

## Indiana Bat Determination Key Standing Analysis

### INTRODUCTION

This standing analysis supports the “Indiana Bat Determination Key” delivered by the U.S. Fish and Wildlife Service’s (Service) Information for Planning and Consultation (IPaC) system. The Service’s Kentucky Field Office (KFO) developed the Indiana Bat Determination Key (DKey) to streamline the process of reviewing projects that typically result in a “no effect” or “may affect – not likely to adversely affect” determination for the Indiana bat (*Myotis sodalis*).

The routine nature of the review for many projects provides an opportunity to programmatically evaluate their effects on this species. The streamlined process facilitated by the Indiana Bat DKey will reduce the amount of staff time necessary to review these projects and provide Federal Action Agencies, consultants, and project proponents an immediate response after they complete the key for a qualified project.

### PROPOSED ACTION

The proposed Action will include a variety of different projects; we expect the majority to be development projects or small-scale utility projects. Development projects may include residential, commercial, industrial, or municipal developments. Small-scale utility projects may include new electric distribution lines, electric substations, water treatment plants, natural gas distribution lines, and pump stations. Small repairs or modifications to existing oil or gas and electrical transmission lines and existing utility facilities may also qualify. Other types of projects, like marine events, cell towers, and recreational trails, may also qualify.

Qualifying projects would not produce stressors other than those evaluated in the effects analysis in this standing analysis, which are: minor noise and vibration, night lighting, minor loss and degradation of aquatic resources, and some small-scale forested habitat removal. Projects that would expose the Indiana bat to additional stressor(s) do not qualify to use this key. Additional stressors that do not qualify for this key include noise and vibration from blasting (i.e., other than fireworks in a marine event), loss and/or degradation to streams that would require an individual permit under section 404 of the Clean Water Act, prescribed fire, creation of a new water-borne contaminate source (e.g., leachate pond), modifications to existing bridges, and construction or operation of wind turbines. If a non-qualifying project may affect the Indiana bat, project-specific consultation (or other programmatic consultation, if applicable) with the Service is recommended to ensure compliance with the Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 *et seq.*

### **Conservation Measures**

To protect Indiana bat hibernacula, this standing analysis does not cover effects from projects within 0.5 mile of a known Indiana bat hibernacula, unless one of the following conservation measures from the bulleted list below is implemented:

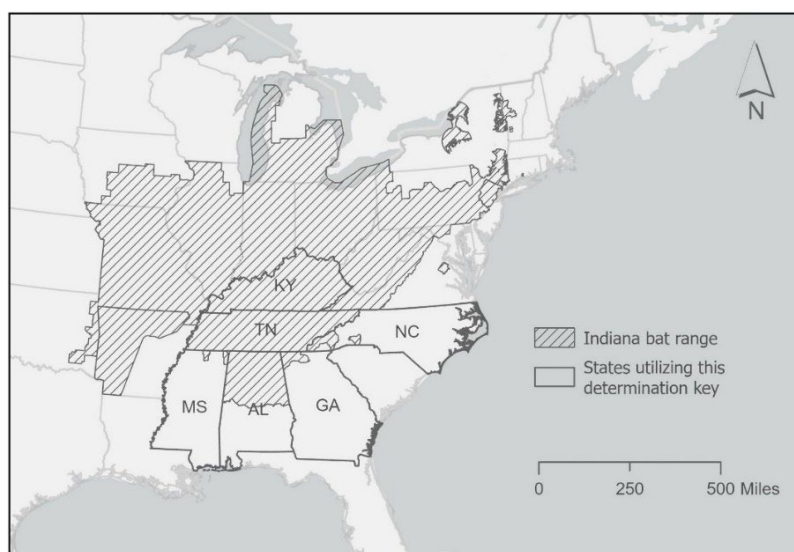
- The project proponent or its consultant shall verify that the project site does not contain any features or potential winter habitat components that could potentially provide undocumented Indiana bat hibernacula, or
- The project proponent or its consultant shall demonstrate that any potential features or potential winter habitat components in the project site are not suitable through a Phase I winter habitat assessment.<sup>1</sup>

To protect Indiana bat summer roosting habitat, this standing analysis will cover effects from projects that implement one of the following conservation measures or groups of conservation measures from the bulleted list below:

- The project will avoid removal of suitable Indiana bat forested habitat,
- The project has demonstrated that Indiana bats are not likely to use forested habitat that will be removed (e.g., approved habitat model, presence/absence survey, emergence count)<sup>1</sup>,
- The project will avoid removal of suitable Indiana bat maternity roost trees (primary and secondary) and avoid removal of Indiana bat forested habitat that would create a gap greater than 1,000 feet, isolating the remaining habitat, or
- The project will avoid removal of suitable Indiana bat primary roost trees, will remove all suitable Indiana bat forested habitat during the unoccupied timeframe, and will avoid creating a gap greater than 1,000 feet in the forested canopy.

## ACTION AREA

The Action Area is the entire Commonwealth of Kentucky and the States of Alabama, Georgia, Mississippi, North Carolina, and Tennessee, in which the Indiana bat range intersects.



<sup>1</sup> The KFO will review the results of the habitat assessment or survey to verify that they support a “no effect” or “may affect – not likely to adversely affect” determination.

## STATUS OF THE SPECIES

The Indiana bat occurs throughout the Action Area, and we consider the species to be potentially present in any area of the Action Area with suitable habitat. Implementation of the conservation measures will ensure that the individually covered project areas do not include features that could be used as hibernacula by Indiana bats. Project proponents have the opportunity to conduct presence/absence surveys or to develop habitat models to provide site-specific information about the summer presence of Indiana bats in a project area.

