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IN REPLY REFER TO:

BIOLOGICAL OPINION

FOR THE

Habitat Conservation Planning Assistance Grant to the Iowa Department of Natural Resources

FY 2015 Cooperative Endangered Species conservation Fund Grant Program

U.S. Fish and Wildlife Service
Rock Island Illinois Ecological Services Field Office
1511 47th Avenue
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Biological Opinion

Summary

This document transmits the biological opinion of the Fish and Wildlife Service (Service) prepared under the authority of and in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). This opinion is based on information provided in the July, 2015 Biological Evaluation prepared by the MidAmerican Energy Company (MEC), the Proposal to Conduct Baseline Studies to Support the Development of a Multi-Species Habitat Conservation Plan (Grant Proposal) submitted to the Service by the state of Iowa Department of Natural Resources (IADNR), and other supporting documents, literature, and data sources, as cited herein.

This biological opinion evaluates the actions associated with grant monies to be released to the IADNR under the Habitat Conservation Planning Assistance Grant program (covered activities or proposed action, hereafter). It evaluates the potential direct and indirect effects to the Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*, NLEB) that may occur as a result of implementing the grant and non-federal cost-share funds and the interrelated and/or interdependent activities associated with this grant. The purpose of formal section 7 consultation is to ensure that any action authorized, funded, or carried out by the Federal government is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat of the species.

The Service has determined in this opinion that these activities will not jeopardize the continued existence of the Indiana bat or the NLEB but may result in incidental take of these species. The western prairie fringed orchid (*Platanthera praeclara*), eastern prairie fringed orchid (*Platanthera leucophea*), prairie bush clover (*Lespedeza leptostachya*) and Mead's Milkweed (*Asclepias meadii*), are also listed as federally threatened for the project area, respectively, but this action is not expected to affect these species.

Consultation History

The section 6 grant review and approval process is as follows. Project proposals are developed by the States in coordination with the Service's field offices. Field offices review proposals to evaluate the merits, benefits, and risks. Section 7 review entails ensuring: (1) the proposed activities have been contemplated in a Biological Opinion, (2) the appropriate conservation measures identified within the Biological Opinion have been incorporated into the project design, (3) the effect of the project is commensurate with what was anticipated in the Biological Opinion, (4) the type and amount of take does not exceed the level identified in the Biological Opinion, and (5) the appropriate terms and conditions have been incorporated into the project design. Following completion of the project, States submit reports describing the success of the project and detailing the extent or amount of take that occurred.

1. Description of the Proposed Action

The MEC, in partnership with the IADNR, proposes to develop a multi-species Habitat Conservation Plan (HCP) for operational and planned wind power facilities in the State of Iowa. The State is a leader in wind energy capacity, ranking third in the nation for installed megawatt capacity. MEC constitutes the majority of that capacity. Through the development of the HCP, MEC will be seeking incidental take authorization under Section 10 of the Endangered Species Act for the Indiana bat, NLEB, and bald eagle (*Haliaeetus leucocephalus*). The HCP will also serve to assist MEC in satisfying statutory and regulatory compliance with the IADNR. Furthermore, the development of the HCP will support critical studies and investigations associated with bat distribution, migration (timing and direction) and risk associated with wind energy in the state of Iowa. This information, in turn, can be used to inform other HCP planning efforts throughout the Midwest.

The ESA regulations define the term "action" to mean all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. 50 C.F.R. §402.02. The action being evaluated in this biological opinion is the issuance of federal dollars to the IADNR from the Cooperative Endangered Species Conservation Fund under Section 6 of the Endangered Species Act. Specifically, these dollars are being issued under the Habitat Conservation Planning Assistance Grant Program. The purpose of the activities supported by these grant monies and associated matching funds is to facilitate the development of the HCP for wind energy facilities owned and operated by MEC.

The Section 6 grant application indicates that MEC will provide direct or in-kind contributions to support baseline studies that will meet or exceed 25 percent of the requested matching funds. A key component to the objective of completing an informed HCP is the connection of the distribution and migration studies to actual mortality data, which in turn, informs risk and long-term take estimations. It is our understanding that matching funds provided by MEC will support baseline acoustic surveys, migration studies, the development of a particle tracking model, and annual all-bat mortality monitoring at operational wind facilities.

The Purpose and Need for actions funded by grant and match monies are stated in the grant application as:

> "An absolutely essential component of the development of a successful HCP is the estimation of potential take of covered species. The take estimation drives the HCP because minimization and mitigation measures, as well as analyses of the impacts of the action on the species are contingent upon the extent of the expected take. Northern long-eared bats and Indiana bats have been killed in several states by operational wind turbines, primarily during fall migration, and therefore it can be inferred that some or all of existing and proposed wind facilities developed by MEC may be at risk of taking these species. Risk must be assessed before accurate take estimation can be completed. Furthermore, risk to northern long-eared and Indiana bats depends largely on their position on the landscape relative to wind development and their migration routes between summer habitat and winter hibernacula. Currently, the distribution and migration pathways of these two species in Iowa are utterly unknown. This is essential information that must be collected before MEC can begin to develop a risk analysis. Once this information is gathered MEC intends to complete an HCP."

The following is a list and description of the activities conducted as a part of, or in support of the HCP Planning Assistance Grant and match funds. It should be noted that these activities will be located in all Iowa counties, generally excluding those south of I-80 and east of I-35. This area is excluded because substantial distribution data for both species has been collected for this portion of the state, but very little bat data exist north and west of this area.

A. NLEB and Indiana Bat Distribution Study
    a. Methods:
        i. Identification of potential habitat for NLEBs and Indiana bats in the area of interest using desktop analyses;
        ii. Strategic acoustic sampling of that habitat to determine presence or probable absence and potential capture sites for subsequent migration studies;
    b. Relationship to HCP:
        i. Understanding the distribution of listed bat species and the characteristics of known occupied forested habitat in Iowa will allow for better siting of future wind projects.
        ii. Mapping known populations of listed bat species will allow for mitigation measures that will have a direct benefit to existing populations of these species.

B. Pilot Migration Study
    a. Methods:
        i. Capturing and tagging of NLEBs in their summer habitat in multiple locations across the state;
        ii. Recording of the timing and trajectory of their fall migration through a network of receiving towers;
        iii. Analyses of the transmitter signal data collected by receiving towers to identify wind facilities near migration pathways.
    b. Relevance to HCP:
        i. Defining the timing of fall migratory periods will increase the accuracy of conservation measures, such as seasonal cut-in speed increases.
        ii. Trajectory data will help inform a risk analysis for existing projects and provide for more informed siting of future projects.
        iii. Trajectory data will also provide foundation for the next phase of migration monitoring, which is hoped to delineate migration corridors.
        iv. Migration pathway data is also hoped to lead to the discovery of new hibernacula in the State, which can guide conservation measures and mitigation efforts.

C. Particle Tracking Model
    a. Methods:
        i. Development of a particle tracking model to map carcass fall distribution around turbines.
        ii. Application of the model to predetermined wind speed, direction, and blade rotation scenarios.

b. Relevance to HCP:
    i. The particle tracking model will enable accurate correction of existing and future on-the-ground/raw mortality data. Correction of raw carcass data is essential to determining actual mortality of all bat species at a turbine location and evaluating risk. The correction of carcass data is also essential to calculating potential take estimations of listed species
    ii. Carcass fall patterns predicted by the particle tracking model, combined with actual on-the-ground carcass distribution data, will inform optimal search plot size and shape.
    iii. Comparison of predicted fall patterns under certain wind speeds to actual on-the-ground/raw data will provide insight into conditions under which mortality is greatest, thus informing conservation measures to be contemplated in the HCP.

D. Mortality Monitoring
    a. Methods:
        i. In the period between fall, 2015 and winter, 2017, mortality monitoring will occur at each operational wind turbine in the MEC fleet (nearly 2000 turbines).
        ii. Mortality monitoring will be conducted on all roads and pads, and a subset of turbines will also have cleared plots.
        iii. Mortality monitoring will be focused on bat species and eagles, but will also document any bird fatalities encountered.
        iv. Where possible, fatality events will be correlated to wind and weather patterns and turbine operations to understand their influence on fatalities.
    b. Relevance to HCP:
        i. On-the-ground bat mortality data is crucial to the development of accurate risk analyses in the HCP through the quantification of all-bat mortality. Based on current information, all-bat mortality and mortality events of more common species with similar flight biology are indicators of risk to listed species. Therefore, gathering of all-bat mortality data at MEC facilities, combined with distribution and migration studies, is critical in successfully analyzing risk and developing a take estimate for the HCP.
        ii. Because of differences in landscapes, habitats, and juxtaposition of hibernacula and summer habitats, extrapolation of existing mortality data from other facilities in other states may be inaccurate and likely to misrepresent actual risk to listed species on the Iowa landscape. Also, very little mortality data is currently available for Iowa. Therefore, gathering and using site-specific mortality data is the most accurate way to assess risk at MEC facilities.
        iii. Mortality data will provide lines of field evidence to validate the particle tracking model.
        iv. Mortality data can be checked against predictions of the particle tracking model to enhance the understanding of wind conditions associated with mortality events, which in turn, will inform conservation measures.

v. Mortality data analyzed in conjunction with weather and/or turbine operational data will provide insight into environmental risk factors as well as useful conservation measures.

1.2 Interrelated/Interdependent Actions

The term "interrelated actions" is defined as those actions which are part of a larger action, and depend on the larger action for their justification 50 C.F.R. § 402.02. As described in the Section 7 Consultation Handbook (NMFS and USFWS 2008), the analysis of whether activities are interrelated to, or interdependent with, a proposed action under consultation are conducted by applying a "but for" test. In other words, if another activity in question would not occur "but for" the proposed action under consultation, then the activity is interrelated or interdependent and should be analyzed with the effects of the action.

Since submission of the Section 6 grant application in January 2015, MEC, the Service, and IADNR have jointly identified additional baseline monitoring studies that MEC is currently implementing. Specifically, in April 2015, MEC commenced a comprehensive bat monitoring program at its wind energy facilities to gather additional baseline data to support this conservation planning effort. Field study plans have been developed in collaboration with the Service and the IADNR to ensure data are sufficient to inform the conservation planning process. MEC's bat monitoring program includes acoustic surveys, bat mist netting, and migration tracking near existing facilities. The cost of these studies is substantial.

