Avian and Bat Risk Assessment:
Beech Ridge Wind Energy Project Expansion Area
Greenbrier and Nicholas Counties, West Virginia.

February 2012

Prepared for:

Beech Ridge Energy II LLC
One South Wacker Drive, Suite 1900
Chicago, Illinois 60606

Prepared by:

David Young, Zapata Courage, and Tory Poulton
Western EcoSystems Technology, Inc.
Cheyenne, Wyoming & Waterbury, Vermont

WEST Inc.

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

TABLE OF CONTENTS

1.0 INTRODUCTION 2
1.1 Study Objectives 2
1.2 Methods 3
1.3 Environmental Setting 3
2.0 Avian Resources 11
2.1 Raptors 11
2.2 Migratory Birds 15
2.3 Breeding Birds 16
3.0 BAT RESOURCES 20
3.1 Bat Species 20
3.3 Bat Hibernacula 25
4.0 SPECIAL STATUS SPECIES 29
4.1 Federally-listed Species 29
4.2 USFWS Birds of Conservation Concern 33
4.3 State-Listed Species 34
4.4 Other Species of Concern 34
5.0 SUMMARY 37
6.0 LITERATURE CITED 38

APPENDIX A – SITE VISIT: FIELD NOTES AND PHOTOS, MARCH 21, 2011

APPENDIX B - AVIAN MIGRATION OBSERVATORIES DATA

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 an 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 33 WTGs immediately adjacent to the 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 in an effort to comply with the PSC requirement by covering the area proposed for the project expansion and is intended to fulfill the avian and bat risk assessment requirement and supplement the results from the 2005 surveys.

1.1 Study Objectives

The purpose of this risk assessment is to conduct an early screening of bird and bat resources of the BRWEP expansion area and surrounding environs that may be impacted by the Project. The principal objectives of the risk assessment are to: (1) provide site-specific bird and bat resource data based on available information and; (2) evaluate potential impacts from the proposed wind energy project based on the available information. The protocol for the risk assessment was similar to those used previously at the BRWEP (Canterbury 2006), and follow national guidance and recommendations for study of wind energy facilities (Anderson et al. 1999, WTGAC 2010, Strickland et al. 2011).

The scope for the risk assessment included the following components:

- Evaluation of mapped data to identify and characterize key resources, land cover, land use, and habitat within the study area including identification of protected, sensitive or special bird or bat habitat (e.g., Important Bird Areas, bat hibernacula).
- Characterization of avian and bat species potentially affected by development within the BRWEP expansion area;
- Evaluation of sensitive or protected avian and bat resources potentially affected by the proposed project (e.g., State or Federally listed species).

1.2 Methods

The area evaluated in this risk assessment includes the area proposed for new project facilities within the BRWEP expansion area, defined as the Project Area, and the area encompassed by a 2-mile (3.2 kilometer) buffer around the Project Area, defined as the Evaluation Area. The Project Area and Evaluation Area collectively, are referred to as the study area.

Several sources of available information and data were used to identify and characterize potential bird and bat resources within the study area, including existing public data sources, a reconnaissance field visit, results from wildlife surveys conducted within the study area, existing technical reports, published literature, field guides, and internet resources.

The study area was visited on March 12, 2011 by a Research Wildlife Biologist, David Tidhar, from WEST Inc., to evaluate habitat, current land use and condition, presence of unique habitat or features that may elevate use by birds and bats, and record general wildlife notes or observations such as raptor nests, prey populations, or physiographic features important to wildlife. All wildlife species observed during the field visit were recorded and representative photographs were taken within the study area (Appendix B).

1.3 Environmental Setting

The BRWEP expansion area is located in West Virginia near the towns of Duo and Quinwood and immediately adjacent to the existing BRWEP (Figures 1.1). The study area lies within the Central Appalachians Ecoregion (EPA 2010), which stretches from central Pennsylvania to northern Tennessee. The Central Appalachians Ecoregion is primarily a high, dissected, rugged plateau composed of sandstone, shale, conglomerate and coal. The high hills and low mountains of the region are covered by a mixed mesophytic northern hardwood forest. The study area is within the Forested Hills and Mountains subsection of the Central Appalachians (EPA 2010). Topography within the project area is generally a series of rolling ridges dropping into valleys at an elevation of approximately 2,300 – 4,699 feet (700-1400 meters; Figures 1.2 and 1.3)

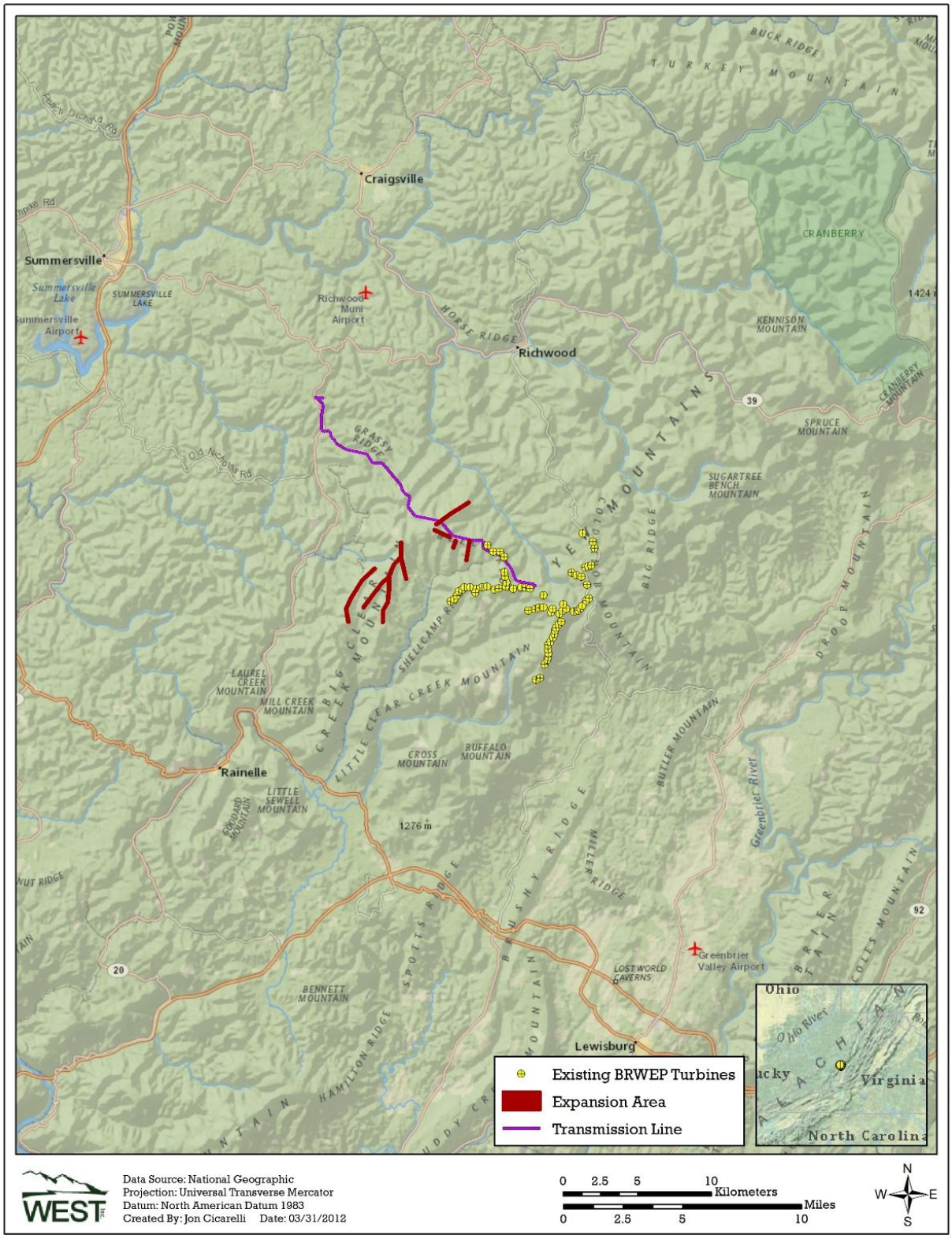

Figure 1.1 Location of the existing proposed BRWEP expansion area.

The field visit on March 12, 2011 revealed that ridge-top and areas of adjacent slopes throughout the study area have been clear-cut (similar to the existing BRWEP). Typically, the potential development areas for wind project facilities are restricted to upper elevation ridge-tops while the overall Evaluation Area encompasses additional ridge-tops and valley bottoms. There were a few small areas of mixed deciduous/coniferous forest in the south-east portion of the Evaluation Area associated with abandoned surface mines. No open mine shafts were observed during the field visit. Most of the evidence of past mining appeared to be surface mining, and the potential for open vertical or horizontal shafts in the study area is considered low. Some rocky outcrops were detected along one development corridor of the Project Area and intermittently elsewhere in the study area. No obvious caves were observed and there was a lack of extensive talus fields and rocky outcrops. There were numerous areas of open exposure in all aspects due to clear-cutting. Additionally, because of the extensive clear-cutting, there is little intact mature forest and most forest observed was in various successional stages of growth.

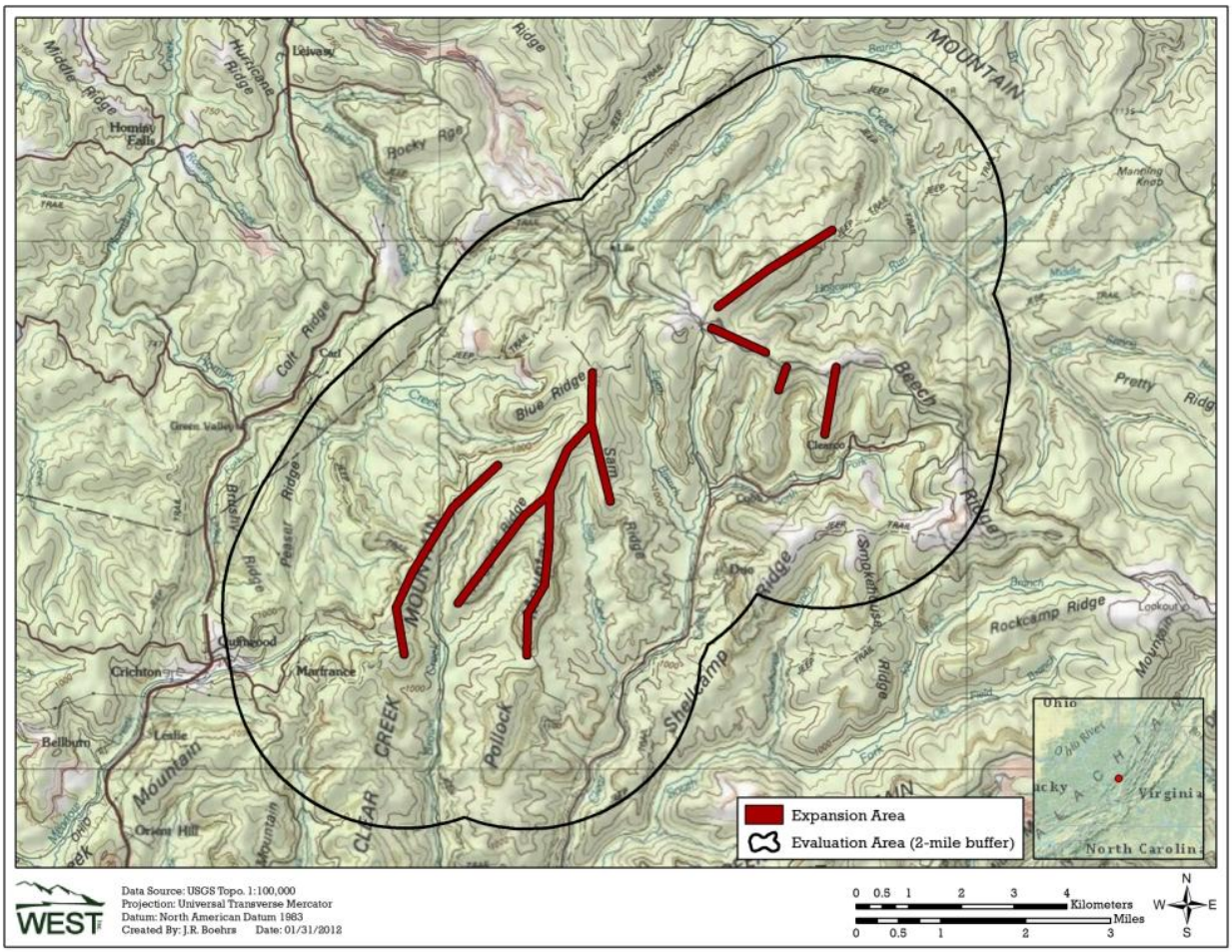

Figure 1.2 Site location and topographic map of the BRWEP expansion Project Area and Evaluation Area.

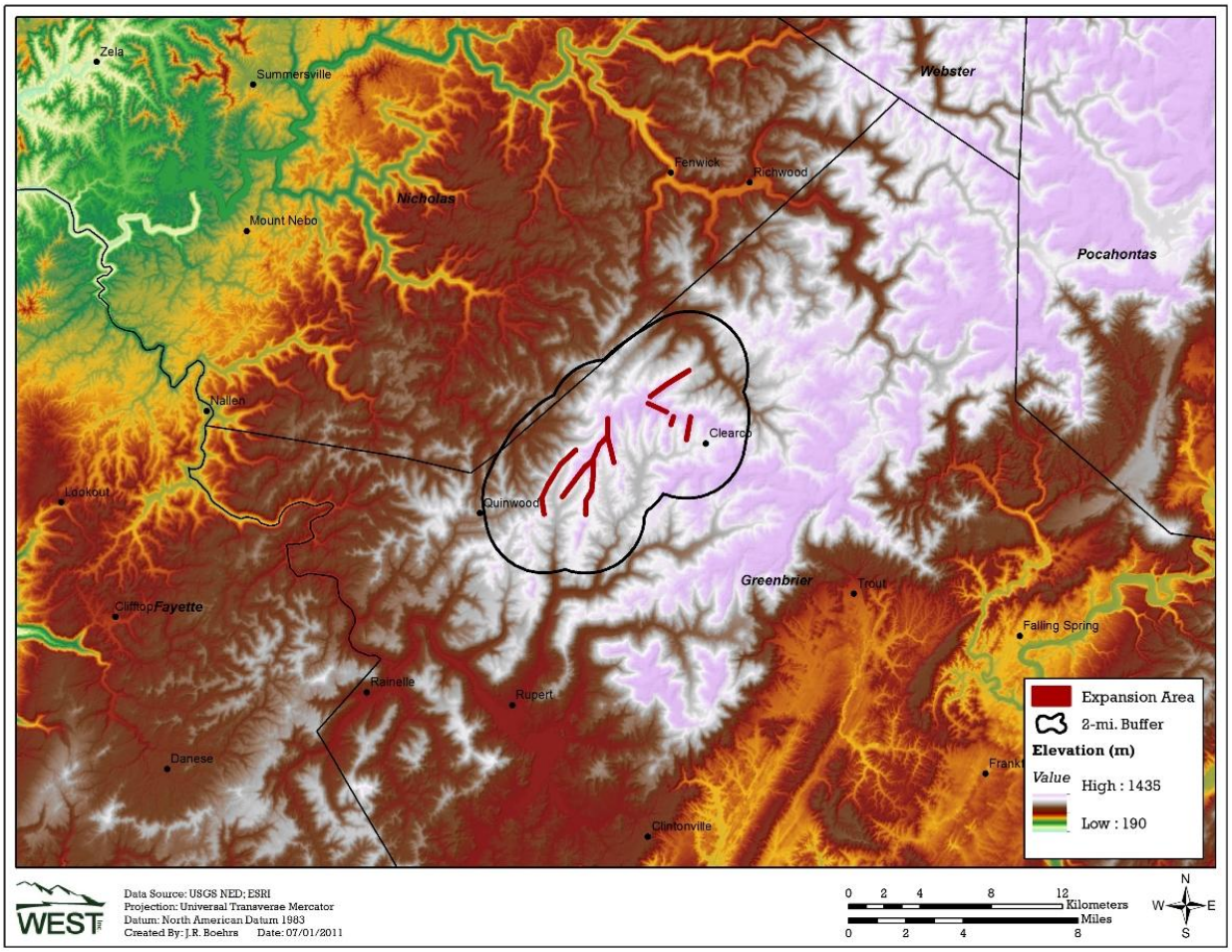

Figure 1.3 Digital elevation map of the proposed BRWEP expansion area and surrounding region.

Land Cover and Land Use

The proposed BRWEP expansion area, defined as the proposed corridors where project facilities may be constructed (Figure 1.2), encompasses approximately 765 acres. According to the National Landcover database (2001; Table 1.1; Figure 1.4) the Project Area is predominately deciduous forest [607 acres (79.4%)] with small inclusions of mixed forest, shrub/scrub, grassland, and developed areas (Table 1.1). The data obtained from the National Landcover database (NLCD 2001) may not directly reflect the current condition due to land management activities, but provides a general assessment of landcover and habitat types present and the relative proportions of each. Additional information from site specific surveys, such as the wetland delineation surveys (Potesta & Associates, Inc, 2010), provide more specific information and ground-truthing of existing data.

