00	NS	NS	NS

Appendix B:
Average number of raptor observations recorded per observer-hour by date at the Beech Ridge Wind Energy Project expansion area and four other established hawk watch sites in the Appalachian Mountain Region.

Date	Beech Ridge Expansion, WV	Belmont Valley, VA	Allegheny Front, PA	Washington Monument State Park, MD
9/12/2011	2.33	0.00	23.88	15.41
9/14/2011	1.67	0.80	57.22	24.57
9/15/2011	0	16.44	8.00	10.20
9/16/2011	3.00	180.84	269.89	88.40
9/18/2011	3.00	289.00	175.47	71.77
9/21/2011	1.00	NS	2.94	235.82
9/22/2011	17.00	NS	6.33	14.89
9/24/2011	1.00	16.27	75.26	43.70
9/26/2011	1.33	NS	20.22	47.52
9/27/2011	5.67	NS	75.40	18.86
9/29/2011	3.33	NS	12.40	42.82
10/3/2011	0	NS	5.87	NS
10/5/2011	2.67	NS	6.38	9.94
10/7/2011	2.00	NS	20.50	6.75
10/9/2011	3.67	NS	28.13	3.26
10/11/2011	3.00	NS	29.18	15.75
10/14/2011	2.67	NS	4.00	3.14
10/20/2011	0	NS	0.89	2.48
10/21/2011	0	4.00	0.80	4.24
10/22/2011	2.33	1.33	5.89	8.44
10/23/2011	1.67	0.71	12.24	3.25
10/26/2011	0.67	NS	1.29	2.57
10/27/2011	0	NS	NS	NS
11/1/2011	1.67	NS	58.00	4.71
11/2/2011	1.67	NS	22.00	11.09
11/3/2011	3.00	NS	6.33	26.89
11/6/2011	2.67	NS	3.33	1.60
11/7/2011	2.67	NS	3.13	NS
11/8/2011	1.00	NS	3.53	NS
11/13/2011	0.92	NS	0.75	NS
11/14/2011	3.00	NS	0.57	0.00
11/17/2011	8.00	NS	1.20	6.67
11/18/2011	1.00	NS	1.63	1.23
11/23/2011	0	NS	NS	NS
11/24/2011	0.67	NS	1.07	1.50
11/25/2011	2.67	NS	1.63	NS
11/27/2011	0.67	NS	0.46	NS
11/28/2011	0	NS	7.38	NS
11/29/2011	0	NS	6.00	NS
Average	**1.98**	**21.62**	**17.16**	**18.93**