Ongoing monitoring studies conducted by MEC, along with scientific research and operational modifications to the projects within the action area, are integral to the overall conservation planning process described in the Section 6 grant application. These activities have been developed through a series of meetings between MEC, the Service, and IADNR. MEC's conservation program will be conducted in coordination with other activities noted in the grant application. MEC's monitoring and adaptive management strategy was developed in consultation with the Service and the IADNR to facilitate actions contemplated in the Section 6 grant application. As such, the proposed actions are interrelated to, or interdependent with the overall implementation of the Section 6 grant.

1.3 Action Area

Since 2004, MEC has installed more than 3,300 MW of existing wind generation capacity in Iowa, and has planned to construct an additional 705 MW in the foreseeable future. Table 1 lists each of the facilities, their locations, and sizes.

Table 1. MEC Wind Energy Facility Specifications

Facility Name	County	Project Area (Sq. Miles)	Total Project Acres	Number of Turbines	Turbine Size (MW)	Total Project MW
Existing Facilities						
Adair	Adair/Cass	26	16,640	76	2.3	174.8
Carroll	Carroll	25	16,000	100	1.5	150
Century	Hamilton/Wright	28	17,920	145	1.5/1	200
Charles City	Floyd	18	11,520	50	1.5	75
Eclipse	Guthrie/Audubon	31	19,840	87	2.3	200.1
Highland	O'Brien	92	58,880	217	2.3	502
Intrepid	Sac/Buena Vista	43	27,520	122	1.5/1	175.5
Laurel	Marshall	16	10,240	52	2.3	119.6
Lundgren	Webster	52	33,280	107	2.3	251
Macksburg	Madison	22	14,080	48	2.3	112.6
Morning Light	Adair	13	8,320	44	2.3	101.2
Pomeroy	Pocahontas	33	21,120	184	1.5/2.3	286.4
Rolling Hills	Cass/Adair/Adams	69	44,160	193	2.3	443.9
Victory	Crawford/Carroll	28	17,920	66	1.5	99
Vienna	Marshall/Tama	15	9,600	45	2.3	105.6
Vienna II	Marshall	11	7,040	19	2.3	44.6
Walnut	Pottawattamie	32	20,480	102	1.5	153
Wellsburg	Grundy	36	23,040	60	2.3	140.8
Planned Facilities						
Adams	Adams County	16	10,126	64	2.3/2.4	154.3
TBD	Ida County	184	117800	134	1.8/2.3	301
TBD	O'Brien County	94	60,454	104	2.3/2.4	250.3

The action area consists of all of the above wind facility projects, which include the turbines, lands of participating landowners, as well as associated onsite infrastructure. The action area also includes bat survey locations (exact locations to be determined) across the state of Iowa. There will be several survey sites in each county in Iowa, excluding those counties both entirely south of Interstate 80 and entirely east of Interstate 35. These counties were excluded because numerous mist-net and acoustic surveys have been conducted in these counties over the past few decades (prompted by the potential presence of the Indiana bat). Also, there are no operational wind farms currently in this part of the state.

2. Status of the Species

This section presents biological or ecological information relevant to formulating this Biological Opinion. Appropriate information on species' life history, habitat and distribution, and other data on factors necessary to survival are included to provide background for analysis in later sections. This analysis documents the effects of past human and natural activities or events that have led to the current range-wide status of the species. Portions of this information are also presented in listing documents, the recovery plan (USFWS 1983), and the draft revised recovery plans (USFWS 1999 and USFWS 2007), and are referenced accordingly.

2.1 Species Description

Indiana bat

The Indiana bat is an insectivorous, temperate, medium-sized bat that migrates annually from winter hibernacula to summer habitat in forested areas. The bat has a head and body length that ranges from 41 to 49 mm, with a forearm length of 35 to 41 mm. The fur is described as dull pinkish-brown on the back but somewhat lighter on the chest and belly, and the ears and wing membranes do not contrast with the fur (Barbour and Davis 1969). Although the bat resembles the little brown bat and the NLEB, it is distinguished by its distinctly keeled calcar and a long, pointed, symmetrical tragus.

NLEB

The NLEB is a medium-sized bat with an average adult weight of 5 to 8 grams, average body length from 77 to 95 millimeters, and forearm length between 34 and 38 millimeters (Caceres and Pybus 1997). Its fur ranges from medium to dark brown on the dorsal side, and tawny to pale-brown on the ventral side, with dark brown ears and wing membranes. As indicated by its common name, the NLEB is distinguished from other Myotis species by its relatively long ears (average 17 mm (0.7 in)) (Whitaker and Mumford 2009) that, when laid forward, extend beyond the nose up to 5 mm (0.2 in) (Caceres and Barclay 2000). Within its range, the NLEB is sometimes confused with the little brown bat (*Myotis lucifugus*) or the western long-eared myotis (*Myotis evotis*). The NLEB is distinguished from the little brown bat by its longer ears, tapered and symmetrical tragus, slightly longer tail, and less glossy pelage (Caceres and Barclay 2000), and from the western long-eared myotis by its darker pelage and paler membranes (Caceres and Barclay 2000).

2.2 Diet and Foraging

Indiana Bat

Indiana bats forage over a variety of habitat types but prefer to forage in and around the tree canopy of both upland and bottomland forest or along the corridors of small streams. Bats forage at a height of approximately 2-30 meters under riparian and floodplain trees (Humphrey et al. 1977). They forage between dusk and dawn and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects. Females in Illinois were found to forage most frequently in areas with canopy cover of greater than 80%, and typically utilize larger foraging ranges than males (Garner and Gardner 1992).

NLEB

The NLEB forages on a variety of insect types and does so primarily above the understory, but under the canopy in forested habitats (Nagorsen and Brigham 1993). It is capable of both capturing prey in midair and gleaning perched insects from surfaces. This gleaning ability, combined with agile flight capabilities, enables the NLEB to forage in dense forests with heavy understory (Foster and Kurta 1999). The NLEB has shown a preference for forested hillsides

and ridges over riparian areas (Brack and Whitaker 2001; LaVal et al. 1977) and other data indicates that mature forests are important foraging habitat for the NLEB (Caceres and Pybus 1997). It is estimated that the NLEB has a home range of 47 to 425 acres (Lacki et al 2009), with an average maternal home range of approximately 160 acres (Owen et al. 2003).

In general, the NLEB consumes moths, flies, leafhoppers, caddisflies, and beetles. However, the most common insects found in the diet of the NLEB are moths and beetles (Feldhammer et al. 2009; Brack and Whitaker 2001). The NLEB's foraging patterns include a peak activity period within five hours of sunset, and a second peak within eight hours of sunset (Kunz 1973). Insects consumed during these periods do not seem to be significantly different (Brack and Whitaker 2001).

2.3 Summer Habitat and Home Range

Indiana Bat

Female Indiana bats emerge from hibernation ahead of males; most winter populations leave by early May. Some males spend the summer near hibernacula in Missouri (LaVal and LaVal 1980) and West Virginia (Stihler, pers. observ. October 1996, in USFWS 2000). In spring when fat reserves and food supplies are low, migration is probably hazardous (Tuttle and Stevenson 1977). Consequently, mortality may be higher in the early spring, immediately following emergence.

Females may arrive in their summer habitats as early as April 15 in Illinois (Gardner et al. 1991, Brack 1979). During this early spring period, a number of roosts (e.g., small cavities) may be used temporarily, until a roost with larger numbers of bats is established. Humphrey et al. (1977) reported that Indiana bats first arrived at their maternity roost in early May in Indiana, with substantial numbers arriving in mid-May. Birth of young occurs in late June and early July (Easterla and Watkins 1969, Humphrey et al. 1977) and the young are able to fly between mid-July and early August (Mumford and Cope 1958, Cope et al. 1974, Humphrey et al. 1977, Clark et al. 1987, Gardner et al. 1991a, Kurta et al. 1996). Female Indiana bats exhibit strong site fidelity to summer roosting and foraging areas. That is, they return to the same summer range annually to bear their young (Garner and Gardner 1992).

In general, Indiana bats roost in large, often dead or partially dead trees with exfoliating bark and/or cavities and crevices (Callahan et al. 1997; Farmer et al. 2002; Kurta et al. 2002). Trees in excess of 16 inch diameter at breast height (dbh) with exfoliating bark are considered optimal for maternity colony roost sites, but trees in excess of 9 inch dbh appear to provide suitable maternity roosting habitat (Romme et al. 1995). Indiana bat maternity roosts can be described as primary or alternate based upon the proportion of bats in a colony consistently occupying the roost site. Maternity colonies typically use 10 to 20 trees each year, but only one to three of these are primary roosts used by the majority of bats for some or all of the summer (Garner and Gardner 1992). Alternate roosts are used by individuals, or a small number of bats, and may be used intermittently throughout the summer or used on only one or a few days. Females frequently switch roosts to find optimal roosting conditions, switching roosts every few days on

average. The reproductive condition of the female, roost type, and time of year affect switching. When switching between day roosts, Indiana bats may travel as little as 23 feet (7 m) or as far as 3.6 miles (5.8 km) (Kurta et al. 1996; Kurta et al. 2002). In general, moves are relatively short and typically less than 0.6 mile (1 km) (USFWS 1997).

The range of maternity colony sizes observed for the Indiana bat is 10-100 adult females (Kurta and Rice 2002), and 60 females is the average of the overall variability in maternity colony size. The home range of a maternity colony is the area within a 2.5-mile radius (i.e., 12,560 acres) around documented roosts or within a 5-mile radius (i.e., 50,265 acres) around capture location of a reproductive female or juvenile Indiana bat or a positive identification of Indiana bat from properly deployed acoustic devices. Based on data provided in the Indiana bat draft revised Recovery Plan (USFWS 2007), a maternity colony needs at least 10% suitable habitat (i.e., forested habitat) to exist at a given point on the landscape.

After the summer maternity period, Indiana bats migrate back to traditional winter hibernacula. Some male bats may begin to arrive at hibernacula as early as July. Females typically arrive later and by September the number of males and females is almost equal. Autumn "swarming" occurs prior to hibernation. During swarming, bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day. By late September many females have entered hibernation, but males may continue swarming well into October in what is believed to be an attempt to breed with late arriving females. Swarming behavior is further described below in Section 2.4

Male Indiana bats may be found throughout the entire range of the species. Males appear to roost singly or in small groups, except during brief summer visits to hibernacula. Males have been observed roosting in trees as small as 3 inches dbh.