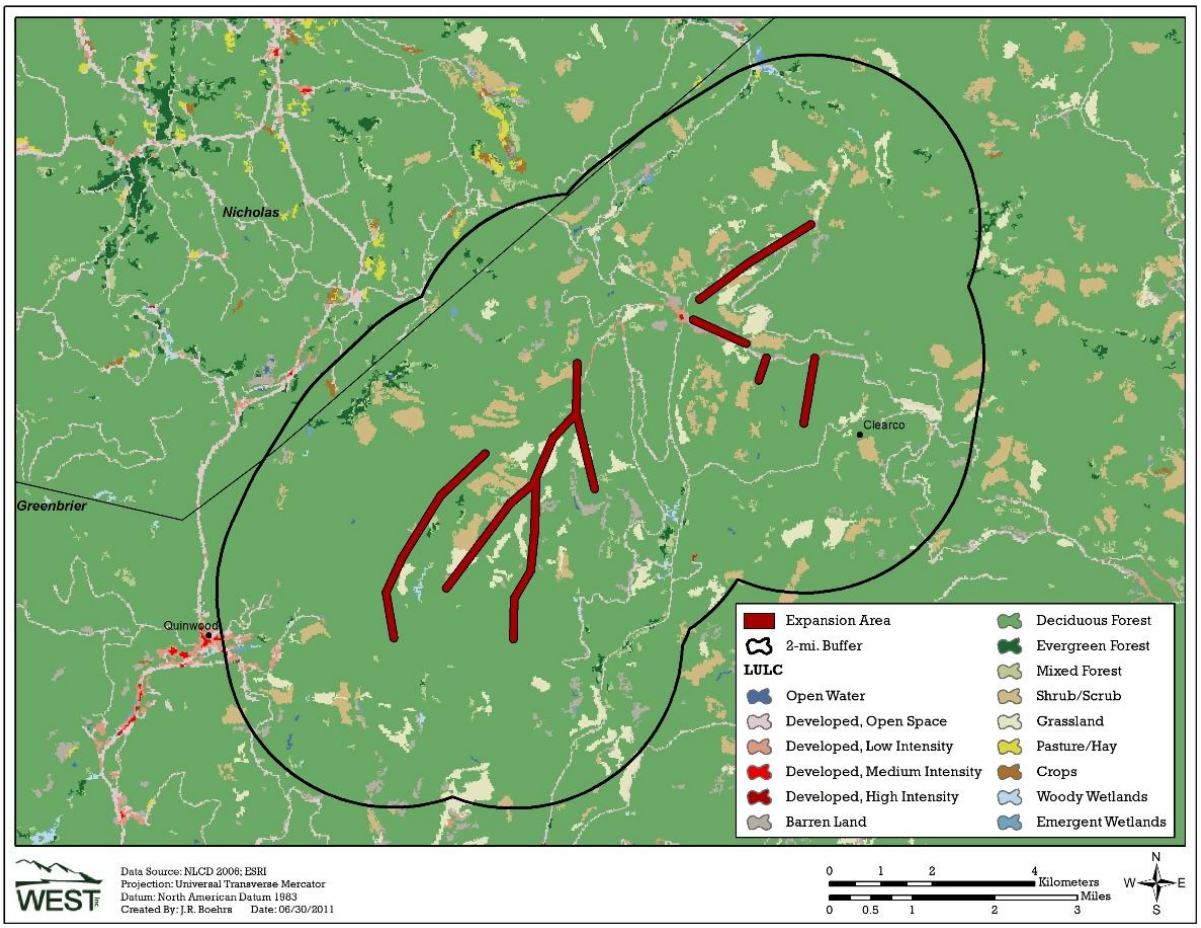

Figure 1.4 Land cover types within the proposed BRWEP expansion area and surrounding region.

Table 1.1 Land use/land cover types present within the Project and Evaluation areas (Source: NLCD 2001).

	Project Area		Evaluation Area	
Cover Type	**Acreage**	**% Composition**	**Acreage**	**% Composition**
Open Water	-	-	18.82	0.05
Developed, Open Space	7.38	0.96	565.52	1.60
Developed, Low Intensity	4.16	0.54	97.37	0.28
Developed, Medium Intensity	-	-	5.10	0.01
Barren	33.85	4.42	508.51	1.44
Deciduous Forest	607.32	79.36	30,844.28	87.51
Evergreen Forest	-	-	169.93	0.48
Mixed Forest	10.34	1.35	328.80	0.93
Scrub/Shrub	27.83	3.64	1,449.07	4.11
Grassland	74.36	9.72	1,156.29	3.28
Pasture/Hay	-	-	3.50	0.01
Crops	-	-	9.42	0.03
Woody Wetlands	-	-	46.35	0.13
Emergent Wetlands	-	-	41.78	0.12
Total	**765.24**	**100**	**35,244.74**	**100**

The larger Evaluation Area, defined as the area encompassed by a 2-mile (3.2 kilometer) buffer surrounding the Project Area, encompassing over 35,000 acres, is comparable to the Project Area in land cover composition (Table 1.1). The predominant land use class is deciduous forest, accounting for 30,844 acres (87.5%); with smaller inclusions of evergreen and mixed forest (Table 1.1). Within the Evaluation Area there are small streams and ponds accounting for approximately 18.8 acres of open water, agricultural land (pasture/hay and crops), and either woody or emergent wetland areas accounting for approximately 87 acres combined, which are land cover types not mapped within the Project Area (Table 1.1; Figure 1.4, NLCD 2001).

Wetlands and Riparian Areas

General information regarding wetlands and other aquatic habitats is based on data from the USFWS National Wetlands Inventory (Table 1.2; Figure 1.5), land-use data (Table 1.1; Figure 1.4), the field visit, and formal wetland surveys conducted in the Project Area. Formal wetland delineations for the Project Area were conducted between September 21 and October 1, 2010 (Potesta & Associates, Inc. 2010). Results of the field surveys identified ten streams (five perennial, four ephemeral, and one intermittent) and five wetlands. Of the five wetlands, 0.44 acre was considered jurisdictional, and 0.66 acre was considered isolated in nature. The total area of wetland is relatively small, and is not expected to result in disproportionately greater use by avian and bat resources than surrounding areas. To the extent practical, the jurisdictional waters will be avoided during development of the BRWEP expansion area (Beech Ridge Energy LLC, 2011 p.33).

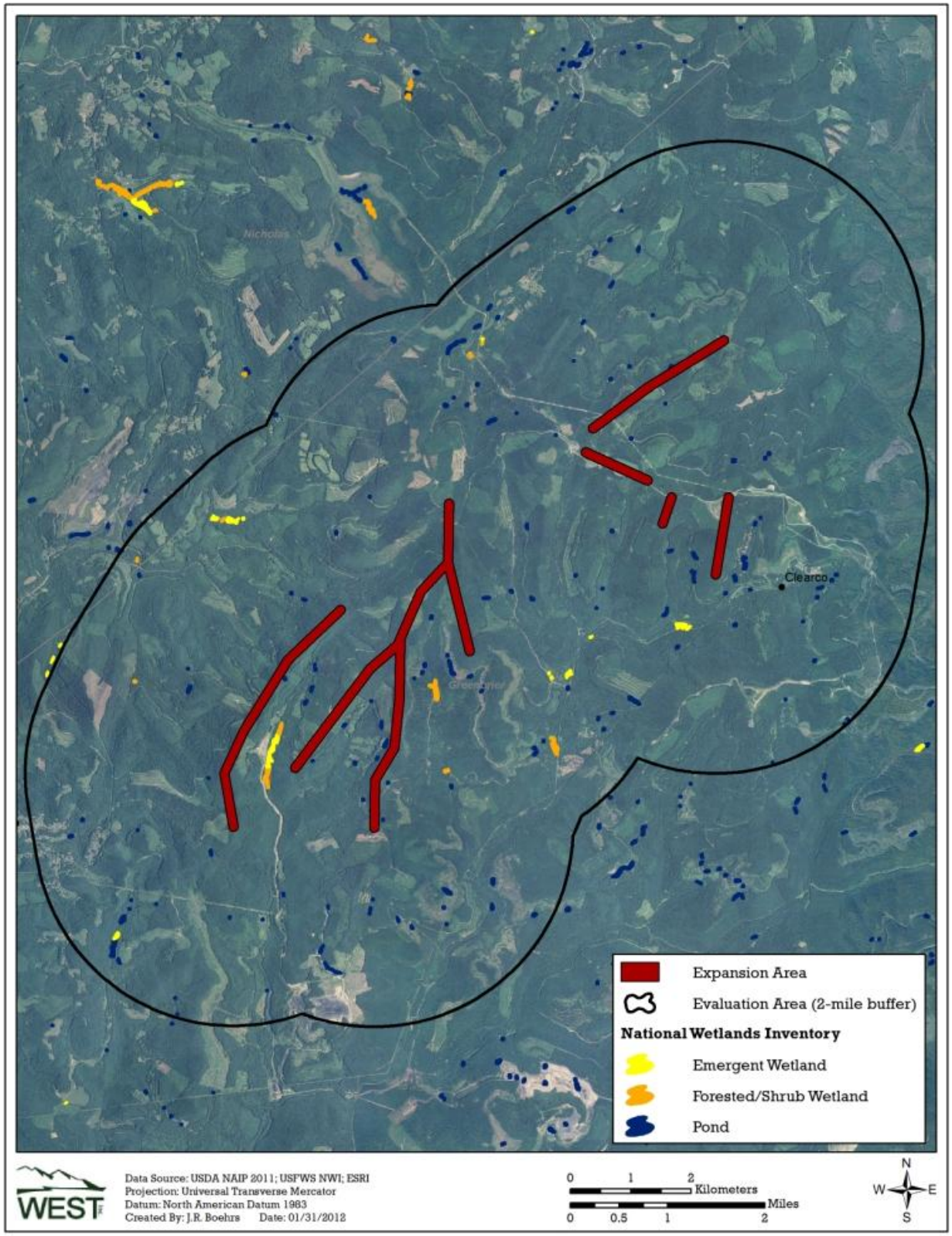

Figure 1.5 National Wetlands Inventory map of the proposed BRWEP expansion area and surrounding region.

Based on USFWS National Wetland Inventory data there are 101 acres within the Evaluation Area that are classified as wetland. The majority of wetlands within the evaluation area are classified as ponds, comprising approximately 60 acres (~59% of wetland areas). The remaining 41 acres are classified as emergent wetlands (~21 acres) and scrub/shrub forested wetlands (~20 acres). Over the entire evaluation area, wetlands comprise approximately 0.30 percent of the land cover.

Table 1.2 Wetland types present within the evaluation area. (USFWS National Wetlands Inventory).

Wetland Type	Evaluation Area	
	Acreage	Percent
Emergent Wetland	20.85	20.6
Forested/Shrub Wetland	20.50	20.2
Pond	60.09	59.2
Total	**101.44**	**100**

Public Lands

The Project is primarily located on a 63,000-acre tract privately owned by MeadWestvaco. BRE has leased approximately 3,172 acres and additional road rights-of-way from this landowner for the construction and operation of the expansion area. Only a small portion of the 3,172-acre Project Area will host wind project facilities.

The study area does not contain any state, federal, or tribal lands, nor does it contain any conservation lands as identified by The Nature Conservancy (TNC) or Important Bird Areas (IBA) as identified by the National Audubon Society (NAS).

There are no TNC preserves or IBAs in Greenbrier or Nicholas Counties. The nearest TNC preserve is the Slaty Mountain Preserve in Monroe County, West Virginia located approximately 35 miles southwest of the study area. The nearest IBAs are Dutch River and New River Gorge – Garden Ground Mountain located approximately 42 miles northwest and 40 miles southwest of the study area, respectively. While information from these resources is applicable to the Appalachian Mountain region, due to the distance from the study area, these resources are not likely to be impacted by the project nor are the resources at those locations likely to influence bird and bat abundance or composition in the study area. The proposed expansion of the BRWEP will not impact any state, federal, or tribal lands, or any TNC lands or NAS IBAs.

2.0 Avian Resources

2.1 Raptors

From available migration (NACFRP 2010; AFMO 2007; HRMO 2011; Canterbury 2006) and breeding bird data (WVBBA 2011), fourteen diurnal raptor species, six owl species, and two vulture species could occur in the study area at some time during the year (Table 2.1).

Table 2.1 Raptor species and potential seasonal occurrence in the study area.

Common Name	Scientific Name	Winter	Spring	Summer	Fall
Raptors					
Red-shouldered hawk	*Buteo lineatus*	X	X	X	X
Red-tailed hawk	*Buteo jamaicensis*	X	X	X	X
Broad-winged hawk	*Buteo platypterus*		X	X	X
Rough-legged hawk	*Buteo lagopus*	X			
Sharp-shinned hawk	*Accipiter striatus*	X	X	X	X
Cooper's hawk	*Accipiter cooperii*	X	X	X	X
Northern goshawk	*Accipiter gentilis*	X	X		X
American kestrel	*Falco sparverius*	X	X	X	X
Peregrine falcon	*Falco peregrinus*		X		X
Merlin	*Falco columbarius*	X	X		X
Northern harrier	*Circus cyaneus*		X	X	X
Golden eagle	*Aquila chrysaetos*	X	X		X
Bald eagle	*Haliaeetus leucocephalus*		X		X
Osprey	*Pandion haliaetus*		X		X
Owls					
Great-horned owl	*Bubo virginianus*	X	X	X	X
Barred owl	*Strix varia*	X	X	X	X
Eastern screech-owl	*Megascops asio*	X	X	X	X
Long-eared owl	*Asio otus*	X	X		X
Northern saw-whet owl	*Aegolius acadicus*		X	X	X
Barn owl	*Tyto alba*	X	X	X	X
Vultures					
Black vulture	*Coragyps atratus*		X	X	X
Turkey vulture	*Cathartes atratus*		X	X	X

Potential Migrant Raptors

Two geographical features primarily used by raptors during migration are ridgelines and shorelines of large bodies of water. Updrafts formed as the wind hits the ridges, and thermals created over land and not water make for energy-efficient travel over long distances (Liguori 2005). In addition to mountain ridges, rivers and associated riparian areas, which often attract and concentrate large numbers of potential prey for migrants, may also be used as travel corridors or stopover locations (Bildstein, 2006).

There are three well-established bird banding and/or raptor migration observatories within 100 miles of the study area. The Allegheny Front Migration Observatory (AFMO) located within the

Dolly Sods Wilderness Area located approximately 93 miles north of the study area has a yearly banding station and flyover count. The AFMO was established in 1958 and annually gathers data from August to October. The Hanging Rock Migration Observatory (HRMO) is located on Peters Mountain 40 miles south/south-east of the study area. The HRMO has collected yearly fall raptor migration counts since 1952. Three Rivers Migration Observatory (TRMO) is located approximately 43 miles to the southwest of the study area. Mist-netting and banding data have been collected annually at TRMO since 1995. The TRMO mist-netting site is in the Allegheny Plateau at elevations of 2400-2600 ft. (~750-812 m) containing old fields, upland mixed deciduous forest and areas with clear-cuts (Canterbury 2006). Results of surveys from these bird migration observatories (Appendix D) provide information on species composition most likely to be present in the study area during migration seasons (Table 2.1).

There have been several survey efforts within the study area that have included or focused on avian migration:

- Avian surveys were conducted for the original Beech Ridge Project Area prior to construction in 2005 (Canterbury 2006);
- Raptor migration surveys were conducted for BRWEP post-construction in the spring and fall of 2011 to fulfill PSC requirements (Young et al. 2012a);
- Raptor Migration and Avian Use surveys were conducted pre-construction for the proposed Beech Ridge expansion area during spring and fall 2011 (Young et al. 2012b).

Results of these studies documented the following raptor species, including vultures and owls, within either the existing BRWEP or the expansion area: turkey vulture; black vulture; osprey; bald eagle; golden eagle; northern harrier; sharp-shinned hawk; cooper's hawk; red-shouldered hawk, broad-winged hawk, red-tailed hawk, American kestrel, merlin, eastern screech owl, northern saw-whet owl, and barred owl.

Radio telemetry studies, monitoring golden eagle and bald eagle conducted by the National Aviary Conservation and Field Research Project (NACFRP 2010), show that both species have been tracked into West Virginia and provide confirmation that eagles from more northern latitudes are likely to migrate through and potentially spend the winter throughout the region and potentially within the study area. For example, a map showing movement patterns of golden eagle during the winter of 2010 indicates that at least three tagged individuals have been observed moving as far south as southern West Virginia, eastern Kentucky, and western North Carolina (Figure 2.1).

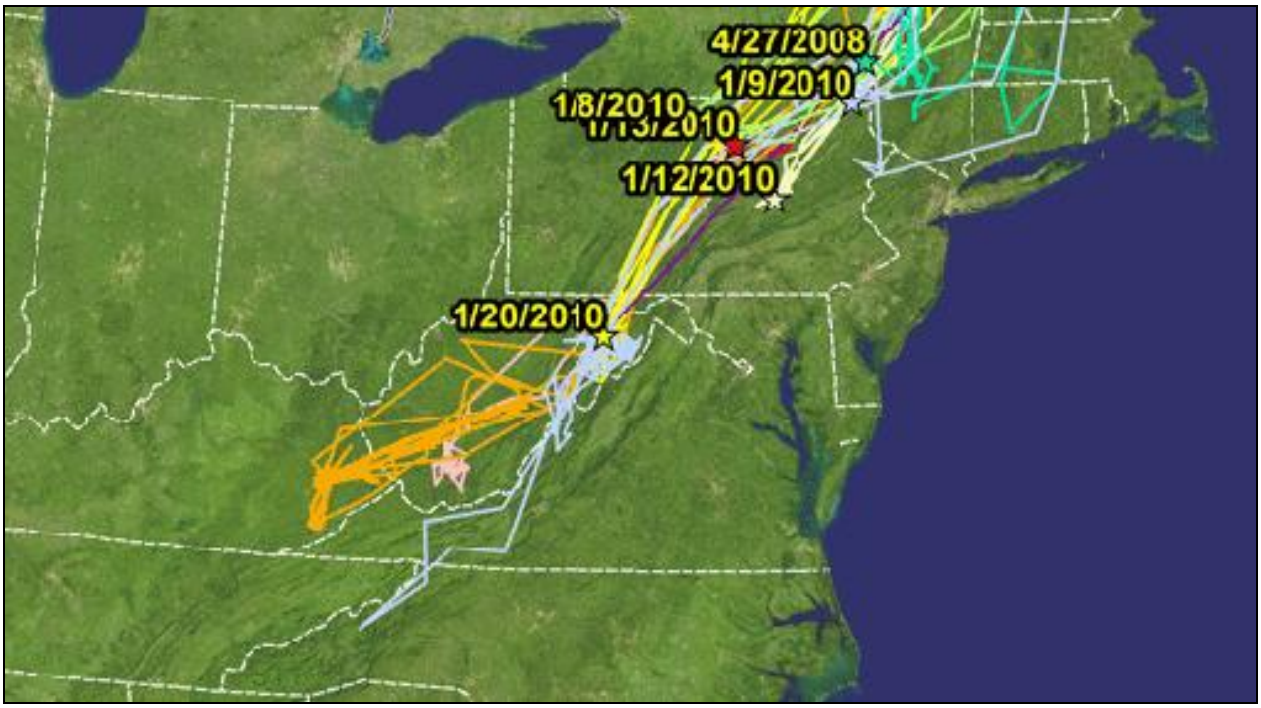

Figure 2.1 National Aviary golden eagle radio telemetry summary map, 2010

The size of the eastern North American population of golden eagles is believed to be small and many of the golden eagles migrating and wintering within areas of the Central Appalachians are summer breeding residents of Canada. This species, like other raptors, commonly uses slope soaring and ridge updrafts during migration and foraging (Barrios & Rodriguez 2004; Hoover & Morrison 2005). Available monitoring data and modeling suggest that eastern golden eagles migrate through a narrow corridor in south-central Pennsylvania (particularly during spring; Brandes & Ombalski 2004), and likely extends southward through Maryland into West Virginia.

Potential Breeding Raptors

The study area is made up of large tracts of deciduous forest. Based on this habitat type, forest-dwelling species such as accipiters and some buteos (e.g., broad-winged hawk, red-shouldered hawk), and a variety of owls are likely to nest within the study area. Grassland and scrub/shrub areas are less common in the study area, but may provide nesting habitat for species such as northern harrier. Observations during the field visit on March 12, 2011, indicate that the overall nesting potential for raptors is likely low due to clear-cutting. There was one active red-shouldered hawk territorial display observed within the Project Area (Appendix A). A nest was not recorded but an adult was observed defending territory and showing early breeding season display behavior. During spring 2005, a raptor study using broadcasting techniques was conducted to determine potential nesting raptors within the Beech Ridge Project Area (Canterbury 2006). The study results confirmed nesting of Cooper's hawk, broad-winged hawk and eastern screech owl. Red-shouldered hawk, red-tailed hawk, northern harrier and

American kestrel also responded to broadcast calls; however nesting sites were not observed (Canterbury 2006). These species are considered possible breeders in the area.

The West Virginia Breeding Bird Atlas (WVBBA) has two databases available online; one published for 1984-89 and one in progress for 2009-14. Within Greenbrier and Nicholas Counties, West Virginia, there are confirmed breeding records in the 2009-14 WVBBA for: red-shouldered hawk, red-tailed hawk, American kestrel, barn owl, and barred owl. Other raptor, vulture, and owl species with probable or possible breeding records in Greenbrier and Nicholas Counties include: black vulture; turkey vulture, bald eagle, osprey, northern harrier, eastern screech owl, and great horned owl. Results from the USGS Breeding Bird Survey routes closest to the study area, Richwood and Smoot routes, confirm the above listed raptors as having the greatest potential nest in the study area.

Raptor Prey Availability

Some studies indicate that raptor mortality at wind-energy facilities (for example, Altamont Pass, California) may be in part due to habitat conditions such as prey availability and behavioral differences between species, influencing the susceptibility of some species for collision with turbines. Orloff and Flannery (1992, 1996) suggested that high golden eagle mortality at Altamont Pass was in part due to the apparently high densities of ground squirrels (*Spermophilus beecheyi*) in the area (Thelander and Smallwood 2007). Continued research at the site revealed that the degree of aggregation of pocket gopher (*Thomomy bottae*) burrows around the turbines was positively correlated to red-tailed hawk fatality rates (Smallwood et al. 2001, Thelander et al. 2003, Thelander and Smallwood 2007). In addition, features providing cover for cottontails (*Sylvilagus auduboni*) appeared to be associated with areas where golden eagles were killed.

Types of prey species present within the study area are likely to be rodent species associated with woodlands, edge habitat, and clear cuts, such as mice and voles, and species associated with deciduous forests, such as squirrel and chipmunk species. During the field visit the presence of cottontail rabbit (*Sylvilagus transitionalis)* was recorded (Appendix A). Songbirds and other small birds are also prey for a number of raptor species and occur throughout the study area. While the Project Area provides suitable habitat for a variety of raptor prey species, based on the vegetation type and habitat characteristics, the Project Area is similar to the surrounding Evaluation Area and overall prey densities within the Project Area are not expected to be above average relative to the surrounding Evaluation Area. Therefore, it is not expected that the Project Area would attract or concentrate raptor use above surrounding areas.

In general, impacts to raptors from wind projects have been low based on results from monitoring studies in the Appalachian Mountains. For example, at the Mount Storm wind project a total of 3 red-tailed hawks, 2 sharp-shinned hawks, 1 broad-winged hawk, and 21 turkey vulture fatalities have been observed during 12,252 turbine searches over a four year period (Young et al. 2009a, 2009b, 2010a, 2010b, 2011a, 2011b, 2012). Similarly at the Mountaineer Wind Project one red-tailed hawk, one sharp-shinned hawk, and three turkey vulture fatalities were observed over a two year period (Kerns and Kerlinger 2004, Arnett et al.

2005), and no hawks or vulture fatalities were observed at the Myersdale or Casselman wind project during monitoring studies within a one year period (Arnett et al. 2005; Arnett et al 2009). Mumma and Capouillez (2011) summarized 11 monitoring studies for nine wind projects in Pennsylvania and report that from 0-2 raptors were found at all sites, and raptors and vultures combined (Accipitriformes) comprised only 2% of avian fatalities found during turbine searches. Potential raptor mortality at the proposed expansion of the BRWEP is not expected to be different that results from these other wind projects within the Appalachian Mountain region.

2.2 Migratory Birds

Avian migration studies conducted in 2005 at the existing BRWEP recorded 100 species during the spring study and 121 species during the fall (Canterbury 2006). Avian Use and Raptor Migration surveys conducted in 2011 within the proposed Project Area recorded 83 avian species during the spring study and 70 species during the fall (Young et al. 2012).

Many species of songbirds migrate at night and collision related impacts with tall man-made structures have been documented. It is generally believed that nocturnal migrating passerines move in broad front patterns rather than along specific topographical or physiographic features (Gauthreaux et al. 2003, NRC 2007). Large numbers of songbirds have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by the lights during foggy or low ceiling conditions, flying circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001). Large mortality events observed at communication towers are often attributed to the guy wires on these structures, and the height of the structure, often greater than 500 feet (~150 m) in height (Erickson et al. 2001), likely because most birds migrate at elevations of 885 feet (~270 m) or higher (Young et al. 2004).

There have been large mortality events reported at wind projects, however, the causes of these have apparently been due to lights and not simply collisions with the turbines. For example, in October 2011, 475 passerines, 4 cuckoos, 2 rails, 1 heron, 1 grebe, and 1 grouse fatalities were recovered at the Laurel Mountain wind project substation over a 15 day period, which were apparently collision related fatalities (Stantec 2011). The substation was lit during the night with high-pressure sodium lamps. In May 23, 2003, 27 songbird fatalities were recovered at the Mountaineer wind project substation and an adjacent turbine (Kerns and Kerlinger 2004). As with the Laurel Mountain incident, sodium vapor lights at the substation and foggy weather during migration season were the apparent causal factors in the incident.

Marine radar surveys conducted at many sites proposed for wind power development help to assess the risk of wind turbines to nocturnal migrants (see Young and Erickson 2006). The range of spring mean passage rates across sites in the northeast was 110 to 409 targets per kilometer per hour (targets/km/hr) with a mean of 281 targets/km/hr. For the fall, the range was from 170 to 380 with a mean of 202 targets/km/hr. For studies in the northeast where target altitude was calculated using a vertical sampling method, the mean altitude of targets was approximately 1341 ft (~409 m) above ground level in the spring and approximately 1463 ft

(~446 m) in the fall. Because mean flight height is higher than turbine height, nocturnal migrant birds may be at greater risk of turbine collision when ascending and descending from stopover habitats or when weather conditions results in lower altitude flights.

The primary habitat type of the study area, deciduous forest, is likely used by forest-dwelling species as foraging or stopover habitat during migration. Other minor habitat types in the study area, such as clear-cuts, grass/shrubland, and wetland may also be used, but due to low relative abundance of these habitats (see Table 1.1), they are not expected to concentrate large numbers of shrubland and wetland dwelling species during migration. While migrant birds will fly over the study area and utilize habitat within the Project Area during migration, the habitat types within the Project Area are similar and available throughout the surrounding Evaluation Area; therefore, the Project Area itself is unlikely to have greater attraction for migrant birds than surrounding areas.

2.3 Breeding Birds

Songbirds (order Passeriformes) are the most abundant bird group in terrestrial ecosystems and are the most often reported as fatalities at wind power facilities (NRC 2007). There are numerous bird species potentially breeding in the study area, most of which are common and have large ranges. The proposed expansion of the BRWEP could impact breeding birds; however, in general, impacts are expected to be similar to other wind projects in the Appalachian Region and are not expected to be significant due to the impacts being spread over numerous species with large populations. As part of the USFWS mandate to protect and conserve trust resources, the USFWS developed a list of Birds of Conservation Concern (BCC) which are those species thought to be vulnerable to population declines, and without additional conservation actions are likely to become candidates for listing under the Endangered Species Act. These are the species thought to be at greatest risk from development, including wind power development. The breeding bird assessment focuses on the potential for the expansion of the BRWEP to impact these species, which could be the most vulnerable to population impacts.

There are 25 species listed as birds of conservation concern within the Appalachian Mountains Bird Conservation Region 28 (Table 2.2; USFWS 2008). These species have been identified as vulnerable to population declines in the region by the USFWS (2008), but do not currently receive special protection above the Migratory Bird Treaty Act and, for bald eagles, the Bald and Golden Eagle Protection Act.

Table 2.2 List of Birds of Conservation Concern in the Appalachian Mountain Region and species records from various data sources.

Common Name	Scientific Name	Site Surveys[1]	USGS BBS[2]	WV BBA[3]
Bald eagle	*Haliaeetus leucocephalus*	X		X
Peregrine falcon	*Falco peregrinus*			
Upland sandpiper	*Bartramia longicauda*			
Northern saw-whet owl (S)	*Aegolius acadicus*	X		
Whip-poor-will	*Caprimulgus vociferus*	X		X
Red-headed woodpecker	*Melanerpes erythrocephalus*	X		X
Yellow-bellied sapsucker (S)	*Sphyrapicus varius*	X		
Olive-sided flycatcher	*Contopus cooperi*		X	
Loggerhead shrike	*Lanius ludovicianus*			X
Black-capped chickadee (S)	*Poecile atricapilla*	X	X	X
Bewick's wren	*Thryomanes bewickii*			
Sedge wren (nb)	*Cistothorus platensis*			
Wood thrush	*Hylocichla mustelina*	X	X	X
Blue-winged warbler	*Vermivora pinus*	X	X	X
Golden-winged warbler	*Vermivora chrysoptera*	X	X	X
Prairie warbler	*Dendroica discolor*	X	X	X
Cerulean warbler	*Dendroica cerulean*	X	X	X
Worm-eating warbler	*Helmitheros vermivora*	X	X	X
Swainson's warbler	*Limnothlypis swainsonii*			
Louisiana waterthrush	*Seiurus motacilla*		X	X
Kentucky warbler	*Oporornis formosus*	X	X	X
Canada warbler	*Wilsonia canadensis*	X	X	X
Henslow's sparrow	*Ammodramus henslowii*			
Rusty blackbird (nb)	*Euphagus carolinus*			
Red crossbill (S)	*Loxia curvirostra*			

Source: USFWS 2008 BCC 2008 list; (S) = Southern Appalachian population; . (nb) = non-breeding in the BCR
[1]Canterbury 2006; Young et al. 2012
[2]Richwood and Smoot BBS routes
[3]Greenbriar and Nicholas Counties

Several sources of available data were used to address the potential for these species to occur in the study area during the breeding season including the site specific surveys, the USGS Breeding Bird Survey (BBS), and the West Virginia Breeding Bird Atlas (BBA). Based on these sources, 17 of the 25 BCC for the Appalachian Region have been recorded in the study area or nearby (Table 2.2). The most applicable data are likely those from the site specific surveys which recorded 14 of the BCC; however, at least one of those species bald eagle is not considered a potential breeding resident due to habitat (Canterbury 2006).

The closest BBS routes to the study area are the Richwood and Smoot Routes (Figure 2.3). Richwood Route lies just north-east of the study area and passes approximately 2.5 miles outside the western edge of the Evaluation Area, running north to south. Smoot Route runs due south with the northernmost and closest portion located approximately 7 miles to the southwest of the Evaluation Area. These routes have been monitored in most years between 1980 and 2010. One-hundred and four (104) species of birds have been observed along the Richwood Route, and 100 species have been observed along the Smoot Route. Information gathered from the surveys along these routes is considered applicable as an indication of species that

may utilize the study area during the spring and summer breeding season and the potential presence of the BCC because these routes are located within a few miles of the study area (USGS 2001).

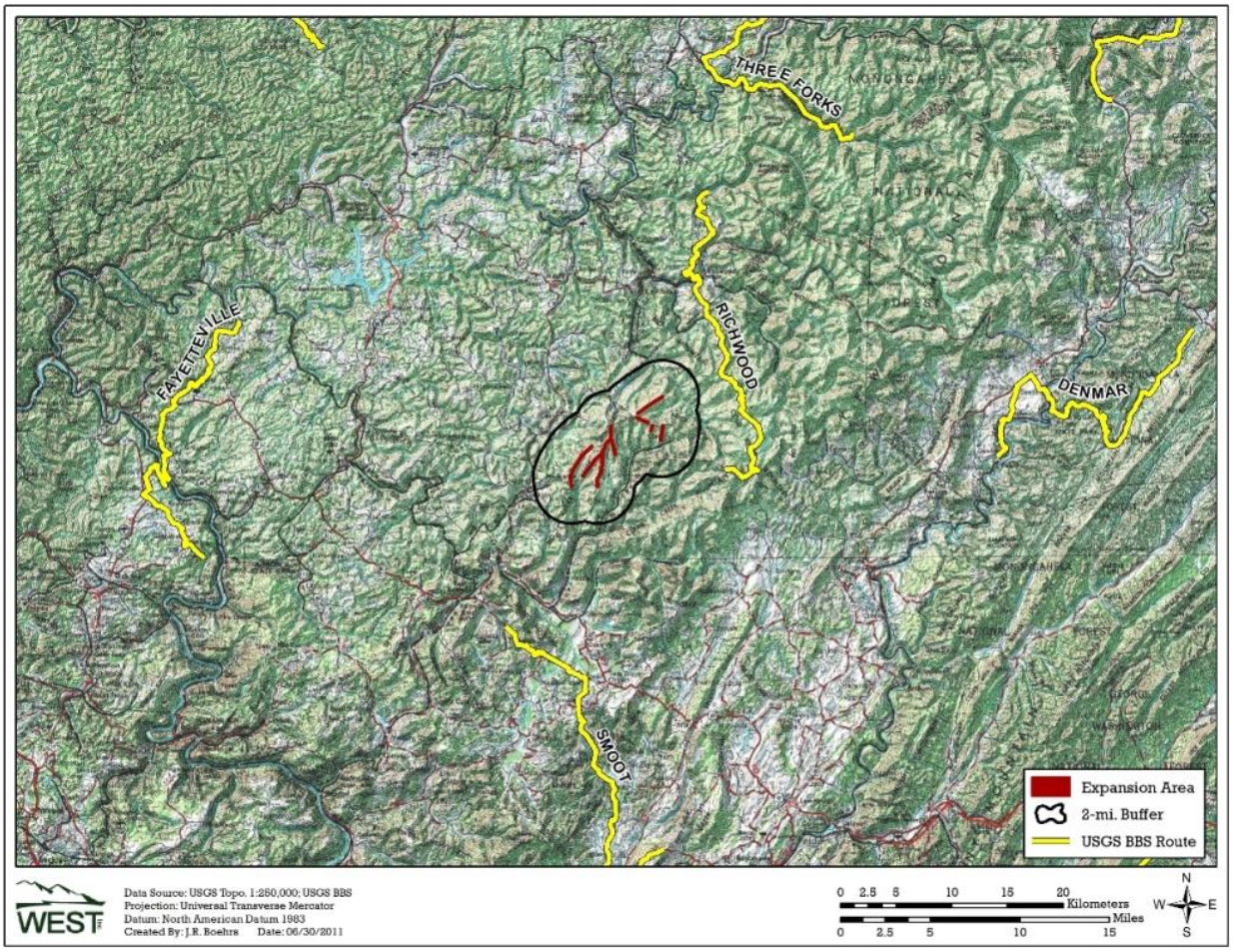

Figure 2.2 USGS Breeding Bird Survey Routes near the study area.

The West Virginia BBA has two databases available online; one published for 1984-89 and one unpublished BBA (2009-14), which is in progress. There are breeding records within the West Virginian BBA for 14 species listed as BCC within Greenbrier and Nicholas Counties, West Virginia (Table 2.2; WVBBA 2011). There are confirmed breeding records as reported in the BBA for: red-headed woodpecker, loggerhead shrike, wood thrush, black-capped chickadee, blue-winged warbler, golden-winged warbler, Kentucky warbler, worm-eating warbler, Louisiana waterthrush, and Canada warbler. Other BCC-listed species with probable or possible breeding records in Greenbrier and Nicholas Counties as reported in the BBA include: whip-poor-will, prairie warbler, cerulean warbler; and bald eagle.