NLEB

During the summer, the NLEB occupies forested habitat and roosts (singly or in colonies) in the cracks, crevices, and bark of both live and dead trees (Lacki and Schwierjohann 2001), but they also have been found to roost in human made structures, such as buildings, barns, sheds, cabins, etc. Also, it appears that the NLEB does not depend on any specific species of tree, but rather the tree characteristics and/or tree decay structure are the most important factors in roost selection (Foster and Kurta 1999). The NLEB has been found to roost below the canopy in forests with a variety of canopy cover percentages, but research has indicated that females do tend to roost in more open areas than males (Perry and Thill 2007). Open areas receive greater solar insolation, which increases roost temperature and therefore pup development.

NLEB exhibit site fidelity to their summer forested habitats (Perry 2011; Johnson et al. 2009a; Jackson 2004; Foster and Kurta 1999). Summer home range includes both roosting and foraging areas, and home range size may vary by sex. Broders et al. (2006) found the maternity roosting area and foraging area of females (mean of 8.6 ha (21.3 acres) and 46.2 ha (114.2 acres), respectively) larger than males (mean of 1.4 ha (3.5 acres) and 13.5 ha (33.4 acres)), but Lereculeur (2013) found no difference between sexes at a study site in Tennessee. Broders et al. (2006) and Henderson and Broders (2008) found the foraging areas of either sex were six or

more times larger than roosting areas. At sites in the Red River Gorge area of the Daniel Boone National Forest, Lacki et al. (2009b) found female home range size to range from 19 to 172 ha (47 to 425 acres). Owen et al. (2003) estimated average maternal home range size at 65 ha (161 acres).

The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 602 m (1,975 ft) with a range of 60 to 1,719 m (197 to 5,640 ft) (Sasse and Pekins 1996). Henderson and Broders (2008) found that female NLEB on Prince Edward Island traveled approximately 1,100 m (3,609 ft) between maternity roosting and foraging areas. In New Brunswick, Broders et al. (2006) reported the mean distance between the centers of maternity roosting areas and foraging areas as 584.6 m (1,918.0 ft) for females and 405.8 m (1,331.4 ft) for males.

Roosts trees are often in fairly close proximity to each other. In Missouri, Timpone et al. (2010) radio-tracked 13 NLEB to 39 roosts and found the mean distance traveled between roost trees was 0.67 km (0.42 mi) (range 0.05–3.9 km (0.03–2.4 mi)). In Michigan, the longest distance moved by the same bat between roosts was 2 km (1.2 mi), and the shortest was 6 m (20 ft) (Foster and Kurta 1999). In the Ouachita Mountains of Arkansas, Perry and Thill (2007) found that individuals moved among snags distributed in an area of about 2 ha (5 acres). Johnson et al. (2011) found that NLEB form social groups in networks of roost trees centered on a central-node roost, which may function like a primary maternity roost tree for an Indiana bat colony (i.e., locations for social behavior, thermal buffering), but were identified in this study by the degree of connectivity with other maternity roost trees rather than by the number of individuals using the tree.

Males and females generally roost separately (Caceres and Barclay 2000), and some studies cited above suggest differences in summer home range size between males and females. Despite these differences, males and females may share a large fraction of their foraging habitat within the occupied forested landscape. An analysis of mist net survey data in Kentucky (Service 2014, unpublished data cited in the final listing rule) shows that most males and non-reproductive females are captured in the same locations as reproductively active females (1,712 of 1,825 capture records or 94 percent), suggesting substantial overlap in the summer home range of reproductive females and other individuals.

Maternity colonies, consisting of females and young, are generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3); however, one group of 100 adult females was observed in Vermilion County, Indiana (Whitaker and Mumford 2009, p. 212). In West Virginia, maternity colonies in two studies had a range of 7 to 88 individuals (Owen *et al.* 2002, p. 2) and 11 to 65 individuals, with a mean size of 31 (Menzel *et al.* 2002, p. 110). Lacki and Schwierjohann (2001, p. 485) found that the number of bats within a given roost declined as the summer progressed. Pregnant females formed the largest aggregations (mean=26) and post-lactating females formed the smallest aggregation (mean=4). The largest reported colony size was 65 bats. Other studies have also found that the number of individuals roosting together in a given roost typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, p. 667; Lacki and Schwierjohann 2001, p. 485; Garroway and Broders 2007, p. 962; Perry and Thill 2007, p. 224; Johnson *et al.* 2012, p. 227).

2.4 Migration, Swarming, and Winter Habitat

Migration Routes of Indiana bats and NLEB

A 2011 spring migration study at the Blackball Mine hibernacula in Illinois documented that the majority of tagged Indiana bats emerging from Blackball travelled south and west down the forested Illinois River corridor (Hicks et al. 2011). This suggests that during spring migration Indiana bats may follow watershed drainage corridors enroute to their summer habitats in Illinois. Because Indiana bats and NLEBs share hibernacula and have many overlapping summer habitats in Illinois, it is logical to infer that NLEBs may have similar spring migration patterns. However, no direct spring migration route data from Illinois or Iowa exists for the NLEB, at present.

Fall migration routes or patterns for both species are currently unknown. The recent discovery of four Indiana bat and five NLEB carcasses at various wind facilities in Illinois, Indiana, Iowa, Missouri, and Ohio in the fall demonstrates that some individuals cross open, treeless landscapes during their fall migration. Additionally, a 2014 fall migration telemetry study conducted on a population of Indiana bats and NLEBs living in the Middle Fork of the Vermillion River riparian corridor showed that most tagged individuals did not appear to follow the river corridor when the maternity colonies broke up, but rather headed northeast across the open landscape (Boyles and McGuire, personal communication unpublished report). If other bats from other maternity colonies have the same tendency to cross open landscapes during fall migration, some level of mortality risk during fall migration is likely associated with wind turbines in the region. This risk is difficult to quantify with currently available data. The Service continues to engage with our partners to gather information to inform this risk.

Indiana Bat Swarming and Hibernation

Indiana bats begin leaving their summer range in early August for their hibernacula (Humphrey et al. 1977, Kurta et al. 1993). Some Indiana bats may stay near their summer ranges into early October (Kurta and Rice 2002). Members of a maternity colony may not hibernate in the same cave, and may migrate to caves that are over 190 miles (300 km) apart (Kurta and Murray 2002).

Upon arrival at hibernating caves in August-September, Indiana bats swarm, during which large numbers of bats fly in and out of cave entrances from dusk to dawn, with relatively few roosting in the caves during the day (Cope and Humphrey 1977). Swarming continues for several weeks and mating occurs during the latter part of the period. Fat supplies are replenished as the bats forage prior to hibernation. With the exception of the proximity to the hibernacula, swarming habitat is essentially the same as summer habitat (see description below). During fall swarming, Indiana bats roost in standing dead trees and live hickories (Kiser and Elliot 1996). In Kentucky, Kiser and Elliot (1996) found that Indiana bats foraged in upland communities. They postulated that the temperatures within the stream corridors and riparian vegetation during the autumn were too cool, which could impact the activity and density of insects in riparian areas. Insect abundance and activity may be greater in the uplands where temperatures are generally warmer.

Roost switching is common during swarming (Kiser and Elliot 1996, MacGregor et al. 1999, Gumbert et al. 2002).

Generally, Indiana bats hibernate from October through April (Hall 1962, LaVal and LaVal 1980), depending upon local weather conditions. They hibernate in large, dense clusters, ranging from 300 bats per square foot to 484 bats per square foot (Clawson et al. 1980, Clawson, pers. observ. October 1996 in USFWS 2000). Also, Indiana bats tend to hibernate in caves with large volume and structural diversity that ensures stable internal temperatures, with little likelihood of freezing (Tuttle and Kennedy 2002). These caves or mines typically have two or more entrances that have a chimney effect on air flow. Tuttle and Kennedy (2002) found that populations occupying roosts with midwinter temperatures of 3.0 – 7.2° C increased in number over the past 20 years, but those with temperatures outside of this range decreased in population size. Consistent with these ranges, preliminary data from a study being conducted by Dzurick and Tomasi (2005) suggest that the optimal hibernation temperature is approximately 5°C.

NLEB Swarming and Hibernation

The NLEB is not considered a long-distance migratory species. Researchers have documented short regional migratory movements between seasonal habitats (summer roosts and winter hibernacula) of between 56 km (35 mi) and 89 km (55 mi) (Nagorsen and Brigham 1993; Griffin 1940b; Caire et al. 1979). The spring migration period typically runs from mid-March to mid-May (Caire et al. 1979; Easterla 1968; Whitaker and Mumford 2009); fall migration typically occurs between mid-August and mid-October. The final listing rule for the NLEB identifies the active season for the species between spring and fall migration as approximately April – October. For purposes of this BO, we use April 1 – October 31 as the NLEB active season within the Action Area.

The NLEB occupy their summer habitat from approximately April through August and then begin to swarm near their hibernacula in August or September (Caire et al. 1979), depending on the geographical region. In Indiana, the majority of NLEB's in Copperhead Cave have been observed to enter hibernation during October, and emerge from about the second week of March to mid-April (Whitaker and Mumford 2009). Hibernation periods farther north may begin earlier and last longer (Stones and Fritz 1969; Fitch and Shump 1979). The NLEB has been observed to share hibernacula with other bat species (Whitaker and Mumford 2009), but is rarely observed in concentrations over 100 in a single hibernaculum (Barbour and Davis 1969). NLEB individuals also rouse and may switch hibernacula throughout the winter, which makes it difficult to accurately estimate winter population numbers (Griffin 1940; Whitaker and Rissler 1992b; Caceres and Barclay 2000).