One of the most prevalent concerns with wind projects is the potential for direct impacts (mortality) of migratory birds through collisions with turbines. In general, impacts to birds from

regional wind projects have been in the range of approximately 4-8 birds per turbine per study period[1] (Table 2.3). Impacts to birds in general, which would include birds migrating through the project and summer breeding residents at the BRWEP expansion area are not expected to be different than impacts at the other regional projects and will likely fall in the range of 4-8 birds per turbine per year. This level of impact would not be significant given that these impacts are typically spread over many species with large geographic ranges and large populations.

Table 2.3 Summary of bird casualties from post-construction fatality monitoring studies conducted at wind-energy facilities in the vicinity of the Project.

Project Name, State	Project size (No. of Turbines)	No. of Turbine Searches	Estimated # birds/turbine/ study period[1]	90% CI	Study Year(s)	Reference
Mountaineer, WV	44	998	4.04	2.41, 8.33	2003	Kerns & Kerlinger 2004
Buffalo Mtn, TN	3	nr	7.28	1.20, 13.34	2001-03	Nicholson et al. 2005
Buffalo Mtn, TN	18	720	1.80	nr	2005	Fiedler *et al.* 2007
Casselman, PA	23	2,040	4.69	1.25, 14.31[2]	2008	Arnett *et al.* 2009
Casselman, PA	23	nr	4.30	2.7, 6.4[2]	2009	Capouillez and Mumma 2010
Mt Storm, WV	132	2,520	8.74[3]	5.12, 12.77	2009	Young *et al*. 2009b, 2010a
Mt Storm, WV	132	4,401	6.74[3]	3.92, 10.03	2010	Young *et al.* 2010b, 2011a
Mt Storm, WV	132	3,794	8.04[3]	6.59, 12.36	2011	Young *et al*. 2011b, 2012
Average			5.70			

nr = not reported
[1]study period is approximately the period from April through October or November, [2]estimated based on the reported as 95% CI. ; [3]estimate was derived by combining the results from two non-overlapping study periods (spring and fall) which used the same study plots

While some BCC are likely to be at risk from the proposed development based on their documented occurrence in the study area, impacts are not expected to be significant at a population scale. For example, at the Mount Storm wind project, where 12,252 turbine searches have been conducted over a four-year period, seven wood thrush, three Canada warbler, two Kentucky warbler, two yellow-bellied sapsucker, one blue-winged warbler, and one whip-poor-will fatalities have been reported (Young et al. 2009a, 2009b, 2010a, 2010b, 2011a, 2011b, 2012). Based on the date of the find for many of these fatalities, they were likely migrants through the area and may not have been breeding residents in the Appalachian Mountain BCR. At other monitored wind projects in the BCR, three wood thrush and one Canada warbler fatalities were reported for the Mountaineer project (Kerns and Kerlinger 2004), one yellow-

[1] Most regional monitoring studies have occurred from April to October or November which generally covers the primary spring and fall migration periods and the summer breeding season. These studies do not account for potential winter mortality which in general is expected to be lower due to lower density of birds on the landscape during the winter season.

bellied sapsucker was reported for the Casselman project (Arnett et al. 2009), and one cerulean warbler fatality was reported for the Buffalo Mountain Project (Fiedler et al. 2007). Overall the very low fatality rates observed at these projects for BCC, are not likely to have an impact on the BCR population of these species.

The presence of wind turbines may alter the landscape so that wildlife habitat use patterns are altered, thereby displacing wildlife away from project facilities. Typically the greatest concern with displacement impacts for wind energy projects has been in grasslands and other prairie habitats where tall structures create contrast with normal conditions. The proposed study area is situated in a predominantly forested area where there are a number of woodland breeding birds, some of conservation concern. There is similar habitat in the surrounding area and the area is actively managed for timber production. While there is the potential for the project to displace woodland species where forested areas are converted to open space, the abundance of forested habitat in the area will continue to provide habitat for woodland species.

3.0 BAT RESOURCES

3.1 Bat Species

Fourteen bat species have been documented in West Virginia (Table 1.7; see also www.batcon.org, WVDNR 2010). Ten species are believed to have the potential to occur within the study area as year-round residents or during certain seasons: big brown bat, eastern red bat, hoary bat, Seminole bat, silver-haired bat, tri-colored bat, eastern small-footed myotis, Indiana bat, little brown bat, and northern myotis (Table 1.7). Evening bat, Virginia big-eared bat, gray bat, and Rafinesque's big-eared bat are not expected to occur in the project area due to the species ranges in West Virginia (Table 1.7)

Mist-net surveys for bats were conducted in 2005 and 2006 in what was the proposed Beech Ridge Project Area from July 22-26, 2005 and along the proposed transmission line right-of-way from June 12-22, 2006 (BHE 2005, 2006). Both areas where mist-net surveys were conducted are within the current study area for the proposed BRWEP expansion. Results from both surveys combined (both 2005 and 2006) found little brown bats (n=18; 27.3%); big brown bats (n=9; 13.6%); red bats (n=5; 7.6%); tri-colored bat (n=16; 24.2%); and northern long-eared bats (n=16; 24.2%). Additional mist net surveys were conducted in 2010 within the existing BRWEP and the proposed expansion area to document species composition and survey for the presence of the Indiana bat and Virginia big-eared bat (Table 1.8; Young and Gruver 2011). Mist netting surveys occurred during the summer and again in the fall in 2010 (Table 1.8). No Indiana bats or Virginia big-eared bats were captured during any mist-netting surveys conducted at either the existing or proposed Project Areas (see BHE 2005 and 2006; Young and Gruver 2011).

Table 3.1. Bat species recorded in West Virginia.

Species	Description
†Big brown bat *Eptesicus fuscus*	Sedentary. A fairly common generalist species that forms maternity colonies beneath loose tree bark in forests and woodlands, or in buildings, barns and bridges. Uses a variety of habitats including woodlands, riparian areas, and open farmlands. May forage over meadows and trees in pastures or along streams. Hibernates in caves, mines, houses, hollow trees, and rock crevices. Documented throughout West Virginia and a year-round resident. Have been captured during mist-netting in the study area.
†Eastern red bat *Lasiurus borealis*	Long distance migrant. Solitary tree bat. Roosts in the foliage of deciduous or evergreen trees. Generally uses woodland habitats. Forages along forest edge, flood plain timber, fence rows, and other wooded habitats. Documented throughout West Virginia. Expected presence during summer and migration periods. Have been captured during mist-netting in the study area.
†Eastern small-footed myotis *Myotis leibii*	Regional migrant. Generally found in remote, heavily forested mountain regions up to 2000 ft. Hibernates in caves usually in cracks and crevices. Summer roost areas usually associated with rocky outcrops and talus slopes in mountainous areas. Documented in the mountainous regions of WV including Greenbrier and Nicholas Counties and a year round resident. Have been captured during mist-netting in the study area.
Evening bat *Nycticeius humeralis*	Regional migrant: A forest bat that roosts primarily in trees and is almost never encountered in caves. Maternity colonies are in hollow trees, behind loose bark, and sometimes in buildings and attics. Records of the species in the WV are isolated and rare. Very little to no potential to occur in the Project Area.
†Hoary bat *Lasiurus cinereus (cinereus)*	Long distance migrant. Solitary tree bat. Roost in trees along forest borders and edges of forest clearings. Typically forages over water and forest openings such as grassy meadows. Documented throughout West Virginia. Expected presence during summer and migration periods. Have been captured during mist-netting in the study area.
†Indiana bat *Myotis sodalis*	Regional migrant. Forms maternity colonies and roosts during summer under loose bark or in hollow trees in summer. Hibernates in caves or mines in dense clusters. Generally feeds in wooded habitats. Documented throughout WV year-round. Known winter hibernacula in Greenbrier County. Have not been captured during mist-netting in the study area.
†Little brown myotis *Myotis lucifugus (lucifugus)*	Regional migrant. Forms maternity colonies and roosts during summer under loose bark, in buildings, attics, and other man-made structures. Uses a variety of habitats. Hibernates in caves or mines communally in clusters. Forages around trees and in open areas around water. Documented throughout WV year-round. Have been captured during mist-netting in the study area.
†Northern long-eared myotis *Myotis septentrionalis*	Regional migrant. Summer roosts and maternity colonies are typically in trees but have also been found in manmade structures. Typically forages on in wooded areas such as forested hillsides and ridges. Hibernates in caves and mines. Documented throughout WV year-round. Have been captured during mist-netting in the study area.
†Silver-haired bat *Lasionycteris noctivagans*	Long distance migrant. Solitary tree-roosting bat. Forms small maternity colonies in tree cavities, crevices, and small hollows. Roosts and hibernates beneath lose bark, in snags and in manmade structures. Generally forages in forested areas near streams and lakes. Documented throughout West Virginia,

	Expected presence primarily migration periods but may be uncommon summer resident.
†Seminole bat *Lasiurus seminolus*	Long distance migrant. Solitary tree bat. Roosts in the foliage of deciduous or evergreen trees and generally uses woodland habitats or mixed forested and open areas. Forages along forest edges, flood plain timber and fence rows. A single individual was captured in Pendleton County and also documented in Grant County at the Mt. Storm wind project. Generally considered very rare or accidental in West Virginia. Little potential to occur in the Project Area during migration.
†Tri-colored bat *Perimyotis subflavus*	Regional migrant. Roosts in tree foliage or in tree crevices. Generally prefers edge habitats adjacent to agricultural settings near water. Hibernates in caves or mines. In summer, roosts in foliage, cliff crevices or manmade structures. Documented throughout West Virginia year-round. Have been captured during mist-netting in the study area.
†Virginia big-eared bat *Corynorhinus townsendii virginianus*	Sedentary. Forms maternity colonies in mines, caves and buildings. Hibernates in caves and mines. Maternity caves are rarely found greater than 20 miles from winter caves. Forages over a variety of habitats including forested areas around occupied caves or mines. Usually inhabits caves mostly in oak-hickory forest. Recorded year-round in West Virginia. No records for Nicholas or Greenbrier Counties. Little to no potential to occur in the Project Area.
Gray bat *Myotis grisescens*	Regional migrant: Cave-dwelling bat. Summer colonies may occupy a home range that contains several roosting caves scattered along rivers or lakes. Wintering caves are typically deep vertical caves and maybe hundreds of kilometres from summer range. Rare and typically found in the south-western portions of West Virginia. Little to no potential to occur in the Project Area.
Rafinesque's big-eared bat *Corynorhinus rafinesquii*	Regional migrant. Typically forms maternity colonies in hollow trees but have also been found in old buildings and attics. Typically forages near or over water. Hibernates in caves and mines. The species range most closely approximates the historical range of great cypress swamps. Rare and found in very western portion of West Virginia. Little to no potential to occur in the Project area.

†Potential to occur in the study area.

Table 3.2. Summary of bat captures during the summer and fall season mist-net surveys conducted within the BRWEP and expansion areas, 2010.

Species	Summer 2010		Fall 2010	
	n	%	n	%
Little brown bat	51	24.4	14	12.1
Northern long-eared bat	37	17.7	22	19.0
Eastern small-footed bat	12	5.7	11	9.5
Big brown bat	20	9.6	2	1.7
Tri-colored bat	14	6.7	4	3.4
Red bat	74	35.4	53	45.7
Hoary bat	1	0.5	3	2.6
Silver-haired bat	-	-	7	6.0

Acoustic surveys for bats using AnaBat bat detectors were also conducted in 2010 (Young and Gruver 2011). The acoustic surveys were intended to provide information on the seasonal timing and magnitude of bat activity in the study area during the summer maternity and fall migration seasons; and supplement the species composition information from the mist net surveys, to the extent possible. Results for similar species composition as the mist-netting results, with only two exceptions; no hoary bat calls were identified, but eight bat calls were identified as potential Indiana bat calls by two or more quantitative analysis techniques . The potential Indiana bat calls were recorded on July 28, 29, 30 and Aug 5, 2010 (Young and Gruver 2011).

Results of the 2010 acoustic data analysis suggest that Indiana bats were possibly recorded in the study area but in very low numbers. Given the very low number of potentially recorded calls relative to the overall number of recorded calls (6 out of 12,431, or 0.04%), and the fact that acoustic analyses do not provide 100% positive identifications, it is possible that no Indiana bats were actually recorded during the acoustic survey (i.e., detections were false positives). Furthermore, none of the potential Indiana bat calls (selected by two or more screens) were recorded at the two detectors mounted on turbine nacelles; all were recorded at ground level where fatalities with operating rotors would not occur (Beech Ridge Energy , LLC, 2011).

Bat fatalities at wind-energy facilities were first noted during avian surveys in the early 1990s (Orloff & Flannery 1992); however, reports of high numbers of bat fatalities at sites in West Virginia (Kerns & Kerlinger 2004) and Tennessee (Fiedler 2004) elevated concern over potential impacts. The Bats and Wind Energy Cooperative (BWEC) was established in 2005 to determine the extent of bat mortality at wind power facilities and to seek solutions to the problem (Arnett 2007). In 2007, the National Research Council published the findings of the

Committee on Environmental Impacts of Wind Energy Projects whose task was to provide a comprehensive review of scientific literature pertaining to the effects of wind power facilities on the local environment (NRC 2007). Though some wind power facilities have high numbers of bat fatalities there is substantial variation in impacts across regions of the country (Arnett 2008).

Migratory tree bats, such as hoary bat, eastern red bat, and silver-haired bat, comprise most of the bats killed at wind-energy facilities in North America with the majority of collisions occurring in the months of August and September, commonly thought of as the fall migration season for bats (Gruver 2002, Johnson et al. 2003, Arnett et al. 2008). The reason for disproportionate mortalities during this period are unknown; however it may be that behavior of tree bats during the fall puts them at greater risk or they may fly at lower altitudes or behave differently during spring migration than during fall migration. For example, hoary bats fly 1-5 m from the ground while migrating through New Mexico in the spring, but apparently not in the fall (Cryan & Veilleux 2007). In contrast, a hoary bat collided with an aircraft above Oklahoma at an altitude of 2,438 m in October (Peurach 2003).

At least nineteen bat species have been recovered incidentally or during carcass searches at wind-energy facilities throughout the U.S. (Table 3.3; see also Johnson 2005; Kunz et al. 2007; NRC 2007; Arnett et al. 2008; WEST 2011).

Table 3.3 Species composition of bat fatalities from wind-energy facilities in the U.S. based on publicly available data from monitoring studies throughout North America through 2011.

Common Name	Scientific Name	Total Number of Fatalities	Total Percent of Total
†hoary bat	*Lasiurus cinereus*	3,270	39.8
†silver-haired bat	*Lasionycteris noctivagans*	1,659	20.2
†eastern red bat	*Lasiurus borealis*	1,296	15.8
†little brown bat	*Myotis lucifugus*	646	7.9
†big brown bat	*Eptesicus fuscus*	365	4.4
Mexican free-tailed bat	*Tadarida brasiliensis*	325	4.0
†tricolored bat	*Perimyotis subflavus*	325	4.0
unidentified bat		237	2.9
unidentified myotis	*Myotis sp.*	42	0.5
†northern long-eared bat	*Myotis septentrionalis*	12	0.1
western red bat	*Lasiurus blossevillii*	7	0.1
western yellow bat	*Lasiurus xanthinus*	6	0.1
†Seminole bat	*Lasiurus seminolus*	4	<0.1
pocketed free-tailed bat	*Nyctinomops femorosacca*	3	<0.1
†Indiana bat	*Myotis sodalis*	3	<0.1
†eastern small-footed bat	*Myotis leibii*	2	<0.1
big free-tailed bat	*Nyctinomops macrotis*	2	<0.1
unidentified free-tailed bat		2	<0.1
cave myotis	*Myotis velifer*	1	<0.1
canyon bat	*Pipistrellus hesperus*	1	<0.1
long-legged bat	*Myotis volans*	1	<0.1
long-eared bat	*Myotis evotis*	1	<0.1
Total	**19 species**	**8,208**	**100**

†Potential to occur in the study area

Due to the current lack of understanding of bat populations in North America, the species and relative abundance of bats occurring within the study area are difficult to determine. Seasonal movements of bats vary widely. Based on categories described by Fleming and Eby (2005) species can be divided into three movement categories. (1) Sedentary species breed and hibernate in the same local areas usually moving < 50 km (30 mi) between summer and winter roosts; (2) Regional migrants migrate moderate distances (~ 100 to 500 km, 60 to 310 mi); and (3) Long-distance migrants have highly developed migratory behavior sometimes travelling > 1,000 km (620 mi) between summer and winter roosts.

3.3 Bat Hibernacula

There are no known caves or hibernacula in the study area. In June 2006, a Chiropteran Risk Assessment was conducted for the BRWEP and included results of cave surveys conducted near the existing BRWEP (BHE 2006). The study focused on caves within five miles of turbine locations formerly proposed for the BRWEP. Given the proposed expansion area is adjacent to the existing facility (see Figure 1.1); the results of the study are directly relevant to assessing presence of potential hibernacula near the BRWEP expansion area. A summary of results from the BHE cave study (2006) identified 140 known caves within five miles of the then proposed

turbines at BRWEP. The majority (115 caves) were deemed unsuitable for winter habitat for bats due to cave size and the expected air temperatures in these smaller caves. Twenty-four caves were field evaluated. Of these, 12 were found to be unsuitable because entrances to these caves were blocked, or the caves exhibited evidence of flooding to the ceiling. The 12 remaining caves were surveyed for bats in March 2012 and data collected included number and species of bats present, characteristics of the cave entrance, floor and ceiling temperatures, nature of air flow, and amount of water within the cave.

Of the 12 caves surveyed, Portal Cave, Bransford's Cave and Bob Gee Cave contained the greatest number of bats (n=637, 224 and 206, respectively). Seven caves contained 50 or fewer bats and no bats were found in two of the 12 caves. No Indiana bats, Virginia big-eared bats, or other federally-listed or otherwise rare or uncommon species were identified in any of the 12 caves surveyed. Four bat species were observed (in descending order of occurrence): tri-colored bat (n=566), little brown bat (n=490), big brown bat (n=86), and northern long-eared bat (n=3).

Hellhole Cave, which is a regionally significant bat hibernaculum, is located within Pendleton County, approximately 75 miles to the northeast of the study area. This cave is one of the largest hibernation sites in the Appalachian Mountain Recovery Unit for Indiana bat and Virginia big-eared bat. In addition, the cave is one of the world's three or four largest hibernation sites for little brown bat, estimated at holding over 100,000 bats during the winter hibernation season. The cave is also used as a hibernaculum for several other bat species including big brown bat, eastern small-footed bat, northern myotis, and tri-colored bat.

In general, impacts to bats from the expansion of the BRWEP are expected to be similar to the regional average (Table 3.4) in the absence of minimization measures. Hoary bat and red bat are expected to be the two most commonly impacted species (Table 3.5). However, BRE is developing a Habitat Conservation Plan in consultation with the USFWS that includes turbine operational constraints during the period when impacts to bats are greatest, July 15 to October 15. These measures are expected to reduce impacts to bats by 44-93%, based on the best available science.

Table 3.4 Summary of Bat Mortality Reported from Wind Project Monitoring Studies in the Eastern U.S.

Project Name, State	No. of Turbines	Estimated No. Bats/ Turbine/yr	95% Confidence Interval	Study Period	Reference
Buffalo Mountain, TN	3	20.8	19.5-22.1[4]	9/29/00-9/30/03	Fiedler 2004
Buffalo Mountain, TN	18	63.9	nr	4/12/05	Fiedler et al. 2007
Mountaineer, WV	44	47.5	31.8-91.6[4]	4/4/03-11/22/03	Kerns and Kerlinger 2004
Mountaineer, WV	44	37.7[1]	31.2-45.1[4]	8/2/04-9/13/04	Arnett et al. 2005
Myersdale, PA	20	25.1[1]	20.1-32.7[4]	8/2/04-9/13/04	Arnett et al. 2005
Maple Ridge, NY	120	24.5	14.3-34.7	6/17/06-11/15/06	Jain et al. 2007
Maple Ridge, NY	195	15.5	14.1-17.0	4/30/07-11/14/07	Jain et al. 2008
Maple Ridge, NY	195	8.2	7.4-9.0	4/05/08-11/9/08	Jain et al. 2009
Pennsylvania, PA	10	30.1	28.1-33.4[5]	2007	Capouillez and Librandi-Mumma 2008
Casselman, PA	23	32.2	20.8-51.4	7/26/08-10/10/08	Arnett et al. 2009a
Mount Storm, WV	82	24.2[2]	17.1-33.1	7/18/08-10/17/08	Young et al. 2009a
Mount Storm, WV	132	28.6[3]	18.7-40.5	3/23/09-6/14/09 & 7/16/09-10/8/09	Young et al. 2009b, 2010a
Average		29.9			

[1] estimate for the 6-week study period
[2] estimate for the 12-week study period
[3] estimate based on combination of spring and fall results
[4] reported as 90% CI
[5] reported as 99% CI
nr = not reported by authors

Table 3.5 Bat Fatalities Species Composition Found at Wind Project Monitoring Studies in the Eastern U.S.

	Project Number (Percentage)			
Species	Buffalo Mountain	Mountaineer	Mount Storm	Myersdale
Hoary Bat	44 (12.1)	244 (25.9)	305 (32.6)	138(46.2)
Red Bat	222 (61.2)	312 (33.2)	327 (34.9)	82 (27.4)
Silver-haired Bat	20 (5.5)	52 (5.5)	107 (11.4)	18 (6.0)
Tri-colored Bat	71 (19.6)	199 (21.1)	91 (9.7)	23 (7.7)
Little Brown Bat	0 (0.0)	107 (11.4)	56 (6.0)	9 (3.0)
Big Brown Bat	3 (0.8)	15 (1.6)	36 (3.9)	18 (6.0)
Northern Long-eared Bat	0 (0.0)	6 (0.6)	1 (0.1)	2 (0.7)
Seminole Bat	2 (0.6)	0 (0.0)	2 (0.2)	0 (0.0)
Unidentified bat	1 (0.3)	6 (0.6)	10 (1.1)	9 (3.0)
Total	363	941	935	299

	Project Number (Percentage)			
Species	Maple Ridge	PGC	Casselman	Total
Hoary Bat	337 (46.8)	61 (28.9)	74 (29.8)	1,203 (32.4)
Red Bat	83 (11.5)	67 (31.8)	41 (16.5)	1,134 (30.5)
Silver-haired Bat	126 (17.5)	30 (14.2)	64 (25.8)	417 (11.2)
Tri-colored Bat	0 (0.0)	33 (15.6)	27 (10.9)	444 (11.9)
Little Brown Bat	106 (14.7)	10 (4.7)	32 (12.9)	320 (8.6)
Big Brown Bat	44 (6.1)	10 (4.7)	7(2.8)	133 (3.6)
Northern Long-eared Bat	0 (0.0)	0 (0.0)	0 (0.0)	9 (0.2)
Seminole Bat	0 (0.0)	0 (0.0)	2 (0.8)	6 (0.2)
Unidentified bat	24 (3.3)	0 (0.0)	1 (0.4)	51 (1.4)
Total	720	211	248	3,717

4.0 SPECIAL STATUS SPECIES

4.1 Federally-listed Species

Information on federally-listed species for Greenbrier and Nicholas counties was obtained from the USFWS website (USFWS 2011). This includes 11 species, only three of which are bats and none are birds (Table 1.8) – the remainder of the listed species are one amphibian and seven invertebrates which are not addressed in this avian and bat risk assessment. Of the three bat species, only Indiana bat is believed to have potential to occur in the Project Area at some time during the year due to nearby hibernacula. The other two species, gray bat and Virginia big-eared bat, are believed to have little to no potential to occur in the Project area either due to lack of habitat or distance to known populations (Table 1.8). The proposed expansion of the BRWEP has no potential to impact gray bat or Virginia big-eared bat.

Table 4.1 Federally-listed endangered or threatened species listed in Greenbrier and Nicholas Counties, West Virginia [http://ecos.fws.gov/tess_public/].

Species	Status	Habitat	Potential for Occurrence
Gray bat *Myotis grisescens*	E	Regional migrant: Cave-dwelling bat. Summer colonies may occupy a home range that contains several roosting caves scattered along rivers or lakes. Wintering caves are typically deep vertical caves and maybe hundreds of kilometres from summer range. Rare and typically found in the south-western portions of West Virginia. Little to no potential to occur in the Project Area	Habitat utilized by gray bat is not present in the study area. No known caves with gray bat in the study area. No potential to occur in the Project Area.
Indiana bat *Myotis sodalis*	E	Regional migrant. Forms maternity colonies and roosts during summer under loose bark or in hollow trees in summer. Hibernates in caves or mines. Generally feeds in wooded habitats. Documented throughout WV year-round. Known winter hibernacula in Greenbrier County.	Site elevation and available data suggest unlikely occurrence of Indiana bat in the study area. Potential to occur within the study area primarily during migration to and from hibernacula.

Virginia big-eared bat *Corynorhinus townsendii virginianus*	E	Sedentary. Forms maternity colonies in mines, caves and buildings. Hibernates in caves and mines. Maternity caves are rarely found greater than 20 miles from winter caves. Forages over a variety of habitats including forested areas around occupied caves or mines. Usually inhabits caves mostly in oak-hickory forest. Recorded year-round in West Virginia. No records for Nicholas or Greenbrier Counties. Little to no potential to occur in the Project Area.	Little to no potential to occur in the Project Area due to distance to known populations. Have been recorded in the New River gorge in Fayette County approximately 30 miles from the Project Area.

E=Federally endangered

Indiana Bat

The Indiana bat is typically found in wooded or semi-wooded areas near streams, and is associated with cavernous limestone areas in the winter where suitable hibernacula occur. West Virginia contains both winter hibernacula and summer maternity roosts for Indiana bats; and there are documented hibernacula in Greenbrier County (Table 4.2; USFWS 2007). In 2007, approximately 3.1% of the estimated range-wide population of Indiana bats hibernated in West Virginia (USFWS 2008a). This increased to approximately 3.8% in 2009 (USFWS 2010c). Numbers of Indiana bats in West Virginia have steadily increased since 2001 to a recent population estimate of approximately 14,855 individuals (USFWS 2010c). There are 37 known Indiana bat hibernacula in the state, and of these, 27 have extant winter populations (at least one record since 1995) (USFWS 2007). All of the hibernacula in West Virginia are found in the eastern part of the state in the Appalachian Mountains, Central Appalachian Broadleaf Forest Ecoregion (USFWS 2007). All of West Virginia is located in the Appalachian Mountain Recovery Unit for Indiana bat (USFWS 2007).

As of the 2007 *Indiana Bat Draft Recovery Plan: First Revision* (USFWS 2007), only three maternity colonies, located in Boone and Tucker counties, were recorded for the state. Since 2007, a fourth maternity colony has been located in Ohio County. This is believed to represent a small portion of maternity colonies due to the limited nature of surveys for maternity colonies (C. Stihler, WVDNR, pers. comm.). Tucker County has three known hibernacula, while Boone and Ohio counties have no known hibernacula (USFWS 2007). Six counties (Clay, Nicholas, Pendleton, Raleigh, Randolph, and Tucker) have summer records of Indiana bats other than reproductive females or maternity colonies.

An important characteristic for the location of maternity roost sites is a mosaic of woodland and open areas, with the majority of maternity colonies having been found in agricultural areas with fragmented forests (USFWS 2007). Kurta (2004) analyzed data from 393 roost trees in eleven states and found that although at least 33 tree species were used, ash (*Fraxinus* sp.), elm (*Ulmus* sp.), hickory (*Carya* sp.), maple (*Acer* sp.), poplar (*Populus* sp.), and oak (*Quercus* sp.) were the most common types of trees used, accounting for 87% of roost trees documented. On

average, Indiana bats switch roosts every two to three days although this is dependent numerous factors including reproductive condition, roost type, predation, and time of year (Kurta et al. 2002, USFWS 2007). Based on the habitat preference for the species, there is little potential Indiana bat summer habitat within the study area, primarily due to the high elevation of the study area which likely precludes persistent summer use or the presence of maternity colonies due to a shortened summer growing season suitable for rearing young.

There are no maternity colony records within Greenbrier, Nicholas or the immediate surrounding counties; however there are other summer records documented within Nicholas County (USFWS 2007). There are more data for summer and fall roost trees for male Indiana bats in West Virginia than for maternity roosts (Beverly and Gumbert 2004). Beverly and Gumbert (2004) report 26 roosts located for males in West Virginia, including seven snags, eight live trees, and five live-damaged trees. Eleven tree species were used, including shagbark hickory (Carya ovata), sugar maple, American beech, white oak, tulip tree (Liriodendron tulipfera), black cherry, red maple (Acer rubrum), northern red oak, chestnut oak (Q. montana), white ash (Fraxinus americana), and red elm (Ulmus rubra), and the size ranged from 5.0 to 27.2 inches (12.7 to 69.1 cm) DBH. During September in West Virginia (the fall swarming period), male Indiana bats roosted on average within 3.5 miles (5.6 km) of the cave and in trees near ridgetops and often switched roost trees from day to day (C. Stihler, WVDNR, pers. comm.; USFWS 2007).

There are six known Indiana bat hibernacula in Greenbrier County, West Virginia (Table 4.2; USFWS 2007). There are no hibernacula documented in Nicholas County (USFW 2007). Five of the six hibernacula in Greenbrier County are designated Priority 4 (P4)[2] caves and the remaining one is designated as P3 with an estimated population of 54 individuals since 2000. In Pocahontas County, the closest hibernacula to the project area are designated as P3, with an estimated population ranging from 196 to 285 individuals at Martha Cave and 193 individuals recorded at Snedgar Cave (Figure 1.12).

[2] Priority 1 (P1): Essential to the recovery and long-term conservation of the Indiana bat. These sites have a current and/or historically observed winter population of ≥ 10,000 individuals. Priority 1A (P1A) sites have held 5,000 or more Indiana bats during one or more winter surveys conducted during the past 10 years. P1B sites have consistently contained fewer than 5,000 bats over the past 10 years;
Priority 2 (P2): Contributes to the recovery and long-term conservation of the Indiana bat. These sites have a current and/or historical population of > 1,000 but < 10,000 individuals;
Priority 3 (P3): Contribute less the recovery and long-term conservation of the Indiana bat. These sites have a current and/or historical population of 50-1,000 bats;
Priority 4 (P4): Least important to recovery and long-term conservation of the Indiana bat. These sites have a current and/or historical population of fewer than 50 bats.

Table 4.2 Known Indiana bat hibernacula in Greenbrier County, West Virginia.

Hibernaculum name	Type	Hibernaculum ownership	Priority Number	Max. All-time Population Estimate	Max. Population Estimate since 2000	Location with relation to study area
Greenbrier Co.						
Bob Gee	Cave	Private Individual(s)	4	9	0	~12 miles Southeast
General Davis	Cave	Private Organization	4	10	6	~25 miles North
Higginbothamus	Cave	Private Individual(s)	4	?	0	~15 miles Southeast
McFerrin	Cave	Private Individual(s)	4	39	0	~12 miles Southeast
Organ	Cave	Private Individual(s)	4	14	14	~27 miles South
Piercys	Cave	Private Organization	3	54	54	~17 miles South
Pocahontas Co.						
Martha	Cave	Private Individual(s)	3	285	196	~18 miles West
Snedgar	Cave	Private Individual(s)	3	193	193	~14 miles West
Tubb	Cave	Private Individual(s)	4	20	20	>20 miles Northwest
Cass	Cave	Private Individual(s)	4	4	0	>20 miles Northwest
Dreen	Cave	State Owned	4	4	0	>20 miles Northwest
Lobelia Saltpeter	Cave	Private Individual(s)	4	4	0	>20 miles Northwest
Upper Marthas	Cave	Private Individual(s)	4	1	0	~18 miles West

Source: USFWS 2007

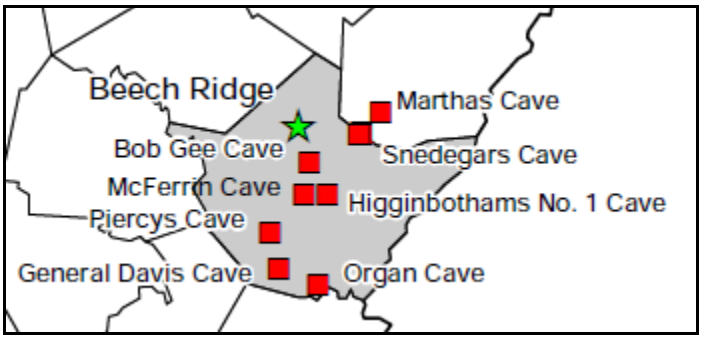

Figure 4.1 Distribution of Indiana bat hibernacula near the BRWEP, designated by the star (source: BHE 2006).

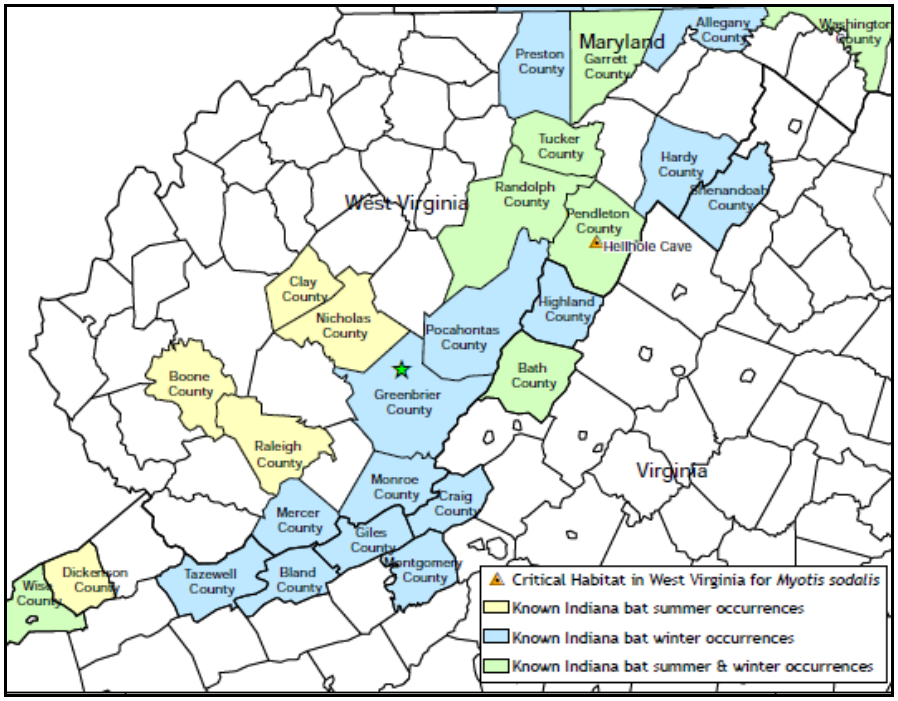

Figure 4.2 Distribution of summer and winter Indiana bat (*Myotis sodalis*) records near the proposed Beech Ridge Expansion Project, designated by the star (source: BHE *2006).*

No Indiana bats have been captured in the Project Area during mist-netting surveys (BHE 2006, Young and Gruver 2011). Acoustic surveys in 2010 recorded eight calls with characteristics similar to Indiana bat calls (Young and Gruver 2011), suggesting that Indiana bats were potentially recorded within the Project Area in very low numbers from late July to early August, which coincides with the beginning of the fall migration period for Indiana Bats. USFWS & KDFWR (2007) suggest that at least two potential Indiana bat call files per night are needed to conclude that the species is present. This occurred only once during the study (night of July 28, 2010). The Indiana bat is also susceptible to WNS and overall results to the population are unknown (USGS 2011). Overtime if the nearby populations die out due to WNS, the potential for Indiana bats to occur in the Project Area will likely decrease.