NLEB predominantly overwinter in caves and abandoned mines. These hibernacula have relatively constant, cool temperatures (0 to 9 degrees Celsius (°C) (32 to 48 degrees Fahrenheit (°F))) (Raesly and Gates 1987; Caceres and Pybus 1997; Brack 2007), with high humidity and no air currents (Fitch and Shump 1979; van Zyll de Jong 1985; Raesly and Gates 1987; Caceres and Pybus 1997). The species appears to favor sites with very high humidity, such that droplets of water are often observed on their fur (Hitchcock 1949; Barbour and Davis 1969). NLEB are typically found roosting in small crevices or cracks in cave or mine walls or ceilings, sometimes

with only the nose and ears visible, which reduces the likelihood of detection during surveys (Griffin 1940a; Barbour and Davis 1969; Caire et al. 1979; van Zyll de Jong 1985; Caceres and Pybus 1997; Whitaker and Mumford 2009). Caire et al. (1979) and Whitaker and Mumford (2009) commonly observed individuals exiting caves with mud and clay on their fur, also suggesting that they had roosted in cracks and crevices.

Griffin (1945) found NLEB in December in Massachusetts in a dry well, and commented that these bats may regularly hibernate in "unsuspected retreats" where caves or mines are not available. NLEB have been found hibernating in other types of habitat that resemble caves or mines, including:

- abandoned railroad tunnels (Service 2015, unpublished data cited in final listing rule);
- near the entrance of a storm sewer in central Minnesota (Goehring 1954);
- the facilities of a hydroelectric dam in Michigan (Kurta et al. 1997); and
- the Sudbury Aqueduct (Massachusetts Department of Fish and Game 2012, unpublished data cited in final listing rule).

Related bat species (e.g., big brown bats) are known to regularly use hibernacula besides caves and mines, such as attics and hollow trees (Neubaum et al. 2006; Whitaker and Gummer 1992). To date, however, the NLEB is only known to over-winter in alternative hibernacula that replicate the physical conditions of suitable caves and mines.

2.5 Distribution and Abundance

Indiana Bat

The historical summer range of the Indiana bat is thought to be similar to its modern range. However, in various places throughout its range the bat has been locally extirpated due to fragmentation and loss of summer habitat. The current species range includes much of the eastern half of the United States, from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida.

Based on censuses taken at all hibernacula, the total known Indiana bat population is estimated to number about 534,239 bats (Figure 4). Population trend data have shown a relatively stable population from 2005 to present. However, with the advent of white-nose syndrome (WNS), future population trends are uncertain.

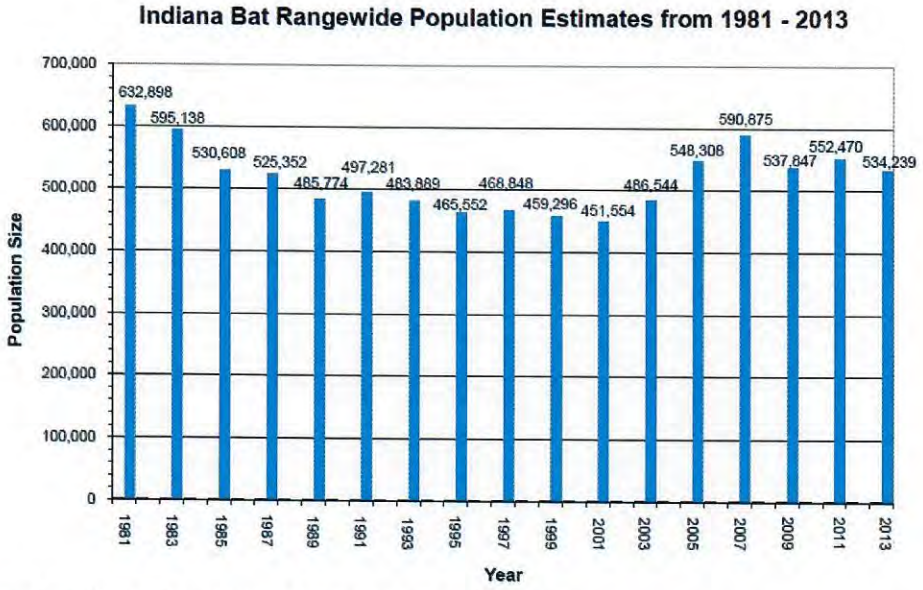

Figure 4. Indiana bat rangewide population estimates from (http://www.fws.gov/midwest/Endangered/mammals/inba/index.html).

NLEB

The NLEB is a wide-ranging North American species that is considered to be present in all Canadian provinces, the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993, and Caceres and Pybus 1997). In the United States, the bat can be found in 39 states (including the District of Columbia) from Maine to Montana, south to Kansas and eastern Oklahoma, and southeast to the Florida panhandle (Whitaker and Hamilton 1998; Caceres and Barclay 2000; Amelon and Burhans 2006).

While the species is wide ranging, it appears to be unevenly distributed, and found in low numbers in both roosts and hibernacula (Amelon and Burhans 2006; Whitaker and Hamilton, 1998). However, populations are generally categorized into the Eastern Population, the Midwest Population, the Southern Population, the Western Population, and the Canada Population, although these will not be considered to be Distinct Population Segments under Endangered Species Act (ESA) (USFWS 2013b). Historically, the species was most frequently observed in the northeastern United States and in the Canadian Provinces of Quebec and Ontario, with sightings increasing during swarming and hibernation periods (Caceres and Barclay 2000). Much of the available data on NLEBs are from winter surveys, although they are typically observed in low numbers due to an apparent preference for inconspicuous roosts (Caceres and Pybus 1997). More than 1,100 NLEB hibernacula have been identified in 29 of 37 states of the species' range in the United States (80 FR 17976), although only a few (1 to 3) individuals were observed in many of these (Whitaker and Hamilton 1998).

Abundance and relative abundance (i.e., numbers of the species as a percentage of the total number of bats in an area) of the species varies substantially across its large range, and has

declined dramatically with the spread of WNS. The final listing rule for the NLEB summarizes the abundance data available for each major region within the range, which we do not repeat here, except to note that data to support a range-wide population estimate for the species are not available at this time. However, the final listing rule at 80 FR 17979 provides a rough population estimate for the states of Illinois, Indiana, Iowa, Ohio, Michigan, and Missouri of about 4 million NLEBs. This estimate is based on: (a) a population estimate for the Indiana bat in these six States derived from hibernacula counts; and (b) the ratio of Indiana bat captures to NLEB captures in summer mist-net surveys. Because these surveys were mostly conducted before the spread of WNS into some of these states, it is likely an overestimate, and the final rule stresses its limitations.

2.6 Status

Indiana Bat

The Indiana bat (*Myotis sodalis*) was listed as an endangered species via notice in the Federal Register on March 11, 1967 (32 Fed. Reg. 48) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U. S. C. 668aa(c)). The reasons for listing the species are summarized in the 2007 Draft Recovery Plan and include destruction/degradation of hibernation habitat, loss/degradation of summer habitat, migration habitat, and swarming habitat, disturbance of hibernating bats, disturbance of summering bats, disease and parasites, predation, and various anthropogenic factors (USFWS 2007).

NLEB

The NLEB was proposed for listing as endangered on October 2, 2013, via a notice in the Federal Register (78 Fed. Reg. 191) and was formally listed as threatened on April 2, 2015. The primary reason for listing is the recent severe and ongoing decline of the species due to white-nose syndrome.

2.7 Threats and Reasons for Decline

Indiana bat

Not all of the causes of Indiana bat population declines have been determined. Although several known human-related factors have caused declines in the past, they may not solely be responsible for recent declines.

Documented causes of Indiana bat population decline include:

Disturbance and vandalism. A serious cause of Indiana bat decline has been human disturbance of hibernating bats during the decades of the 1960s through the 1980s. Bats enter hibernation with only enough fat reserves to last until spring. When a bat is aroused, as much as 68 days of fat supply is used in a single disturbance (Thomas et al. 1990). Human use (e.g., including recreational cavers and researchers) near hibernating Indiana bats can cause arousal (Humphrey 1978, Thomas 1995, Johnson et al. 1998). If this happens too often, the bats' fat reserves may be

exhausted before the species is able to forage in the spring.

Active programs by State and Federal agencies have led to the acquisition and protection of a number of Indiana bat hibernacula. Of 127 caves/mines with populations >100 bats, 54 (43%) are in public ownership or control, and most of the 46 (36%) that are gated or fenced are on public land. Although such conservation efforts have been successful in protecting Indiana bats from human disturbance, they have not been sufficient to reverse the downward trend in many populations.

Improper cave gates and structures. Some hibernacula have been rendered unavailable to Indiana bats by the erection of solid gates in the entrances (Humphrey 1978). Since the 1950's, the exclusion of Indiana bats from caves and changes in air flow are the major cause of loss in Kentucky (an estimated 200,000 bats at three caves) (USFWS 1999). Other cave gates have so modified the climate of hibernacula that Indiana bats were unable to survive the winter because changes in air flow elevated temperatures which caused an increase in metabolic rate and a premature exhaustion of fat reserves (Richter et al. 1993).

Natural hazards. Indiana bats are subject to a number of natural hazards. River flooding in Bat Cave, Mammoth Cave National Park, drowned large numbers of Indiana bats (Hall 1962). Other cases of hibernacula being flooded have been recorded by Hall (1962), DeBlase et al. (1965), and the Service (1999). A case of internal cave flooding occurred when tree slash and debris (produced by forest clearing to convert the land to pasture) were bulldozed into a sinkhole, blocking the cave's rain water outlet and drowning an estimated 150 Indiana bats (USFWS 1999).

Another hazard exists because Indiana bats hibernate in cool portions of caves that tend to be near entrances, or where cold air is trapped. Some bats may freeze to death during severe winters (Humphrey 1978, Richter et al. 1993). Indiana bats are vulnerable to the effects of severe weather when roosting under exfoliating bark during summer. For example, a maternity colony was displaced when strong winds and hail produced by a thunderstorm stripped the bark from their cottonwood roost and the bats were forced to move to another roost (USFWS 1999).

Suspected causes of Indiana bat decline include:

Microclimate effects. Changes in the microclimates of caves and mines may have contributed more to the decline in population levels of the Indiana bat than previously estimated (Tuttle, in lit. August 4, 1998). Entrances and internal passages essential to air flow may become larger, smaller, or close altogether, with concomitant increases or decreases in air flow. Blockage of entry points, even those too small to be recognized, can be extremely important in hibernacula

that require chimney-effect air flow to function. As suggested by Richter et al. (1993) and Tuttle (in lit. August 4, 1998), changes in air flow can elevate temperatures which can cause an increase in metabolic rate and a premature exhaustion of fat reserves.