4.2 USFWS Birds of Conservation Concern

The USFWS lists 25 species as birds of conservation concern within the Appalachian Mountains Bird Conservation Region 28 (Appendix D; USFWS 2008). Potential impacts to these species area addressed above under Avian Resources.

4.3 State-Listed Species

West Virginia does not have a separate threatened and endangered species list; therefore species listed in Table 1.8 are also classified as state-listed.

4.4 Other Species of Concern

As of June 29, 2011 the USFWS announced a 90-day finding on a petition to list the eastern small-footed bat and the northern long-eared bat as endangered or threatened under the Endangered Species Act and initiated a 12-month status review on these species.

With the spread of white-nose syndrome (WNS) throughout the eastern U.S., several once common and abundant bat species, such as the little brown bat, are experiencing population declines (Frick et al. 2010). There is increasing potential for these species to be listed as threatened or endangered by state and federal agencies (CBD 2010). Currently, information is being collected and the conservation status of bat species susceptible to WNS such as the little brown bat, big brown bat, and tri-colored bat are being reviewed by the USFWS (CBD 2010, USFWS 2011a).

<u>Eastern Small-footed Bat</u>

The eastern small-footed myotis (*Myotis leibii*) is considered one the least common bat species in North America (Barbour and Davis 1969; Blasko 2001). Less information exists concerning this species compared to other bat species; however, they are known to range from Ontario and New England southward to Georgia and Alabama and westward into Oklahoma (Barbour and Davis 1969). In West Virginia, they are categorized by the state as an S1 species, which are species considered extremely rare and critically imperiled; there are five or fewer documented occurrences or few remaining individuals occurring within the state (West Virginia Department of Natural Resources n.d.; West Virginia Natural Heritage Program 2007); . The USFWS was petitioned to list eastern small-footed myotis as threatened or endangered in August 2010 (Center for Biological Diversity 2010).

Eastern small-footed myotis is one of the smallest *Myotis* species in North America (McDaniel et al. 1982). Their pelage is generally a dark-yellowish brown with some black undertones. Their average mass is around 0.13 oz (3.8 g) (range 0.11 to 0.20 oz [3.2 to 5.5 g]) (van Zyll de Jong 1985), and average length is around 3.2 inches (83 mm). This species has similar characteristics as other *Myotis* species; however, the eastern small-footed myotis tolerates colder temperatures than the little brown bat (Best and Jennings 1997). Eastern small-footed myotis are among the last *Myotis* species to reach their hibernacula in autumn, often as late as mid-November, and are usually the first to leave in the spring, in March or early April (Barbour and Davis 1969; Fenton 1972). Hibernation generally occurs from October to April where they usually hibernate singly but can be found in small groups or within groups of other species (Fenton 1972). During periods of mild ambient temperatures, activity and movement in and out of hibernacula has been observed in this species (Hitchcock 1965; Schwartz 1954). The maternity period lasts from May to August during which a single pup is born usually in May or June (Barbour and Davis 1969).

Eastern small-footed myotis are mostly found in mountainous regions; in or near deciduous forest, mixed deciduous-evergreen forest, or mixed forest and open farmland (NatureServe 2011); and at elevations of approximately 750 to 3,700 ft (240 to 1,125 m) (Best and Jennings 1997). In West Virginia, they have been found roosting in limestone caves during the spring and summer (Krutzsch 1966). They have been known to roost in caves, buildings, rock bluffs, talus slopes, and tunnels and beneath slabs of rock and stones (Best and Jennings 1997). Caves and abandoned mines are the only known hibernacula sites (Fenton 1972), where they occupy narrow wall crevices or under rocks on the floor (Davis 1955; Krutzsch 1966; Martin et al. 1966). Within these selected hibernacula sites, eastern small-footed myotis prefer the drafty entrances of open mines and caves where the humidity is relatively low (Barbour and Davis 1969; Fenton 1972). Caves and mines are also utilized for summer roosting, but summer roost site selection is similar to little brown bat and other *Myotis* species where buildings, bridges, hollow trees, sloughing bark, rock piles, and cliff crevices are utilized (Natureserve 2011).

Little information exists on the demographic parameters of eastern small-footed myotis. Similar to most bats, they have low reproductive rates (one young per year) and relatively long life spans. They are known to live approximately six to 12 years. Best and Jennings (1997) estimated an annual survival rate of approximately 76% for males and 42% for females. Lower female survival rates have been attributed to the greater demands of reproduction on females, higher metabolic rates, longer sustained activity during the summer months, and greater exposure to disease-carrying parasites especially in maternity colonies (Hitchcock et al. 1984; Best and Jennings 1997).

Dispersal and migratory distances of eastern-small footed myotis are believed to be influenced by the availability of hibernacula and roosting sites across the landscape (Johnson and Gates 2008). They are generally believed to be sedentary or regional migrants (Fleming and Eby 2005) and have been found in late summer during periods of active migration for bats, but the whereabouts of these individuals during other seasons is generally unknown (Barbour and Davis 1969). Although little information exists about migration patterns of eastern small-footed myotis, Johnson and Gates (2008) documented females moving <165 ft (<50 m) between successive diurnal roosts during the summer maternity period, and they typically switched roosts every day unless inclement weather prevented foraging.

Northern Long-Eared Bat

The northern myotis is a common bat species in the mid- to northeastern U.S., with continental range extending into southeastern and western Canada. The global status of the northern bat has been G4, which are species that are apparently secure (NatureServe 2011), and it currently has no special status in the state of West Virginia. The USFWS was petitioned to list northern myotis as threatened or endangered in August 2010 (Center for Biological Diversity 2010).

The northern myotis is a small bat weighing approximately 0.17 to 0.35 oz (5 to 10 grams) with yellow to brown coloration. Females tend to be larger and heavier than males (Caire et al.

1979). The northern myotis has large ears relative to other similar species and was previously named the northern long-eared bat.

In spring, females leave hibernacula and form maternity colonies of up to 60 individuals (Caceres and Barclay 2000). Parturition dates and subsequent weaning are likely dependent on regional conditions (Foster and Kurta 1999). Studies completed by Broders et al. (2006) over a three-year period in New Brunswick, Canada, found parturition to occur in mid- to late July. Other studies suggest that southeastern population parturition dates occur between mid-May and mid-June (Caire et al. 1979; Cope and Humphrey 1972).

Generally, female northern myotis roost communally, while males select solitary roosts (Caceres and Barclay 2000). Northern myotis have shown site fidelity related to summer roost habitat; however, studies by Foster and Kurta (1999) found that bats changed roost trees approximately every two days. Movement to hibernacula occurs as early as late July and extends as late as October. Copulation occurs outside of hibernacula during swarming behavior; however, fertilization does not occur until spring (Caceres and Barclay 2000).

Northern myotis are likely an opportunistic insectivore that primarily gleans prey from substrates (Faure et al. 1993). They are known to forage under the forest canopy at small ponds or streams, along paths and roads, or at the forest edge (Caire et al. 1979).

Northern myotis most frequently select mature-growth forests with decaying trees and/or live trees with cavities or exfoliating bark during the summer maternity season (Lacki and Schwierjohann 2001; Ford et al. 2006; Foster and Kurta 1999). Day and night roosts are utilized by northern myotis during spring, summer, and fall with old-growth forest communities selected most frequently (Foster and Kurta 1999; Owen et al. 2003; Broders and Forbes 2004). Variation in roost selection criteria has been reported between northern myotis sexes, with females forming maternity colonies in snags, while solitary males roosted in live tree cavities (Lacki and Schwierjohann 2001; Broders and Forbes 2004; Caceres and Barclay 2000). Broders and Forbes (2004) further reported that maternity colonies were more often in shade-tolerant deciduous stands in trees species that are susceptible to cavity formation. This is supported by Lacki and Schwierjohann (2001) findings that colony roosts were more likely to occur in stands with higher density of snags.

Mine and cave sites have been most often reported as hibernacula for northern myotis (Whitaker and Winter 1977; Stone 1981; Griffin 1940).

The total population size of northern myotis is not clearly known; however, estimates suggest the population may be as small as 2,500 or as large as 1,000,000 individuals (Natureserve 2011). Similar to other bat species, northern myotis has a low reproductive rate, with females birthing one offspring per year. The sex ratio for northern myotis populations appears to be dominated by males, with multiple studies reporting higher percentages of males compared to females (Griffin 1940; Pearson 1962; Hitchcock 1949; Stone 1981). The skewed ratio is believed due to greater mortality among females. The northern myotis is a fairly long-lived

species (Thompson 2006), with one individual reported living up to 19 years, suggesting long life-spans (Hall et al. 1957).

Little information exists on the migration patterns and dispersal of northern myotis. The geographic summer and winter ranges appear to be identical (Barbour and Davis 1969); however, it is believed that movement between hibernacula and maternity summer roosts is likely similar to other *Myotis* species and may vary regionally. Some studies have reported movements ranging between approximately 30 and 60 miles (approximately 50 to 100 km) from hibernacula to summer habitat (Caire et al. 1979; Griffin 1945), suggesting they are regional migrants. In managed forests of West Virginia, northern myotis utilized on average a 160.6-acre (65-ha) home range, and patches smaller than this likely represent unsuitable habitat (Owen et al. 2003). Females have been reported to move up to 6,500 ft (approximately 2,000 m) and males 3,300 ft (approximately 1,000 m) between roost sites (Broders et al. 2006).

5.0 SUMMARY

The BRWEP expansion area, including a 2-mile buffer zone, is located adjacent to the existing BRWEP, within Greenbrier and Nicholas Counties, West Virginia, where land cover is predominately deciduous forest with a mosaic of mixed forest, shrub/scrub; grassland, and developed spaces. The rolling topography is not likely to concentrate migrating birds; however raptors and songbirds will be present during migration seasons. Raptor species will likely utilize the ridgeline system for updrafts. This has been evidenced by the raptor migration studies conducted during 2011 in the study area, in which 17 raptor species, including vultures and owls, were recorded. Bald and golden eagles, both protected by the Bald and Golden Eagle Act, were recorded, in low numbers, during the 2011 surveys conducted within both the expansion area and existing BRWEP. The impact of turbines on raptors along Appalachian ridge-tops is not well studied but at other wind projects in the region impacts have been low with generally less than one or two raptor fatalities per year.

High bat mortality at other wind-energy facilities is a concern and some species that appear to be at greatest risk are likely to be found in the study area, for example eastern red bats and hoary bats. There are ten species of bat that have the potential to utilize the forested habitat within the study area for roosting and/or for foraging at some time during the year; including the listed or sensitive species; Indiana bat, eastern small-footed bat, and northern long-eared bat. Both eastern small-footed bat and northern long-eared bat have been captured during mist-net surveys conducted within the Project Area and will likely be exposed to the facility; however, impacts to these two species are expected to be low based on results from other regional monitoring studies and likely population declines of these species due to WNS which is likely having the effect of reduced density of these species on the landscape. Indiana bat could not be definitely confirmed during mist-netting surveys, however, acoustic surveys suggest that this species may occur infrequently in low numbers during the late summer or fall migration and BRE is developing a HCP in consultation with the USFWS to minimize and mitigate potential impacts to this endangered species.

6.0 LITERATURE CITED

Allegheny Front Migration Observatory (AFMO), 2007. Available at http://www.brooksbirdclub.org/afmo2007.pdf. Accessed July 5, 2011.

Amelon, S. and D. Burhans. 2006. Conservation assessment: *Myotis leibii* (eastern small-footed myotis) in the eastern United States *in* USDA Forest Service General Technical Report NC-260: Conservation Assessments for Five Forest Bat Species in the Eastern United States.

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Prepared for the Bats and Wind Energy Cooperative. March 2005.

Arnett, E.B. 2007. Written Statement to Oversight Hearing on "Gone with the Wind: Impacts of Wind Turbines on Birds and Bats" before the Subcommittee of Fisheries, Wildlife and Oceans U.S. House of Representatives Committee on Natural Resources May 2007.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A.Jain, G.D. Johnson, R.R. Koford, C.P. Nicholson, T.J. O'connell, M.D. Piorkowski, and R.D. Tankersley Jr. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72:61–78.

Arnett, E.B., M.R. Schirmacher, M.M.P. Huso, and J.P. Hayes. 2009. Patterns of Bat Fatality at the Casselman Wind Project in South-Central Pennsylvania. 2008 Annual Report. Annual report prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. Bat Conservation International (BCI), Austin, Texas. June 2009. Available online at: http://www.batsandwind.org/pdf/2008%20Casselman%20Fatality%20Report.pdf

Baerwald, E. F. 2008. Variation in the activity and fatality of migratory bats at wind energy facilities in southern Alberta; causes and consequences. Thesis, university of Calgary, Alberta, Canada.

Bald and Golden Eagle Protection Act (BGEPA). 1940. 16 United States Code § 668-668d. June 8, 1940.

Barbour, R.A. and W.H. Davis. 1969. Bats of America. University of Kentucky, Lexington.

Barrios, L. and A. Rodriguez, 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore turbines. *Journal of Applied Ecology* 41: 72-81.

Bat Conservation International (BCI). 2011. Bat Species: US Bats. BCI website. BCI, Inc., Austin, Texas. Accessed July, 2011. Homepage: http://www.batcon.org; Species Profiles:http://batcon.org/index.php/education/article-and-information/species-profiles.html

Beech Ridge Energy LLC, 2011, Beech Ridge Wind Energy Project Habitat Conservation Plan, Greenbrier and Nicholas Counties, West Virginia. Prepared by Beech Ridge Energy LLC, Chicago, Illinois. August 2011. 222pp+appendices

Bell, R. K and J.B. Patterson, 2007. Allegheny Front Migration Observatory Fall Migration, 2007 Report. Grant County, West Virginia.

Best, T. L. and J. B. Jennings. 1997. *Myotis leibii*. Mammalian Species 547: 1-6.

Beverly, J. and M.W. Gumbert. 2005. Indiana Bats in West Virginia, A Review. [Online] URL: <http://www.kanawhahydro.com/correspondance/docs/InitialStudyReport.pdf>. Accessed on November 5, 2010.

BHE Environmental, Inc. (BHE). 1999. Mist net survey for bats in Areas 8, 9, and 10 of the Marlinton/White Sulphur and Cheat/Potomac Ranger Districts, the Monongahela National Forest in Greenbrier and Pendleton Counties, West Virginia. Unpublished report submitted to USDA Forest Service, Monongahela National Forest, Greenbrier Ranger District. 25pp +appendices.

BHE Environmental, Inc. 2005. Mist Net Surveys at the Proposed Beech Ridge Wind Farm, Greenbrier County, West Virginia. Prepared for Beech Ridge Energy LLC, Olney, Maryland. Prepared by BHE Environmental, Inc., Columbus, Ohio.

BHE Environmental, Inc. (BHE). 2006. Chiropteran Risk Assessment: Proposed Beech Ridge Wind Energy Generation Facility, Greenbrier and Nicholas Counties, West Virginia. Unpublished report submitted to Beech Ridge Energy LLC, Olney, Maryland. 37pp + appendices.

BHE Environmental, Inc. (BHE). 2006. Mist Net Surveys at the Proposed Beech Ridge Wind Energy Transmission Corridor, Nicholas and Greenbrier Counties, West Virginia. Prepared For: Beech Ridge Energy LLC, Olney, Maryland. Prepared By: BHE Environmental, Inc., Columbus, Ohio.

Bildstein, K.L. 2006. Migrating raptors of the World: Their Ecology and Conservation. Cornell University Press, Ithica, New York. P.68.

Blasko, J. 2001. *Myotis leibii.* Animal Diversity Web Online. Accessed January 2011. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Myotis_leibii.html.

Brandes, D. and D.W. Ombalski, 2004. Modeling raptor migration pathways using a fluid flow analogy. *J. Raptor Res.* 38(3):195-207.

Broders, H. G. and G. J. Forbes. 2004. Interspecific and intersexual variation in roost-site selection of northern long-eared and little brown bats in the Greater Fundy National Park ecosystem. Journal of Wildlife Management 68: 602-610.

Caceres, M. C. and M. J. Pybus. 1997. Status of the northern long-eared bat (*Myotis septentrionalis*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 3, Edmonton, Alberta. 19 pp.

Caire, W., R.K. Laval, M.K. Laval, and R. Clawson. 1979. Notes on the Ecology of *Myotis keenii* (Chiroptera, Vespertilionidae) in Eastern Missouri. American Midland Naturalist 102: 404-407.

Canterbury, R. A. 2006. Avian Phase I Assessment of Bird Populations on the Meadwestvaco Wind Power Project in Greenbrier County, West Virginia: Spring and Fall 2005. Technical report prepared for Potesta & Associates and Beech Ridge Energy, LLC. Charleston, West Virginia. 124 pp.

Castleberry, S. B. K. V. Miller, and W. M. Ford. December 2007. Survey of Bat Communities in the New River Gorge National River, Gauley River National Recreation Area, and Bluestone National Scenic River: Species Occurrence, Relative Abundance, Distribution, and Habitat Use. Technical Report NPS/NER/NRTR—2007/101. National Park Service. Philadelphia, PA.

Center for Biological Diversity (CBD). 2010. Endangered species review and interim protections sought for little brown bats, *bat disease could cause regional extinction of once-common species*. Available online at: http://www.biologicaldiversity.org/news/press_releases/2010/little-brown-bat-12-16-2010.html

Center for Biological Diversity. 2010. Petition to List the Eastern-Small Footed Bat *Myotis leibii* and Northern Long-Eared Bat *Myotis septentrionalis* as Threatened or Endangered under the Endangered Species Act. CBD, Richmond, Vermont. Available online at: http://www.biologicaldiversity.org/campaigns/bat_crisis_white-nose_syndrome/pdfs/petition-Myotisleibii-Myotisseptentrionalis.pdf.

Chatfield, A., W. Erickson and K. Bay. 2009. Avian and Bat Fatality Study Dillon Wind Energy Facility, Riverside, California. Technical report prepared for Iberdrola Renewables by WEST Inc. 21pp.

Cope, J.B., and S.R. Humphrey. 1972. Reproduction of the Bats *Myotis keenii* and *Pipistrellus subflavus* in Indiana. Bat Research News 13: 9-10.

Cryan, P.M., and J.P. Veilleux. 2007. Migration and the use of Autumn, Winter, and Spring Roosts by Tree Bats. *In:* Lacki, M.J., J.P. Hayes, and A. Kurta, eds. Bats and Forests. Baltimore, Maryland: The Johns Hopkins University Press. Pp. 153-175.

Davis, W.H. 1955. *Myotis subulatus leibii* in Unusual Situations. Journal of Mammalogy 36: 130.

Davis, W.H., and H.B. Hitchcock. 1965. Biology and Migration of the Bat, *Myotis lucifugus*, in New England. Journal of Mammalogy 46: 296-313.

Environmental Protection Agency (EPA). 2010. Level III and IV Ecoregions of the Conterminous United States. www.epa.gov/wed/pages/ecoregions.htm

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, K.J. Sernka, and R.E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. National Wind Coordinating Committee (NWCC) Resource Document. August 2001.

Faure, P.A., J.H. Fullard, and J.W. Dawson. 1993. The Gleaning Attacks of the Northern Long-Eared Bat, *Myotis septentrionalis*, Are Relatively Inaudible to Moths. Journal of Experimental Biology 178: 173-189.

Fenton, M., and G. Bell. 1979. Echolocation and Feeding Behaviour in Four Species of G. Myotis (Chiroptera). Canadian Journal of Zoology 57: 1271-1277.

Fenton, M.B. 1970. Population Studies of *Myotis lucifugus* (Chiroptera: Vespertilionidae) in Ontario. Life Sciences Contributions, Royal Ontario Museum 77: 1-34.

Fenton, M.B. 1972. Distribution and Overwintering of *Myotis leibii* and *Eptesicus fuscus* in Ontario. Life Sciences Occasional Papers 21, Royal Ontario Museum: 1-8. Gallery Science Publication 12: 1-68.

Ford, W.M., S.F. Owen, J.W. Edwards, and J.L. Rodrigue. 2006. *Robinia pseudoacacia* (Black Locust) as Day-Roosts of Male *Myotis septentrionalis* (Northern Bats) on the Fernow Experimental Forest, West Virginia. Northeastern Naturalist 13: 15-24.

Foster, R.W., and A. Kurta. 1999. Roosting Ecology of the Northern Bat (*Myotis Septentonalis*) and Comparisons with the Endangered Indiana Bat (*Myotis sodalis*). Journal of Mammalogy 80: 659-672.

Fiedler J.K. 2004. Assessment of bat mortality and activity at Buffalo Mountain Windfarm, Eastern Tennessee. M.S. Thesis, University of Tennessee, Knoxville, Tennessee.

Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson. 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005. Tennessee Valley Authority, Knoxville, Tennessee. https://www.tva.gov/environment/bmw_report/results.pdf

Fleming, T.H. and P. Eby. 2005. Ecology of Bat Migration. *In:* T.H. Kunz and M.B. Fenton, eds. Bat Ecology. The University of Chicago Press, Chicago, Illinois.

Frick, W.F., J.F. Pollock, A.C. Hicks, K.E. Langwig, D.S. Reynolds, G.G. Turner, C.M. Butchkoski, and T.H. Kunz. 2010. An Emerging Disease Casues Regional Population Collapse of a Common North American Bat Species. Science 329: 679-682.

Gates, J. E., and J. B. Johnson. July 2006 (Revised May 2007). Bat-swarming Inventory at Abandoned Mine Portals at New River Gorge National River, West Virginia. Technical Report NPS/NER/NRTR 2006/046. National Park Service. Philadelphia, PA.

Garton, E.R., F. Grady, and S.D. Carey. 1993. The vertebrate fauna of West Virginia Caves. West Virginia Speleological Survey Bulletin 11.

Gauthreaux, S.A. Jr., C.G. Belser, and D. van Blaricom. 2003. Using a Network of WSR 88-D Weather Surveillance Radars to Define Patterns of Bird Migration at Large Spatial Scales. *In*: Avian Migration, P. Berthold, E. Gwinner, and E. Sonnenschein, eds. Springer, Berlin. Pp. 335-346.

Good, R.E., W. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman, 2011. Bat Monitoring Studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana. Technical report prepared for Fowler Ridge Wind Farm. Prepared by WEST Inc., Cheyenne, Wyoming.

Griffin, D.R. 1940. Notes on the Life Histories of New England Cave Bats. Journal of Mammalogy 21: 181-187.

Griffin, D.R. 1945. Travels of Banded Cave Bats. Journal of Mammalogy 26: 15-23.

Griffin, D.R. 1970. Migration and Homing of Bats. *In*: Biology of Bats. W.A. Wimsatt, ed. Academic Press, New York. Pp. 233-264.

Gruver, J.C. 2002. Assessment of Bat Community Structure and Roosting Habitat Preferences for the Hoary Bat (*Lasiurus cinereus*) near Foote Creek Rim, Wyoming. M.S. Thesis, University of Wyoming, Laramie.

Hanging Rock Migration Observatory (HRMO), 2011. Available at http://www.hangingrocktower.org/. Accessed July 5, 2011.

Harvey, M.J. 1992. Bats of the Eastern United States. Arkansas Game and Fish Commission. 46 pp.

Havens, A., and P. Myers. 2006. *Myotis lucifugus.* Animal Diversity Web Online. Accessed January 2011. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Myotis_lucifugus.html.

Hicks, A. C., Herzog, C. J., von Linden, R. I., Darling, S. R., and J. T. H. Coleman. 2008. White nose syndrome: field observations from the first two winters. First Annual White-nose Syndrome Symposium. Albany, New York, June 9-11, 2008. 40 pp.

Hitchcock, H.B. 1949. Hibernation of Bats in Southeastern Ontario and Adjacent Quebec. Canadian Field Naturalist 63: 47-59.

Hitchcock, H.B. 1965. Twenty-Three Years of Bat Banding in Ontario and Quebec. Canadian Field-Naturalist 79: 4-14.

Hitchcock, H.B., R. Keen, and A. Kurta. 1984. Survival Rates of Myotis leibii and Eptesicus fuscus in Southeastern Ontario. Journal of Mammalogy 65: 126-130.

Hoover, S.L. and M.L. Morrison, 2005. Behavior of red-tailed hawks in a wind turbine development. *J. Wildl. Manage*. 69(1):150-159.

Humphrey, S.R., and J.B. Cope. 1976. Population Ecology of the Little Brown Bat, *Myotis lucifugus*, in Indiana and North-Central Kentucky. American Society of Mammalogists Special Publication No. 4.

Jacques Whitford Stantec Limited (Jacques Whitford). 2009. Ripley Wind Power Project post construction monitoring report. Project No. 1037529.01. Report to Suncor Energy Products Inc., Calgary, Alberta, and Acciona Energy Products Inc., Calgary, Alberta. Prepared for the Ripley Wind Power Project Post-Construction Monitoring Program. Prepared by Jacques Whitford, Markham, Ontario. April 30, 2009.

Johnson, G.D. 2005. A Review of Bat Mortality at Wind-Energy Developments in the United States. Bat Research News 46: 45-49.

Johnson, J. B., J.W. Edwards and P. B. Wood. 2005. Virginia Big-eared Bats (*Corynorhinus townsendii virginianus*) Roosting in Abandoned Coal Mines in West Virginia. West Virginia Cooperative Fish and Wildlife Research Unit and Division of Forestry, West Virginia University, Morgantown. Northeastern Naturalist Vol. 12, No. 2 (2005). Pp. 233-240.

Johnson, G., M. Perlik, W. Erickson, M. Strickland, P. Sutherland, Jr. 2003. Bat Interactions with Wind Turbines at the Buffalo Ridge, Minnesota Wind Resource Area: An Assessment of Bat Activity, Species Composition, and Collision Mortality. EPRI, Palo Alto, California, and Xcel Energy, Minneapolis, Minnesota.

Johnson, J. S., Kiser, J. D., Watrous, K., and T. S. Peterson. 2008. Day-roosts of male and female eastern small-footed myotis *Myotis leibii* in the mid-Atlantic ridge and valley region of West Virginia. Proceedings of the 38th Annual North American Symposium on Bat Research, Scranton, Pennsylvania.

Katzner, T.,D. Brandes, M. Lanzone, T. Miller, and D. Ombalski. 2008. Raptors and Wind Energy Development in the Central Appalachians: Whitepaper version 2.0, 17 August 2008. Accessed online at http://docs.wind-watch.org/windenergyraptorswhitepaper.pdf, July 7, 2011.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collision Fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Technical Report prepared for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee. Curry and Kerlinger, LLC. 39 pp.

Krusic, R. A., Yamasaki, M., Neefus, C., and P. J. Pekins. 1996. Bat habitat use in the White Mountain National Forest. Journal of Wildlife Management 60: 625-631.

Krutzsch, P.H. 1966. Remarks on Silver-Haired and Leib's Bats in Eastern United States. Journal of Mammalogy 47: 121.

Kunz, T.H. and R.A. Martin. 1982. *Plecotus townsendii*. Mammalian Species 175:1-6.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, M.D. Tuttle. 2007. Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses. Frontiers in Ecology and the Environment 5(6):315-324.

Kurta, A. 2004. Roosting Ecology and Behavior of Indiana Bats (*Myotis sodalis*) in Summer. *In:* Indiana Bat and Coal Mining: A Technical Interactive Forum. K. C. Vories and A. Harrington, eds.. Louisville, Kentucky: U.S. Department of Interior, Office of Surface Mining, Alton, Illinois Coal Research Center, Southern Illinois University, Carbondale. Pp. 29-42

Kurta, A., S.W. Murray, and D.H. Miller. 2002 Roost Selection and Movements Across the Summer Landscape. *In*: The Indiana Bat: Biology and Management of an Endangered Species. A. Kurta and J. Kennedy, eds. Bat Conservation International, Austin, Texas. Pp. 118-129.

Lacki, M.J., M.D. Adam, and L.G. Shoemaker. 1993. Characteristics of Feeding Roosts of Virginia Big-Eared Bats in Daniel Boone National Forest. Journal of Wildlife Management 57:539-543.

Lacki, M.J., and J.H. Schwierjohann. 2001. Day-Roost Characteristics of Northern Bats in Mixed Mesophytic Forest. Journal of Wildlife Management 65: 482-488.

Leverett, R. T. 2001. Old-growth forests of the northeast *in* Wilderness Comes Home: Rewilding the Northeast, C. McGrory-Klyza, editor. University Press of New England: Hanover, New Hampshire. 320 pp.

Liguori, J. 2005. Hawks From Every Angle: How to Identify Raptors in Flight. Princeton University Press, Princeton, New Jersey.

Martin, R.L., J.T. Pawluk, and T.B. Clancy. 1966. Observations on Hibernation of *Myotis subulatus*. Journal of Mammalogy 47: 348-349.

McDaniel, V.R., M.J. Harvey, C.R. Tumlison, and K.N. Paige. 1982. Status of the Bat *Myotis leibii* in Arkanasas. Proccedings of the Arkansas Academies of Science 36: 92-94.

Medville, D. and H. Medville, 1995. BULLETIN 13 — Caves and Karst of Randolph. West Virginia. Speleological Survey, West Virginia.

Miller, A. 2008. Patterns of avian and bat mortality at a utility-scaled wind farm on the southern high plains. Thesis. Texas Tech University, Lubbock, Texas, USA.

Mossman, P.R., H.H. Thomas, and J.P. Veilleux. 2007. Food Habits of Eastern Small-Footed Bats (*Myotis leibii*) in New Hampshire. American Midland Naturalist 158: 354-360.

Myers, P., R. Espinosa, C. S. Parr, T. Jones, G. S. Hammond, and T. A. Dewey. 2006. The Animal Diversity Web (online). Accessed July 4, 20011at <http://animaldiversity.org>.

Nagorsen, D. W. and R. M. Brigham. 1993. Northern long-eared myotis (*Myotis septentrionalis*) *in* Bats of British Columbia: Royal British Columbia Museum Handbook. University of British Columbia Press: Vancouver, British Columbia. 165 pp.

National Research Council (NRC). 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press. Washington, D.C. www.nap.edu

National Audubon Society (NAS) 2011. Important Bird Areas in the U.S. Available at http://www.audubon.org/bird/iba. Accessed 09 July 2011.

National Land Cover Database (NLCD). 2001. Landuse/Landcover NLCD 2001. USGS Headquarters, USGS National Center. Reston, Virginia.

National Wind Coordinating Committee (NWCC) 2004, 2006. Available online at: http://www.nationalwind.org/publications/default.htm

NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed July 7, 2011.

Nicholson, C.P., J. R.D. Tankersley, J.K. Fiedler, and N.S. Nicholas. 2005. Assessment and Prediction of Bird and Bat Mortality at Wind Energy Facilities in the Southeastern United States. Final Report. Tennessee Valley Authority, Knoxville, Tennessee.

North East Ecological Services. 2006. An Overview of the Current State of Knowledge of Bats with Specific Reference to the Potential Impacts of Wind Power Highland New Wind Project Highland County, Virginia. 25 p.

Nowak, R. 1994. Walker's Bats of the World. Johns Hopkins University Press, Baltimore, Maryland.

Orloff, S. and A. Flannery. 1992. Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas, 1989-1991. Final Report. P700-92-001. Prepared for Planning Department of Alameda, Contra Costa and Solano Counties and the California Energy Commission, Sacramento, CA, by BioSystems Analysis, Inc., Tiburon, California. March 1992.

Orloff, S. and A. Flannery. 1996. A Continued Examination of Avian Mortality in the Altamont Pass Wind Resource Area. Consultant Report. P700-96-004CN. Prepared for California Energy Commission, Sacramento, CA, by BioSystems Analysis, Inc., Tiburon, California. August 1996.

Owen, S.F., M.A. Menzel, W.M. Ford, B.R. Chapman, K.V. Miller, J.W. Edwards, and P.B. Wood. 2003. Home-range size and habitat use by the northern long-eared myotis (*Myotis septentrionalis*). The American Midland Naturalist 150:352-359.

Pearson, E.W. 1962. Bats Hibernating in Silica Mines in Southern Lllinois. Journal of Mammalogy 43: 27-33.

Peterson, C.A., R.A. Lambert. 2006. Biogeographical Dissimilarities of Wind Power Project Sites within the Potomac Highlands of West Virginia with Respect to Migratory Hibernating Bats. Monterey, VA. April 2006.

Peurach, S.C. 2003. High-Altitude Collision between an Airplane and a Hoary Bat, *Lasiurus cinereus*. Bat Research News 44(1):2-3.

Piorkowski, M.D. and O'Connell, T.J. 2010. Spatial pattern of summer bat mortality from collisions with wind turbines in mixed-grass prairie. The American Midland Naturalist 164:260-269.

Potesta and Associates, Inc. 2010. Wetland and Stream Investigation and Delineation Beech Ridge Wind Expansion Project Greenbrier County, West Virginia. Prepared for Invenergy LLC, St. Albans, West Virginia. Prepared by Potesta & Associates, Inc., Charleston, West Virginia.

Ratcliffe, J., and J. Dawson. 2003. Behavioural Flexibility: The Little Brown Bat, *Myotis lucifugus*, and the Northern Long-Eared Bat, *M. septentrionalis*, Both Glean and Hawk Prey. Animal Behaviour 66: 847-856.

Reid, F. 2006. Peterson Field Guide to Mammals of North America: Fourth Edition. Houghton Mifflin Harcourt. New York.

Schirmacher, M. R., 2006. Survey of Bat Communities at Three National Park Areas in the Central Appalachians of West Virginia. M.S. Thesis, University of Georgia, Athens, Georgia.

Schmidly, D. 1991. The Bats of Texas. Texas A&M University Press, College Station, Texas.

Schwartz, A. 1954. A Second Record of *Myotis subulatus leibii* in North Carolina. Journal of the Elisha Mitchell Science Society 70: 222.

Smallwood, K.S., L. Rugge, S. Hoover, M.L. Morrison and C.G. Thelander. 2001. Intra- and Inter-Turbine String Comparison of Fatalities to Animal Burrow Densities at Altamont Pass. *In*: Schwartz S.S. ed, Proceedings of the National Avian-Wind Power Planning Meeting IV. RESOLVE, Inc. Washington D.C. Pp. 23-37.

Stantec Consulting Services (Stantec). 2011. Bird Mortality Event at Laurel Mountain Substation. Letter to Laura Hill, U.S. Fish and Wildlife Service, West Virginia Field Office, October 25, 2011.

Stihler, C.W. 1995. A Radio Telemetry Study of Female Virginia Big-Eared Bats (*Corynorhinus* (=*Plecotus*) *townsendii virginianus*) at a Maternity Colony in Cave Mountain Cave, Pendleton County, West Virginia, June-July 1994. West Virginia Division of Natural Resources Nongame Wildlife and Natural Heritage Program.