Land use practices. The Indiana bats' maternity range has changed dramatically since pre-settlement times (Giessman et al. 1986; MacCleery 1992; Nigh et al. 1992). Most of the

forest in the upper Midwest has been fragmented, fire has been suppressed, and native prairies have been converted to agricultural crops or to pasture and hay meadows for livestock. Native plant species have been replaced with exotics in large portions of the maternity range, and plant communities have become less diverse than occurred prior to settlement. Additionally, numerous chemicals are applied to these intensely cropped areas. The changes in the landscape and the use of chemicals (McFarland 1998) may have reduced the availability and abundance of the bats' insect forage base. In the eastern U.S., the area of land covered by forest has been increasing in recent years (MacCleery 1992; Iverson 1994; Crocker et al. 2006). Whether or not this is beneficial to the Indiana bat is unknown. The age, composition, and size class distribution of the woodlands will have a bearing on their suitability as roosting and foraging habitat for the species outside the winter hibernation season.

Chemical contamination.

Pesticides have been implicated in the decline of a number of insectivorous bats in North America (Mohr 1972, Reidinger 1972, Reidinger 1976, Clark and Prouty 1976, Clark et al. 1978, Geluso et al. 1976, Clark 1981). The effects of pesticides on Indiana bats have yet to be studied. McFarland (1998) studied two sympatric species; the little brown bat (*Myotis lucifugus*) and the NLEB (*M. septentrionalis keenii*) as surrogates in northern Missouri and documented depressed levels of acetylcholinesterase, suggesting that bats there may be exposed to sublethal levels of organophosphate and/or carbamate insecticides applied to agricultural crops. McFarland (1998) also demonstrated that bats in northern Missouri are exposed to significant amounts of agricultural chemicals, especially those applied to corn. BHE Environmental, Inc. (1999) collected tissue and guano samples from five species of bats at Fort Leonard Wood, Missouri, and documented the exposure of bats to p,p'-DDE, heptachlor epoxide, and dieldrin.

New Threats/Disease epidemics: WNS:

WNS was first documented in New York in February of 2006 and has since been observed to have spread west to Iowa and Missouri,(www.nwhc.usgs.gov). It is currently unknown if WNS is the primary cause or a secondary indicator of another pathogen, but it has been correlated with erratic behavior such as early or mid-hibernation arousal that leads to emaciation and mortality in several species of bats, including the Indiana bat (www.fws.gov). Additional information on the effects of WNS is presented below.

NLEB

The NLEB has been listed as threatened based on the severity of population impacts that have been realized in areas with WNS, and the expected population impacts that will likely occur with the spread of the disease in the future. There are other reasons for decline that are discussed in the listing package, but none as serious as WNS (USFWS 2015).

White-nose syndrome

WNS is an emerging infectious wildlife disease caused by a fungus of European origin, *Pseudogymnoascus destructans*, which poses a considerable threat to hibernating bat species throughout North America, including the NLEB (Service 2011). WNS is responsible for unprecedented mortality of insectivorous bats in eastern North America (Blehert et al. 2009; Turner et al. 2011). The first evidence of the disease (a photo of bats with fungus) was documented near Albany, New York, on February 16, 2006, but WNS was not actually discovered until January 2007, when it was found at four additional caves in the same vicinity (Blehert et al. 2009). Since that time, WNS has spread rapidly throughout the eastern portions of the NLEB range in the U.S. and Canada. As of February 2015, WNS was confirmed in 25 of the 37 U.S. States within the species' range and in 5 Canadian provinces (80 FR 18000). Spores of the fungus disperse to new locations primarily through bat-to-bat contact (Kunz and Reichard 2010); however, evidence suggests that humans may also transport spores between locations (USGS National Wildlife Health Center 2014), which is likely how the fungus arrived in North America.

Post-WNS hibernacula counts available from the northeast U.S., where the epizoitic began, show the most substantial population declines for the NLEB. Turner et al. (2011) compared the most recent pre-WNS count to the most recent post-WNS count for six cave bat species and reported a 98 percent total decline in the number of hibernating NLEB at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia through 2011. For the final listing rule, the Service conducted an analysis of additional survey information at 103 sites across 12 U.S. States and Canadian provinces (New York, Pennsylvania, Vermont, West Virginia, Virginia, New Hampshire, Maryland, Connecticut, Massachusetts, North Carolina, New Jersey, and Quebec) and found comparable declines in winter colony size. At these sites, total NLEB counts declined by an average of 96 percent after the arrival of WNS; 68 percent of the sites declined to zero NLEB, and 92 percent of sites declined by more than 50 percent. Frick et al. (2015) consider the NLEB now extirpated from 69 percent of the hibernacula in Vermont, New York, Pennsylvania, Maryland, Virginia, and West Virginia that had colonies of NLEB prior to WNS. Langwig et al. (2012) reported that 14 populations of NLEB in New York, Vermont, and Connecticut became locally extinct within 2 years due to disease.

Long-term summer survey data (including pre- and post-WNS) for the NLEB, where available, corroborate the population decline evident in hibernacula survey data. For example, summer surveys from 2005 – 2011 near Surry Mountain Lake in New Hampshire showed a 98 percent decline in capture success of NLEB post-WNS, which is similar to the hibernacula data for the State (a 95 percent decline) (Moosman et al. 2013). Other data, much of it received as comments on the proposed listing rule from State wildlife agencies, demonstrate that various measures of summer NLEB abundance and relative abundance (mist net surveys, acoustic surveys) have declined following detection of WNS in the state.

Although the dispersal rate of *P. destructans* across the landscape and the onset of WNS after the fungus arrives at a new site are variable, it appears unlikely that any site within the range of the NLEB is not susceptible to WNS. Some evidence suggests that certain microclimatic conditions may hinder disease progression at some sites, but given sufficient exposure time, WNS has had

similar impacts on NLEB everywhere the disease is documented. Absent direct evidence that some NLEB exposed to the fungus do not contract WNS, available information suggests that the disease will eventually spread throughout the species' range.

Other Threats

The final listing rule for the NLEB describes known threats to the species under each of the five statutory factors for listing decisions, of which disease/predation, discussed above, is the dominant factor. We summarize here the findings of the final listing rule regarding the other four factors that are relevant to this consultation.

Human and non-human modification of hibernacula, particularly altering or closing hibernacula entrances, is considered the next greatest threat after WNS to the NLEB. Some modifications, e.g., closure of a cave entrance with structures/materials besides a bat-friendly gate, can cause a partial or complete loss of the utility of a site to serve as hibernaculum. Humans can also disturb hibernating bats, either directly or indirectly, resulting in an increase in energy-consuming arousal bouts during hibernation (Thomas 1995; Johnson et al. 1998).

During the summer, NLEB habitat loss is primarily due to forest conversion, and to a lesser degree, unsustainable forest management. Throughout the range of NLEB, forest conversion is expected to increase due to commercial and urban development, energy production and transmission, and natural changes. Forest conversion causes loss of potential habitat, fragmentation of remaining habitat, and if occupied at the time of the conversion, direct injury or mortality to individuals. Forest management activities, unlike forest conversion, typically result in temporary impacts to the habitat of NLEB, but like forest conversion, may also cause direct injury or mortality to individuals. The net effect of forest management may be positive, neutral, or negative, depending on the type, scale, and timing of various practices. The primary potential benefit of forest management to the species is perpetuating forests on the landscape that provide suitable roosting and foraging habitat. The primary potential impacts of forest management are greatly reduced with the use of various measures that avoid or minimize effects to bats and their habitat, e.g., limiting the size of clearcuts, avoiding or minimizing timber harvest during the flightless period for bat pups, leaving sufficient numbers of snags and other trees suitable as roosts following harvests, etc.

Wind energy facilities are known to cause mortality of NLEB. While mortality estimates vary between sites and years, sustained mortality at particular facilities could cause declines in local populations. Wind energy development within portions of the species' range is projected to continue.

Climate change may also affect this species, as NLEB are particularly sensitive to changes in temperature, humidity, and precipitation. Climate change may indirectly affect the NLEB through changes in food availability and the timing of hibernation and reproductive cycles.

Environmental contaminants, in particular insecticides, other pesticides, and inorganic contaminants, such as mercury and lead, may also have detrimental effects on NLEB. Contaminants may bio-accumulate (become concentrated) in the tissues of bats, potentially

leading to a myriad of sub-lethal and lethal effects.

Fire is one of the environmental stressors that contribute to the creation of snags and damaged trees on the landscape, which NLEB frequently use as summer roosts. Fire may also kill or injure bats, especially flightless pups. Prescribed burning is a common tool for forest management in many parts of the species' range.

There is currently no evidence that the natural or manmade factors discussed above (hibernacula modification, forest conversion, forest management, wind energy, climate change, contaminants, fire) were separately or cumulatively contributing to significant range-wide population effects on the NLEB prior to the onset of WNS.

2.8 Collisions with Wind Turbines

To-date, seven Indiana bat fatalities have been documented at wind facilities throughout the range of the species. Five of these fatality events occurred in the fall, one occurred in the spring, and the others occurred in July. Several NLEB fatalities have been reported in publically-available literature from several eastern and Midwestern states, as well as Canada. (The Environmental Assessment for the recently permitted Pioneer Trail Wind Farm project identifies 24 specific fatalities) (USFWS 2015). This information, combined with information that suggests bat fatalities of several other species are ubiquitous at wind facilities, indicates that operating wind turbines pose some lethal risk to both species across their ranges. It should also be noted that three take permits have been issued to wind facilities in Region 3. The Fowler Ridge Wind Farm in northwestern Indiana is currently authorized to take 184 Indiana bats over the project's permitted life (2014-2035), which is approximately nine bats per year. The Pioneer Trail Wind Farm Project in east central Illinois has been authorized to take 129 Indiana bats and 86 NLEBs over a 43 year permit term. A take permit also has been issued to the Buckeye Wind Project in Ohio for the taking of up to 130 Indiana bats over a 25-year permit term, but this facility is not yet operational.

According to the American Wind Energy Association (www.awea.org), 11,384 MW of wind power capacity are currently installed in the Midwest and Ozark Central Recovery Units (IA, IL, IN, OH, MO). It is important to note however, that the majority of installed wind power capacity in Iowa is outside of the Indiana bat range, but within the NLEB range. Because of the fatalities mentioned above, it is plausible to assume that some of these facilities pose some level of risk, and may be taking some Indiana bats and NLEBs annually. Given the difficulty of detecting rare events during ground searches at wind facilities, the uncertainty surrounding migration paths of bats from summer to winter habitat, and the variation in topography, habitat configuration, and wind resources at each wind facility, the baseline mortality from wind turbine operation is unknown and very difficult to estimate. Consequently, the effect of wind energy on local, regional, or range-wide populations is exceedingly difficult to quantify.

The multi-year, statewide scope and scale of this HCP planning effort will provide essential and valuable information regarding the risk to listed species by wind energy in Iowa. Through this unique multi-organizational effort the collection of simultaneous distribution, migration, and mortality data will allow for more accurate assessments of wind energy generation impacts to all bat species in Iowa.

3. Environmental Baseline

The purpose of the environmental baseline is to describe past and ongoing human and natural factors that have contributed to the current status of the species and its habitat in the project action area. Range-wide factors affecting the species include those listed previously under Reasons for Decline.

3.1 Status of the Indiana Bat and NLEB within the Action Area

Summer Distribution and Abundance of the NLEB Near MEC Wind Facilities

MEC currently operates 18 existing wind energy facilities that encompass about 377,600 acres throughout much of Iowa. These facilities are located in a landscape dominated by traditional row crop agriculture and pasture/hay fields. Generally, woodland/forest habitats make up only a minor percentage of the land area within any facility. Following Service guidelines (2015), WEST, Inc. conducted Phase 1 desktop habitat assessments for NLEB to determine total acreage of potential suitable habitat at each existing facility (Table 2).

Based on information from this review, WEST also conducted Phase 2 acoustic presence/absence surveys in forested lands at each existing facility during spring and summer of 2015 (May 15 –July 31). Consistent with recommended sampling rates in the 2015 Range-Wide Indiana Bat Summer Survey Guidelines, this survey included multiple acoustic survey sites at those facilities where woodland/forests and potential NLEB habitats are common such as Macksburg and Rolling Hills. For several facilities with only limited potential NLEB habitat, only one or two survey sites were warranted. Table 2 summarizes potential NLEB habitat and confirmed presence of NLEB based on the results of acoustic surveys completed during the summer of 2015.

Table 2. Potential NLEB Habitat and Confirmed Presence at MEC's Existing Wind Facilities

Facility Name	County	Total Project (acres)	Potential NLEB Habitat (acres)	Acoustic Survey Stations	NLEB confirmed presence?
Adair/Morning Light	Adair/Cass	24,960	106	2	N
Carroll	Carroll	16,000	154	2	N
Century	Hamilton/Wright	17,920	8	1	N
Charles City	Floyd	11,520	77	2	N
Eclipse	Guthrie/Audubon	19,840	81	2	N
Highland	O'Brien	58,880	357	3	N
Intrepid	Sac/Buena Vista	27,520	175	2	N
Laurel	Marshall	10,240	106	1	N
Lundgren	Webster	33,280	110	1	Y
Macksburg	Madison	14,080	1,688	14	Y
Pomeroy	Pocahontas	21,120	72	1	N
Rolling Hills	Cass/Adair/Adam	44,160	1,690	14	Y
Victory	Crawford/Carroll	17,920	28	1	N
Vienna/Vienna II	Marshall/Tama	16,640	26	1	N
Walnut	Pottawattamie	20,480	177	3	N
Wellsburg	Grundy	23,040	4	1	N

Acoustic surveys recorded and confirmed NLEB calls in the vicinity of the Lundgren, Macksburg, and Rolling Hills facilities. NLEB calls were recorded at multiple stations, in several cases more than three miles apart. Using the currently accepted foraging radius of NLEBs (1.5 miles), WEST has estimated that a minimum of six separate NLEB summer roost sites are found within or nearby these facilities (1 at Lundgren, 2 at Macksburg, and 3 at Rolling Hills). With an average population size of 31 (Menzel *et al.* 2002, p. 110), this is a minimum population of 186 bats.

Distribution and Population Estimates Across Iowa

As described in the USFWS final rule to list the NLEB as threatened (see Federal Register, Vol. 80, NO. 63, pgs. 17974-, April 2, 2015), there are no firm population size estimates for NLEB in Iowa nor range-wide. However, the Rock Island Field Office currently has positive occurrence records for 13 counties in southeast Iowa. The status of the species in the remaining counties is unknown, due to lack of survey data. Currently, WNS has been confirmed in southeast Iowa during the winter/spring of 2014-2015; the fungus that causes WNS was first found at a hibernaculum in Iowa in the winter of 2011–2012 (https://www.whitenosesyndrome.org). At a large hibernacula in northeast Missouri, WNS has been confirmed and losses of little brown bats and eastern pipistrelles are substantial. Indiana bat populations (and presumably NLEB populations) in this hibernacula have not yet suffered noticeable losses. While the population status of NLEB in Iowa is currently unknown, it is believed to be relatively healthy in areas where suitable habitat remains. This is likely true in areas where larger tracts of contiguous

forest remain, such as along major river systems. Based on the best available survey information, population level impacts have not yet been realized in Iowa as they have been in eastern states where WNS has been present for longer periods.

In order to generate coarse estimates of NLEB populations in Iowa we used three different methods described below.

MEC Wind Project Acoustic Survey Data Extrapolation

We extrapolated acoustic habitat sampling data collected at MEC facilities to forested habitats in the state. Using acoustic data collected at MEC facilities, it is assumed that at least six NLEB maternity colonies may exist in the habitat within surveyed areas. This number was generated with the assumption that colonies have a discrete, non-overlapping home range with a diameter of 1.5 miles. Specifically, acoustic sites with positive NLEB calls within 1.5 miles of each other were considered to have recorded bats from the same colony. Those greater than 1.5 miles from each other were considered to have recorded bats from separate colonies.

We assume that each of these six colonies includes at least 31 female bats during the summer months (based on information from Menzel et al. 2002, mean NLEB maternity colony size is around 31 bats). Therefore, a minimum of 186 NLEB females might be found in forested habitats within and surrounding the surveyed areas. Assuming a 1:1 female to male ratio, the total estimated population of NLEBs in the surveyed areas would be 372. Combining this population size with the acreage surveyed (3,935 acres) yields an estimated density of 0.0945 NLEB per acre of potential habitat.

Extrapolating that density (assuming species density is consistent) across forested habitats in Iowa provides one potential estimate of NLEB abundance in Iowa. The National Land Cover Database (www.mrlc.gov) shows that approximately 2.2 million acres of forested habitat of similar types occurs throughout the state of Iowa (aggregating forested patches 15 acres or larger). Using this rationale, the NLEB population estimate would be approximately 208,963 bats. It is important to note here that little information exists regarding the potential density of maternity colonies on the Iowa landscape. If maternity colony home ranges overlap, this estimate could be understated.

Alternative Home Range Size and Percent Occupancy Rate Method:

Telemetry-based studies estimate a relatively small mean summer home range size for individual NLEB: 161 acres (range 44–241) (Owen et al. 2003); and 179 acres (range 46–425) (Lacki et al. 2009b). Home ranges are not necessarily circular, but for comparison/analytical purposes we calculate the travel distances within these home ranges based on the radius of a circle of these sizes (1,492 and 1,574 ft respectfully). Adult females and volant juveniles forage nightly departing from a day roost, and individuals switch roosts frequently. In two studies individual bats used up to 5 roosts in less than 19 days (Sasse and Perkins 1996), and up to 5 roosts in less than 13 days (Timpone et al. 2010). The distance traveled between consecutive roosts varies widely from 20 ft (Foster and Kurta 1999) to 2.4 miles (Timpone et al. 2010). Likewise, the distance traveled between roost trees and foraging areas in telemetry studies varies widely.

Sasse and Perkins (1996) found a mean of 1,975 ft while Henderson and Broders (2008) found a mean of 3,609 ft. Circles with a radius of these distances have an area of 281 and 939 acres, respectively, which is larger than individual home range size reported in the literature.

Existing literature therefore suggests that the median home range size (between 281 and 939) is 610 acres. Dividing the total forested area in Iowa (approximately 2.2 million acres) by 610 yields approximately 3,624 discrete potential home ranges that could be occupied by a colony of NLEBs. The Service's current records (through 2012) indicate that approximately 37 % (45 of 122) of the mist-netting locations surveyed in Iowa captured one or more NLEBs, the majority of which were female or juveniles. Applying this 37% occupancy rate to the 3,624 discrete potential home ranges in Iowa indicates that there could be 1,341 maternity colonies in Iowa. An estimated colony size of 62 bats (average of 31 females per colony and a 1:1 ratio of females to males in occupied habitat) yields a population estimate of 83,142 NLEBs.

NLEB Listing Package Midwest Population Estimate Method

Finally, the listing package (Federal Register, Vol. 80, NO. 63, pg. 17974, April 2, 2015) provides an estimate of approximately four million NLEBs in the states of Illinois, Indiana, Iowa, Ohio, Michigan, and Missouri which is based on a mist-net capture species composition ratio of NLEBs and Indiana bats applied to winter population estimates for the Indiana bat.

Of the 56.5 million total forested acres in these six states (www.nrs.fs.fed.us/pubs, accessed 21 Aug, 2015), Iowa's 3 million acres of forested land is approximately 5.3%. We assume that NLEBs are equally distributed among forested areas in this multi-state region and therefore we can apply this percentage to the total estimated NLEB population in Iowa. Consequently, 5.3 % of 4 million bats is 212,000 bats.

NLEB Iowa Population Estimate Summary

These three methods provide a population estimate range of 83,142 to 212,000 bats. Each method has its limitations and assumptions, causing unavoidable error. However, this represents the best available information upon which to base our analysis. The results of the studies proposed under the grant are expected to provide a more accurate population estimate for NLEBs in Iowa. Collection of this concrete data will support long-term conservation decisions. For the purpose of this effects analysis, we assume that the population of NLEB's in Iowa is 200,000 bats.