Stihler, C. W., and V. Brack, Jr. 1992. A survey of Hibernating Bats in Hellhole Cave, Pendleton County, WV. Proceedings of the West Virginia Academy of Science, 64:97-103.

Stihler, C. 2003. Shedding light on West Virginia's cave-dwelling bats. West Virginia Wild Magazinehttp://www.wvdnr.gov/wildlife/magazine/Archive/03Summer/shedding_Light.shtm.

Stone, R.C. 1981. Endangered and Threatened Species Program: Survey of Winter Bat Populations in Search of the Indiana Bat in the Western Upper Peninsula of Michigan. Michigan Department of Natural Resources.

Thelander, C.G. and K.S. Smallwood. 2007. The Altamont Pass Wind Resource Area's effects on birds: A case history. In Birds and Windfarms: Risk assessment and mitigation, M.J. de Lucas, G.F.E. Janss and M. Ferrer eds. Quercus, Madrid, Spain.

Thelander, C.G., K.S. Smallwood and L. Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Wind Resource Area. Report by BioResource Consultants to the National Renewable Energy Laboratory, Golden, Colorado.

Thompson, F.R., III, ed. 2006. Conservation Assessments for Five Forest Bat Species in the Eastern United States. General Technical Report Nc-260. North Central Research Station, U.S. Forest Service, St. Paul, Minnesota. 82 pp.

Timpone, J.C., J.G. Boyles, K.L. Murray, D.P. Aubrey and L.W. Robbins. 2010. Overlap in Roosting Habits of Indiana Bats (*Myotis sodalis*) and Northern Bats (*Myotis septentrionalis*). Am. Midl. Nat. 163:115–123.

U.S. Fish and Wildlife Service (USFWS). 1982. Gray Bat Recovery Plan. Prepared by the U.S. Fish and Wildlife Service in cooperation with the Gray Bat Recovery Team. Atlanta, Georgia. 91 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. Gray Bat (Myotis grisescens); 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Midwest Region, Columbia, Missouri Ecological Services Field Office, Columbia, Missouri. 34pp. Online version available at <http://ecos.fws.gov/docs/five_year_review/doc2625.pdf>

U.S. Fish and Wildlife Service (USFWS). 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 258 pp.

U.S. Fish and Wildlife Service (USFWS). 2008a. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. Online version available at <http://www.fws.gov/migratorybirds/>

U.S. Fish and Wildlife Service (USFWS). 2008b. Virginia Big-eared bat; 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service West Virginia field Office, Beech Ridge Expansion, West Virginia. 10pp. Online version available at < http://ecos.fws.gov/docs/five_year_review/doc1963.pdf>

U.S. Fish and Wildlife Service (USFWS). 2009. Gray Bat (*Myotis grisescens*); 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Midwest Region, Columbia, Missouri Ecological Services Field Office, Columbia, Missouri. 34pp. Online version available at http://ecos.fws.gov/docs/five_year_review/doc2625.pdf

U.S. Fish and Wildlife Service (USFWS). 2011. Endangered and Threatened Wildlife and

Plants; 90-Day Finding on a Petition To List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Threatened or Endangered. U.S. Fish and Wildlife Service Northeast Region, State College, Pennsylvania Ecological Services Field Office, State College, Pennsylvania. 12pp. Online version available at http://www.regulations.gov/#!documentDetail;D=FWS-R5-ES-2011-0024-0001.

US Fish and Wildlife Service (USFWS). 2011a. Review finds endangered species protection may be warranted for two bat species. Accessed on August 3, 2011 at: http://www.fws.gov/northeast/newsroom/wvnfsq.html.

US Geological Survey (USGS). 2001. North American BBS Methodology Training. Accessed 2010. USGS Breeding Bird Surveys (BBS), Patuxent Wildlife Research Center. Laurel, Maryland. Methodology Training available online at: http://www.pwrc.usgs.gov/BBS/participate/training/; Description and Methods available online at: http://www.pwrc.usgs.gov/BBS/participate/training/1.html

U.S. Geological Survey (USGS). 2006. Status of Listed Species and Recovery Plan Development; Virginia Big-eared Bat (*Plecotus townsendii virginianus)*: Endangered, West Virginia. Northern Prairie Wildlife Research Center Online. Accessed October 28, 2010. http://www.npwrc.usgs.gov/resource/wildlife/recoprog/states/species/plectowv.htm

U.S. Geological Survey (USGS). 2011. White-Nose Syndrome Threatens the Survival of hibernating Bats in North America Northern Prairie Wildlife Research Center Online. Accessed July 8, 2011. http://www.fort.usgs.gov/wns/.

van Zyll de Jong, C.G. 1985. Handbook of Canadian Mammals: Bats. National Museums of Canada, Ottawa, Ontario.

Waldien, D. L., Hayes, J. P., and E. B. Arnett. 2000. Day-roosts of female long-eared *Myotis* in western Oregon. Journal of Wildlife Management 64: 785-796.

West Virginia Department of Natural Resources. n.d. Rare, Threatened and Endangered Species. West Virginia Department of Natural Resources, South Charleston, West Virginia. Accessed April 2011. Available online at: http://www.wvdnr.gov/wildlife/RETSpecies.asp.

West Virginia Natural Heritage Program. 2007. Rare, Threatened and Endangered Animals. Wildlife Resources, West Virginia Department of Natural Resources, South Charleston, West Virginia. February 2007. Accessed January 12, 2011. Available online at: http://www.wvdnr.gov/Wildlife/documents/Animals2007.pdf

Whitaker, J. O. and R. E. Mumford. 2009. *Myotis septentrionalis*/northern myotis *in* Mammals of Indiana. Indiana University Press: Bloomington, Indiana. 660pp.

Whitaker, J.O., and F.A. Winter. 1977. Bats of the Caves and Mines of the Shawnee National Forest, Southern Illinois. Transactions of the Illinois Academy of Science 70: 301-313.

Yates, M. D. and R. M. Muzika. 2006. Effect of forest structure and fragmentation on site occupancy of bat species in Missouri Ozark forests. Journal of Wildlife Management 70(5): 1238-1248.

Young, D.P Jr., and J. Gruver. 2011. Bat Mist Netting and Acoustic Surveys Beech Ridge Wind Energy Project, Greenbrier and Nicholas Counties, West Virginia. Technical report Prepared for: Beech Ridge Energy, LLC. 34 pp. Prepared By: Western EcoSystems Inc., Cheyenne, Wyoming.

Young, D.P Jr. 2011. Baseline Avian Use Surveys Beech Ridge Expansion Wind Energy Project, Greenbrier and Nicholas Counties, West Virginia. Technical report Prepared for: Beech Ridge Energy, LLC. 34 pp. Prepared By: Western EcoSystems Inc., Cheyenne, Wyoming.

Young, D.P Jr., and W.P. Erickson. 2006. Wildlife Issue Solutions: What have Marine Radar Surveys Taught Us about Avian Risk Assessment? Paper presented to Wildlife Workgroup Research Meeting VI, NWCC, November 14-16, 2006, San Antonio, Texas.

Young, D.P. Jr., D. Strickland, W. P. Erickson, K. J. Bay, R. Canterbury, T. Mabee, B. Cooper, and J. Plissner. 2004. Baseline Avian Studies Mount Storm Wind Power Project, Grant County, West Virginia, May 2003 - March 2004. Technical report Prepared for: NedPower Mount Storm, LLC. 141 pp.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2009a. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: March - June 2009. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. August 17, 2009.

Young, D.P. Jr., W.P. Erickson, K. Bay, S. Nomani, and W. Tidhar. 2009b. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring, July - October 2008. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 17, 2009.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2010a. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2009. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 12, 2010.

Young, D.P. Jr., K. Bay, S. Nomani, and W.L. Tidhar. 2010b. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: April - July 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 27, 2010.

Young, D.P. Jr., S. Nomani, W. Tidhar, and K. Bay. 2011a. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 10, 2011.

Young, D.P. Jr., S. Nomani, Z. Courage, and K. Bay. 2011b. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: April - July 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. August 29, 2011.

APPENDIX A

SITE VISIT: FIELD NOTES AND PHOTOS; MARCH 12, 2011

Wildlife observed during the site visit; March 12, 2011

Birds	
American crow	*Corvus brachyrhynchos*
European starling	*Sturnus vulgaris*
Barred owl	*Strix varia*
Mourning dove	*Zenaida macroura*
Cooper's hawk	*Accipiter cooperii*
Black vulture	*Coragyps atratus*
Turkey vulture	*Cathartes aura*
Red-tail hawk	*Buteo jamaicensis*
Red-shouldered hawk	*Buteo lineatus*
Mammals	
Eastern cottontail rabbit (tracks)	*Sylvilagus transitionalis*
American black bear (tracks)	*Ursus Americanus*
White-tailed deer	*Odocoileus virginianus*
Raccoon (pellets)	*Procyon lotor*
Porcupine (pellets)	*Erethizon dorsatum*

Photos A: Rolling topography with mosaic of deciduous forest and open areas.

Photos B: Large tracts of deciduous forest

Photos C: Clear-cut areas

Photos D: Drainage areas

Photos E: Rocky Outcrops

APPENDIX B

AVIAN MIGRATION OBSERVATORIES[3] DATA

[3] Within 100 miles of the Beech Ridge Wind Energy Project

Allegheny Front Migration Observatory, Grant County, West Virginia; Flyover Results 2007 and 2006 (in parentheses).

Wood Duck 1 (0)	Red-tailed Hawk 26 (6)	Tree Swallow 1373 (138)
Double-creasted Cormorant 6 (2)	Golden Eagle 3 (2)	Cliff Swallow 17 (0)
Great Blue Heron 4 (1)	American Kestrel 13 (21)	Barn Swallow 635 (58)
Black Vulture 13 (4)	Merlin 11 (19)	Red-breasted Nuthatch 338 (8)
Turkey Vulture 10 (11)	Peregrine Falcon 2 (1)	Eastern Bluebird 4 (0)
Osprey 23 (17)	Common Nighthawk 38 (16)	American Robin 176 (252)
Bald Eagle 15 (5)	Chimney Swift 17 (14)	Cedar Waxwing 1613 (1242)
Northern Harrier 20 (4)	Red-headed Woodpecker 1 (1)	Scarlet Tanager 27 (16)
Sharp-shinned Hawk 100 (47)	Yellow-bellied Sapsucker 2 (1)	Rose-breasted Grosbeak 86 (261)
Cooper's Hawk 18 (6)	Northern Flicker 95 (264)	Purple Finch 128 (8)
Red-shouldered Hawk 3 (3)	Eastern Phoebe 2 (5)	Pine Siskin 8 (0)
Broad-winged Hawk 1195 (864)	American Crow 185 (2)	Dragonflies 125 (60)

Allegheny Front Migration Observatory, Grant County, West Virginia; Banding Results 1958-2007.

ALLEGHENY FRONT MIGRATION OBSERVATORY CUMULATIVE TOTALS
1958-2007

TOTAL SPECIES 120 (plus 2 hybrids)		TOTAL INDIVIDUALS 220,397			
1	American Green-winged Teal	835	Brown Creeper	27172	Blackpoll Warbler
96	Sharp-shinned Hawk	36	Carolina Wren	27	Cerulean Warbler
3	Cooper's Hawk	9	Bewick's Wren	1349	Black-and-white Warbler
5	American Kestrel	75	House Wren	1622	American Redstart
8	Merlin	571	Winter Wren	218	Worm-eating Warbler
35	American Woodcock	6430	Golden-crowned Kinglet	4201	Ovenbird
16	Black-billed Cuckoo	3920	Ruby-crowned Kinglet	123	Northern Waterthrush
12	Yellow-billed Cuckoo	108	Blue-gray Gnatcatcher	24	Louisiana Waterthrush
9	Eastern Screech-Owl	428	Veery	19	Kentucky Warbler
83	Northern Saw-whet Owl	675	Gray-cheeked Thrush	367	Connecticut Warbler
19	Whip-poor-will	13641	Swainson's Thrush	29	Mourning Warbler
32	Ruby-throated Hummingbird	1255	Hermit Thrush	5592	Common Yellowthroat
6	Red-headed Woodpecker	1315	Wood Thrush	418	Hooded Warbler
5	Red-bellied Woodpecker	887	American Robin	1171	Wilson's Warbler
181	Yellow-bellied Sapsucker	1	Varied Thrush	588	Canada Warbler
219	Downy Woodpecker	767	Gray Catbird	3	Yellow-breasted Chat
25	Hairy Woodpecker	145	Brown Thrasher	648	Scarlet Tanager
60	Northern Flicker	17	European Starling	963	Eastern Towhee
2	Olive-sided Flycatcher	1	American Pipit	87	Chipping Sparrow
163	Eastern Wood Pewee	388	Cedar Waxwing	320	Field Sparrow
154	Yellow-bellied Flycatcher	43	Blue-winged Warbler	46	Vesper Sparrow
32	Acadian Flycatcher	54	Golden-winged Warbler	190	Savannah Sparrow
51	Traill's Flycatcher	4	Brewster's Warbler	2	Henslow's Sparrow
145	Least Flycatcher	1	Lawrence's Warbler	98	Fox Sparrow
2	Empidonax (sp?)	23371	Tennessee Warbler	574	Song Sparrow
47	Eastern Phoebe	42	Orange-crowned Warbler	369	Lincoln's Sparrow
2	Great Crested Flycatcher	2553	Nashville Warbler	529	Swamp Sparrow
1	Eastern Kingbird	235	Northern Parula	1616	White-throated Sparrow
19	White-eyed Vireo	18	Yellow Warbler	217	White-crowned Sparrow
554	Blue-headed Vireo	1935	Chestnut-sided Warbler	6701	Dark-eyed Junco
56	Yellow-throated Vireo	9466	Magnolia Warbler	11	Northern Cardinal
7	Warbling Vireo	16066	Cape May Warbler	1667	Rose-breasted Grosbeak
745	Philadelphia Vireo	29253	Black-throated Blue Warbler	140	Indigo Bunting
2445	Red-eyed Vireo	1018	Yellow-rumped Warbler (Myrtl	7	Rusty Blackbird
4171	Blue Jay	16861	Black-throated Green Warbler	1	Common Grackle
1	American Crow	9322	Blackburnian Warbler	9	Brown-headed Cowbird
1039	Black-capped Chickadee	2	Yellow-throated Warbler	30	Baltimore Oriole
7	Carolina Chickadee	34	Pine Warbler	319	Purple Finch
222	Tufted Titmouse	41	Prairie Warbler	1	Red Crossbill
881	Red-breasted Nuthatch	292	Palm Warbler	61	Pine Siskin
153	White-breasted Nuthatch	7707	Bay-breasted Warbler	1332	American Goldfinch

Hanging Rock Raptor Observatory Flyover Results 1974 to 2009; Monroe County, West Virginia.

Survey Year	Osprey	Bald Eagle	Golden Eagle	Northern harrier	Sharp-shinned hawk	Cooper's hawk	Red-shouldered hawk	Broad-winged hawk	Red-tailed hawk	American Kestrel	Merlin	Peregrine
2009	39	71	28	9	304	71	14	1,875	243	44	3	15
2008	25	36	5	15	195	30	4	2,215	50	54	0	4
2007	36	43	17	14	316	91	8	1,735	364	39	3	2
2006	40	56	7	10	312	59	6	2,737	93	67	4	2
2005	77	33	14	8	265	70	8	1,442	166	60	1	1
2004	61	46	8	16	252	73	5	2,678	132	40	3	3
2003	58	20	3	13	422	120	8	2,248	154	75	6	12
2002	37	20	4	8	197	56	7	3,697	166	40	1	4
2001	70	31	12	12	158	91	18	1,551	115	64	11	7
2000	59	37	27	17	414	127	12	4,261	214	93	6	10
1999	38	20	15	11	288	70	4	2,701	202	80	3	6
1998	41	8	2	13	307	60	5	2,882	43	63	8	0
1997	35	18	11	19	339	119	7	2,763	244	73	5	0
1996	86	25	8	4	258	105	0	3,256	76	32	5	5
1995	29	14	8	10	274	41	4	4,428	58	32	0	0
1994	24	8	5	6	261	39	4	1,974	43	58	0	0
1993	25	9	0	7	391	70	8	5,008	46	54	3	2
1992	27	6	9	8	252	76	2	1,865	50	51	2	0
1991	45	7	2	9	548	85	5	3,735	248	94	1	3
1990	43	2	1	8	312	77	4	3,030	36	75	2	0
1989	21	2	1	4	78	28	2	1,220	12	33	0	2
1988	29	2	6	8	153	27	4	3,153	102	37	0	1
1987	28	2	1	10	417	230	2	4,730	22	65	0	0
1986	31	0	0	6	218	62	2	5,993	2	50	1	0
1985	6	1	2	1	39	13	0	985	22	8	0	0
1984	9	0	0	6	86	3	2	1,222	4	23	0	0
1983	10	0	2	5	72	8	4	2,444	3	19	0	0
1982	18	2	0	0	100	16	2	3,518	22	38	0	0
1981	29	1	0	3	167	11	0	7,106	7	40	0	0
1980	16	1	0	5	88	10	0	5,666	9	9	0	0
1979	10	0	0	2	65	11	0	4,181	11	23	0	0
1978	14	0	0	5	87	10	0	4,761	2	35	0	0
1977	13	0	0	7	257	40	3	5,186	10	17	0	0
1976	24	0	0	5	100	19	4	6,220	15	37	0	0
1974	17	1	0	3	8	17	6	10,501	11	8	0	0
Total Ind. 1974 to 2009	**1,170**	**522**	**198**	**287**	**8,000**	**2,035**	**164**	**122,967**	**2,997**	**1,630**	**68**	**79**