Population Distribution and Abundance of the Indiana bat in Iowa

Currently, the Indiana bat is known to occur fairly regularly in the southeast quadrant of Iowa, from Guthrie County west to the Mississippi River, and Boone County south to the Missouri State line. The most recent Ozark Central Recovery Unit population estimate (2013) indicates that there are approximately 200,000 Indiana bats in Illinois, Missouri, Iowa, and northern Arkansas. There is a large recently discovered hibernacula in northeast Missouri containing approximately 123,000 Indiana bats. It is logical to assume that a large proportion of those bats can be expected to migrate into southeast Iowa, but the total Iowa-specific population isn't currently known. For the purposes of this biological opinion, we will use the current population of this hibernaculum in the effects analysis because it is the smallest population unit from which the take could reasonably be expected to occur.

3.2 Factors Affecting the Indiana Bat and NLEB Environment within and adjacent to the Action Area

The wind energy facility portion of the action area is expected to continue to produce agricultural crops as normal, and no major land use changes are expected during the term of the action. Some agricultural crops may be cleared around turbines to facilitate mortality searches, but this is not expected to impact foraging of Indiana bats or NLEBs. No commercial development greatly altering bat habitat in or adjacent to the action area is expected, as these communities are agricultural based. Occasionally, landowners clear forested areas for timber harvest or other reasons. However, the extent of this potential future clearing, if any, cannot be predicted.

Regular federal actions having the most effect on the NLEB and Indiana bat currently in Iowa include those actions that include tree clearing as a component of the project. Clean Water Act-permitted projects, roadway projects, pipeline installations, transmission line development and maintenance, and waterway alteration projects generally have a federal nexus and therefore constitute federal actions. There are numerous federal actions occurring in Iowa at the time of this biological opinion, but the majority of those are considered to be affecting, but not likely to be adversely affecting these two species.

4. Effects of the Action

"Effects of the action" refers to the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated and or interdependent with that action which will be added to the environmental baseline. The Act defines direct effects as those considered immediate effects of the project on the species or its habitat. Indirect effects are those caused by the proposed action that are later in time, but are still reasonably certain to occur (50 CFR §402.02). Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consultation.

Non-lethal take

The Grant Proposal indicates that a pilot migration study will occur as part of this study. This will involve mist-netting, tagging, and tracking of NLEB and Indiana bats across the landscape. The act of capturing and tagging these bats may cause harm or harassment. Further inquiry to the IADNR indicates that no more than 20 NLEB and five Indiana bats are likely to be tagged during mist-netting efforts under the Grant. Researchers associated with this effort will pursue a a Section 10(a)(1)(A) permit, and the extent of this take will be analyzed during the processing of that permit request.

Lethal Take

All bat species known from the Midwest U.S. have the potential to collide with spinning turbine blades (including the NLEBs and Indiana bats), which is generally lethal. Additionally, flying in very close proximity to spinning turbine blades may cause barotrauma, which is also lethal.

Understanding the connection of bat distribution and migration pathways to actual, realized mortality at spinning turbines through the monitoring of mortality events is vital to the conservation of all bat species. Understanding the relationships of these variables is the only way to effectively use pre-construction use surveys to guide siting and operation of future projects to avoid or minimize their impact to listed species. In the absence of this data, future projects would be built before project impacts can be measured and understood. Conservation measures available after wind project construction, in the absence of good siting, are currently limited to cut-in speed increases, which inhibits generation of electricity and the efficacy of the project.

As a result of the implementation of this grant and the interrelated and interdependent activities incidental lethal take of NLEBs and Indiana bats may occur.

4.1 Direct Effects

Very little data exists on wind turbine-related fatalities of NLEBs and Indiana bats. For this reason it is difficult to accurately quantify the potential incidental take that could result from the implementation of the grant and the interrelated and interdependent activities. However, the Service used the best available information in the following two NLEB take estimation methods, as described below. Take estimate methodology for the Indiana bat is also described below.

Application of Existing Permitted Project Take Estimation

The Pioneer Trail Wind Farm (PTWF) in east-central Illinois has recently been authorized to take three Indiana bats and two NLEB per year under their Section 10(a)(1)(B) permit, with the implementation of their HCP. This project consists of 94 turbines and in the HCP, take estimates for this project (uncurtailed) were calculated using species composition ratios from actual mortality data collected at Fowler Ridge Wind Farm in Indiana. The estimated per-year NLEB fatality rate was 2.2688 bats per year. In the current absence of actual NLEB mortality data from MEC facilities, it is plausible, although not ideal, to apply this take estimation to MEC facilities because the PTWF is also located in a primarily agricultural landscape with a few occupied, forested riparian corridors surrounding the project. Applying a rate of 2.2688 NLEBs per 94 turbines to MEC's currently operational fleet of 1,781turbines would yield an estimate of 42.98 NLEB fatalities per year, with a total of up to 128.94 bats over the three year period. Two additional projects are in development and are reasonably expected to come online before the expiration of incidental take authorized in this biological opinion. These additional projects would bring the total turbines to 2,059. Applying the 2.2688 NLEBS/94 turbines to the potential 2,059 turbines yields a potential take estimate of approximately 49.69 NLEBs per year.

A notable assumption of the above take estimation is that all-bat mortality would be approximately 30.17 bats per turbine, which is the mortality rate measured at the Fowler Ridge Wind Facility in Indiana. We believe this is a significant overestimate of all bat mortality that can be expected in Iowa. Of 17 reports from Illinois and two reports from Iowa that are currently accessible by the Service, the highest mortality rate was approximately 19 bats per turbine (uncurtailed). The lowest mortality rate reported at an uncurtailed project was approximately three bats per turbine. Because Iowa has approximately two thirds of the forested

land that Indiana has, and these acres are highly fragmented in most areas of the state, it is reasonable to expect that all bat mortality would be significantly less than that measured at the Fowler Ridge Wind Farm. An all bat estimate of 15 bats per turbine or less is more reasonable, and therefore the corresponding take estimate associated with this method would be approximately 25 bats per year.

Extrapolation of Existing NLEB Fatality Data

The Service has compiled the mortality monitoring results from 69 separate monitoring reports spanning 17 years (1998-2014) and approximately 6000 turbines in the range of the NLEB. Among these reports, a total of 36 NLEB carcasses have been discovered. Two of these report six NLEB in a single year (2007), one reports five in one year (2011), and the remaining reports have no more than 2 NLEBs at any project in any given year. The average number of turbines surveyed in any given year for the whole dataset is approximately 350, and the average number of turbines surveyed annually since 2003 (when the first NLEB in our dataset was reported) is approximately 400 (range 20-975, median 432). Some limitations of this dataset include: sampling regime and correction factors were not available for all reports, different numbers of projects were surveyed each year, only one or two consecutive years of data is provided for most projects, projects span fourteen states and one Canadian province, projects are located in different habitat types with different adjacent or dominant landscape features, and the seasonality of the carcass discoveries are unknown. However, it remains the best mortality information available to this office at this time. Upon implementation and completion of this grant, it is probable that better, Iowa-specific mortality data will be available for application to the MEC HCP and future projects in the state.

Extrapolating this data into fatalities per 100 turbines per year yields an average of 1.09 NLEBs/100 turbines/year (range 0.12 – 4, median 0.59). Note, in this calculation we excluded one year that was an outlier: 2004 data where two NLEBs were observed at a single, 20 turbine facility. Applying this average of 1.09 NLEBS/100 turbines/year to MEC's operational fleet of 1781 yields an estimated take of 19.4 bats per year. Expanding this to include the two foreseeable projects expected to come online before 2017 yields a potential take estimate of approximately 23 NLEBs per year.

Estimation of Indiana Bat Take

MEC currently operates 354 turbines distributed across six projects within the range of the Indiana bat in Iowa. These projects are located on the northernmost and westernmost edge of the species range. Of these projects Laurel and Macksburg are probably the most likely locations of an Indiana bat take event, should one occur. These two projects are located in the middle to southern portion of a county in which Indiana bats are listed. Portions of Rolling Hills, Adair/Morning Light, Vienna, and Eclipse are also in counties for which the Indiana bat is currently listed, but they are on the northern and western edges of these counties. All known Indiana bat hibernaculum are either east or south of these projects. Additionally with the recent discovery of a very large hibernacula in northeast Missouri, it is plausible to infer that a large percentage of the Indiana bats in Iowa migrate in a southeasterly direction to this hibernacula. Given that migratory direction, there is likely a very low risk that Rolling Hills, Adair/Morning

Light, Vienna, and Eclipse would take a migrating Indiana bat because these projects are at the very edge of the Indiana bat range. As such, no known populations from the north or west would be expected to cross paths with these projects on their way to hibernacula. Additionally we believe that the risk of take during the spring and summer at these projects is low because 2015 summer acoustic work at these four projects did not return any likely Indiana bat calls.

There are 100 turbines in the Laurel and Macksburg projects. If the PTWF uncurtailed take rate of 4.5376 Indiana bats per 94 turbines per year is applied to these two projects, 4.827 Indiana bats could be taken at these two projects per year. However, as discussed above in the NLEB take estimation section, we expect that this is roughly twice the potential estimated take because overall bat mortality in Iowa is expected to be about half (or less) of that calculated at Fowler Ridge. This brings the calculated take estimate for these two projects to approximately 2 Indiana bats per year. At the remaining projects on the edge of the range, it is our opinion that no more than four Indiana bat fatalities are likely to occur among the four facilities. Therefore, our estimated Indiana bat take across all MEC projects within the range of the Indiana bat is six Indiana bats per year. This estimate was derived by calculating and attributing take on a per-wind project basis. Take may not be distributed evenly among the facilities as we have described above and therefore we analyze the effect of the whole take estimate on the population of the closest hibernacula.

Take Numbers Analyzed in the Biological Opinion

We use the higher estimate of 25 NLEBs per year in this biological opinion because it is more conservative to do so. As described above, we estimate that approximately six Indiana bats could potentially be taken in any given year. Due to natural variability in all biological systems, it is expected that bat migration patterns and associated collision risk may vary from year to year. Therefore, annual take may not be exactly 25 each year. For the purposes of this biological opinion, we are considering that no more than 75 NLEBs and 18 Indiana bats could potentially be incidentally taken from 2015 to 2017. To address this uncertainty the Service, MEC, and the IADNR will implement an adaptive management strategy. Under this adaptive management strategy (described below in Section 4.4.3), MEC will meet and confer with the Service if a NLEB or Indiana bat carcass is discovered. The company will then implement any adaptive management measures that the parties agree are warranted to ensure that the take authorization will not be exceeded and the impact of the incidental take is minimized.

Preliminary results of spring and summer mortality monitoring at MEC facilities indicates that very few (<50) carcasses of all bat species were found among the 826 monitored turbines. Of those, no listed species were found. Therefore, it is reasonable to expect that most or all incidental take would be realized during the fall migration season (August 15 – October 15). As stated in Section 2, we expect that NLEB males and females are present on the landscape at a 1:1 ratio which means that approximately half of the potential incidental take would be females, with the other half being males. Alternatively, we expect that Indiana bats have a 2:1 female to male ratio in summer habitat and during fall migration, so we can expect that 75% of the Indiana bats potentially taken would be female.

4.2 Indirect Effects

The indirect effects of the implementation of this grant and the interrelated and interdependent activities are expected to be generally beneficial to both NLEBs and Indiana bats. The positive indirect effects that are expected to result are listed below under the associated activity:

- Acoustic Monitoring
  - Will increase general public and regulatory agency knowledge of the distribution of NLEBs and Indiana bats in Iowa, which will be the foundation for:
    - State-wide mortality risk analyses and informed siting of future wind projects.
    - Future research into habitats and habits of the NLEB in the State of Iowa.
    - More informed project impact analysis by regulatory agencies.
    - Identification of potential mitigation lands for the HCP and other actions in the state.
- Migration Pilot Study
  - Will provide insight into migration pathways of NLEBs
  - Will provide an informed basis of logistical and bat behavioral knowledge for a near-future state-wide scale migration study.
  - Will begin to narrow the search in Iowa for potential NLEB hibernacula, to promote the conservation of this habitat.
- Ballistics Model
  - Will allow more accurate correction of past, current, and future mortality monitoring data.
  - Will enable the optimization of plot size and shape for future mortality monitoring efforts to maximize detection probability with search effort.
  - Promote the standardization of the search area correction factor in mortality estimators.
- Mortality Monitoring
  - Will provide carcass data with which to field-check the ballistics model
  - Will enable the quantification of all-bat mortality at wind facilities across the MEC fleet.
  - Will facilitate the estimation of wind energy impacts to bird and bat species, which is essential to determining the significance of project wildlife impacts.
  - Will promote the most accurate long-term take estimation practicable to be used in the development of the MEC HCP.

4.3 Conservation Measures

The following conservation measures have been coordinated among MEC, IADNR, and the USFWS. These measures are expected to reduce impacts to listed species and ensure that incidental take remains below the levels analyzed in and authorized by this biological opinion.

1) Turbine Operational Software Modification

- MEC is currently in the process of modifying the turbine operational software across their fleet, beginning with those projects that contain known or potentially occupied

forested habitat.

- Turbine operational software modifications will create the ability to feather blades at each individual turbine at each operational project.
- The ability to feather blades will allow projects to implement the adaptive management measures, described below.

2) MEC Fleet-Wide Bat Studies

- MEC has hired WEST, Inc. (an independent, federally-permitted environmental consulting firm that is also authorized by IADNR to work in Iowa) to conduct acoustic surveys at each of the 18 currently operational facilities in summer of 2015. Surveys will follow the Service's 2015 survey guidelines for presence-absence, and results will inform risk analyses, local and regional population estimates for listed bats, and acoustic detector efforts and placement under the grant.
- MEC has also hired WEST, Inc. to track trajectories and potential migration paths of migrating bats that are captured within project boundaries in the fall of 2015. Like the acoustic surveys, this information will inform risk analysis, adaptive management measures, as well as logistics of the proposed migration studies funded by the Grant. Furthermore, this migration study will provide insight into exposure risk, which can guide future monitoring efforts to verify that permitted and/or authorized take is not exceeded.
- MEC, through WEST, Inc. will conduct traditional mist-net bat survey studies, where applicable, to clarify any ambiguous acoustic results and better understand listed bat use in project boundaries.

3) Adaptive management

- During mortality monitoring efforts at MEC wind facilities, should a dead or injured listed species be found, MEC or their representative will notify the Service within 48 hours of its discovery and/or positive identification.
- In the event of a confirmed listed species mortality event, MEC, IADNR, and the Service will meet and confer to discuss the circumstances of the event and appropriate conservation measures, which could include, but are not limited to:
    - Additional targeted searches at the turbine or facility implicated in the find.
    - Feathering of blades and/or an increase in the cut-in speed of the turbine.
    - Feathering of blades and/or increasing the cut-in speed of turbines with similar risk profiles.
    - The installation of bat deterrent devices, should that technology become commercially available.

5. Cumulative Effects

Cumulative effects include the effects of state, local or private actions that may occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. The Service is unaware of any other Federal or non-Federal actions that are reasonably certain to occur which may adversely affect the Indiana bat or NLEB in the project Action Area. The action area is located in a landscape that is predominantly agricultural. Many of the core

forested areas that provide suitable habitat for the NLEB and Indiana bat in Iowa are located along major river and stream corridors transecting Iowa. Many of these lands are owned by public entities such as the Service's National Wildlife Refuge System, the Iowa DNR, and/or county conservation boards. Other core forested areas are privately owned, and are generally located along streams and other waterways which do not lend themselves to easy clearing or land use conversion. Tree clearing (summer habitat alteration) could occur on privately owned tracts. However, the amount and intensity of these actions on private land in the action area are not expected to change the scope or magnitude of effects anticipated from this project. Therefore, the cumulative level of effects anticipated from these activities, combined with the project effects, is not anticipated to have measurable changes to Indiana bat populations or habitat within the action area.

6. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA, prohibits the take of endangered and threatened species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Incidental take is being authorized for activities associated with the implementation of the section 6 HCP planning grant.

6.1 Amount or Extent of Take

As a result of implementing the proposed action, including the development of an effective conservation strategy, and its interrelated/interdependent activities, no more than 75 NLEB's and 18 Indiana bats are expected to be taken over the project life (fall 2015 through winter 2017. This take is expected to be distributed fairly evenly across the project area and permit period, with approximately 25 NLEBs and 6 Indiana bats taken each year. However, due to environmental stochasticity, this number may vary from year to year and potential take could occur more frequently at a subset of facilities than at the rest. Take coverage will begin upon signature of this biological opinion and extend through 2017. Monitoring and adaptive management (as described in Section 4) will be implemented to ensure that this take number is not exceeded.

6.2 Effect of the Take

Effect of the take on Indiana bats at the hibernacula population Level

Due to the large geographic scale of the project, it is difficult to predict how many maternity colonies may be affected by the estimated take. Therefore, we must analyze the effect of the take at the next population size level, which is the hibernacula level. The closest known hibernaculum to the population of Indiana bats in Iowa is located in southeast Missouri. This hibernaculum is estimated to contain approximately 123,000 Indiana bats. The 18 bats that could be taken in the MEC project area comprise approximately 0.00015% of this population.

Effect of the take on Indiana bats at the recovery unit and rangewide population level

Given that the effect of the take at the hibernacula level was negligible, the effect of the take on the survival and recovery of the species at the recovery unit and rangewide level, which have much larger population sizes, is also expected to be negligible.

Effect of the take of NLEBs

As described above in Section 3, Environmental Baseline, we estimate that the population of NLEBs in the state is approximately 200,000 bats. Therefore, 75 bats taken from this population constitutes 0.00037% of the population. Furthermore, this take is expected to occur during a short-term basis between 2015 and 2017, before the full effects of WNS are expected to have affected Iowa's bat populations. It is our biological opinion that the effect of the take on the survival and recovery of this species will be negligible.

6.3 Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize and monitor the impacts of the incidental take to NLEBs and Indiana bats. In order to exempt from the prohibitions of section 9 of the ESA the Service, IADNR, and MEC must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are mandatory.

1. MEC shall monitor and document the extent of NLEB and Indiana bat taking resulting from implementation of the conservation planning strategy.

2. The Service, IADNR and MEC shall implement the adaptive management strategy identified in this biological opinion, and section 4.4.1 of the July 3, 2015, Biological Evaluation[1].

[1] The proposed action contained in the draft BE dated July 3, 2015, was revised through discussions between the Service, IADNR, and MEC. MEC resubmitted a final BE reflecting these discussions on August 24, 2015.

6.4 Terms and Conditions

The following terms and conditions implement reasonable and prudent measure #1.

1. MEC shall monitor bat fatalities as described in Section 1.6 of the BE and this biological opinion.

2. By April 1 of each year during the term of the proposed action, MEC shall provide the IADNR and Service with a written summary of monitoring data obtained during the prior monitoring season. This written summary will help inform implementation of the monitoring and adaptive management strategies.

3. IADNR and MEC shall provide data and study results collected under the actions described above in Section 1 of this biological opinion to the Service, upon request. This data includes, but is not limited to:

    (i) All-bat mortality monitoring data, to include carcass finds and the results of searcher efficiency and carcass removal trials;

    (ii) Weather and turbine operational data directly related to fatality events (should they occur);

    (iii) Copies of reports that are required under the section 6 grant administrative process;

    (iv) Raw and processed acoustic, mist-net, and migration study data; and

    (v) Other scientific reports and data collected under this grant and relevant to the development of the HCP.

The following terms and conditions implement reasonable and prudent measure #2.

1. Should listed species be found during monitoring required under this biological opinion, the Service, MEC and the IADNR shall promptly meet and confer to discuss applicable adaptive management measures. These measures could include, but are not limited to:

    (i) Additional targeted searches at the turbine or facility implicated in the find;

    (ii) Feathering of blades and/or an increase in the cut-in speed at the turbine or group of turbines implicated in the find;

    (iii) Feathering of blades and/or increasing the cut-in speed of turbines with risk profiles similar to the turbine implicated; and

    (iv) The installation of proven, cost-effective bat deterrent devices at the turbine or group of turbines implicated in the find, should that technology become commercially available.

7. Jeopardy Analysis

After reviewing the current status of the Indiana bat and NLEB, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects as described above, it is the Service's biological opinion that the proposed covered activities, interdependent actions, and interrelated actions are not likely to jeopardize the continued existence of the Indiana bat or the NLEB. There is no critical habitat for the Indiana bat nor the NLEB in the project action area, and therefore, destruction or adverse modification of critical habitat as a result of the project is not expected.

8. Reinitiation Notice

As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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