The Indiana bat is a migratory species that is restricted to caves, underground mines, or other similar structures in the winter but can be found in forests throughout its range (midwestern and eastern United States) during the summer. Most Indiana bats hibernate from October through April. In the summer, they utilize a variety of forested habitats, including riparian forests, bottomlands, and uplands, where they roost in trees and forage on insects. Females give birth and raise their young in one or more primary roost trees, typically with other females and their young. Collectively, this assemblage of bats is called a maternity colony. Maternity colonies, often comprised of more than 100 adult females, roost under sloughing bark of dead snags and partially dead trees in forested settings (USFWS, 2007). Reproductive females require multiple alternate roost trees to fulfill summer habitat needs. Females typically give birth to one pup sometime around late May or early June, and juveniles are weaned when they are three to five weeks old. According to the Draft Indiana Bat Recovery Plan (USFWS, 2007), young Indiana bats become volant from early July to the first few days of August. During the fall “swarming” period, Indiana bats occupy the forested habitat around hibernacula where they mate and acquire additional fat reserves prior to hibernation (Hall, 1962; LaVal and LaVal, 1980). They also utilize this habitat during spring emergence before migrating to their summering areas. Suitable roost trees for Indiana bats are greater than or equal to five inches diameter at breast height (DBH), can be living or dead, and exhibit any of the following characteristics: exfoliating bark, broken limbs, broken tops, cracks, or crevices. Primary maternity roost trees are typically greater than nine inches DBH.

While White Nose Syndrome (WNS) has had a significant impact on Indiana bat populations within the Northeast and Appalachian Recovery Units (i.e., 93 and 77 percent declines respectively since the arrival of WNS in North America in 2006), but Indiana bat populations in the Midwest Recovery Unit (RU), of which KY, GA, AL, and the majority of TN fall within, have only documented a 15 percent decline since 2007. In fact, the Midwest RU population of Indiana bats increased by 11 percent from 2019 to 2022 indicating that populations remain largely stable despite the presence of WNS throughout all caves within the RU (USFWS, unpublished data 2023).

Additional information about the species, including status, life history, and conservation information on the species, can be found in documents accessed from the Service’s Environmental Conservation Online System (ECOS) (<https://ecos.fws.gov/ecp/species/9045>) and is incorporated by reference in this document.

## ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Indiana bat, its habitat, and ecosystem within the Action Area. The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation and does not include the effects of the action under review.

### *Distribution Within the State of Alabama*

Most recorded Indiana bat summer roosts have been hardwood species; however, in Alabama, roosts have primarily been observed in loblolly pine (*Pinus taeda*) snags. In Indiana, lactating female Indiana bats have been recorded from June 10 to July 29. In the most southern portion of the species range, it is probable that a slightly earlier timeframe could be expected, as has been documented from monitoring of a known maternity roost in Shoal Creek Ranger District in Alabama (A. Edelman, J. Stober, pers. comm. 2016). A non-volant period of June 1 – July 31 has been applied throughout most of the species’ range; however, a non-volant period of May 1 – July 15 will be used in this Standing Analysis for Alabama. Adults forage (by hawking) on winged insects within three miles of occupied maternity roosts. Indiana bats typically do not frequently forage within the canopy of trees (USFWS, 2007). Swarming of both male and female Indiana bats and subsequent mating activity occurs at cave entrances prior to hibernation. Indiana bats roost under sloughing bark and in cracks of dead, partially dead, and live trees in the autumn period. Indiana bats usually require trees larger than five inches DBH for roosts, although larger roosts are believed to be preferred. Roosts are generally much larger than five inches DBH in Alabama’s Shoal Creek Ranger District and in other reports (Eschler and Roby, 2019; Torrey, 2018).

Two winter hibernacula are known from the Bankhead National Forest (NF) (i.e., Armstrong Cave and Backwards Confusion Cave). They were first detected in February of 1999 and their presence has been confirmed by cave monitoring conducted bi-annually during 2001, 2003, 2005, 2007, 2009, 2011, and 2013 and annually since 2013. In 2013, 92 and 9 Indiana bats were recorded for Armstrong Cave and Backwards Confusion Cave, respectively (ADCNR 2022). In early 2014, WNS was confirmed present in Armstrong and Backwards Confusion Caves. Current research efforts (i.e., including radio tracking following emergence) are ongoing to establish the use of Bankhead NF by Indiana bats outside of the hibernation period. Attempts for tagging in spring of 2015 and 2016 were unsuccessful because Indiana bats, which had been present in the cave in late fall, were already absent presumably due to early emergence and warm weather. Recent cooperative research has documented the use of tree roosts on Bankhead NF in fall prior to the winter hibernation period. However, no maternity roosts or summer tree roosts have been identified on Bankhead NF to date (A. Cochran, pers. comm. 2016).

Indiana bats have been documented on the Talladega District of the Talladega NF because of an FWS-funded radio telemetry study looking at spring dispersal patterns in the species. After tracking a female bat approximately 150 miles from Rose Cave in Tennessee to the Shoal Creek Ranger District (SCRD) of the Talladega NF in spring 2012, an effort was undertaken to confirm the presence of a maternity colony on the district in 2013 (Roby, 2012). Radio telemetry conducted on 11 bats during 2012 and 2013 resulted in the identification of 16 roosts, with 1 tree used both years. All roosts were snags. In 2014, Copperhead Consulting tagged one bat that was

followed to the SCRDR only to be lost and not relocated. In 2015, bats were tagged at 2 caves in Tennessee, and a total of 12 bats (6 from Rose Cave and 6 from Hubbard Cave) migrated to the SCRDR (Culbertson and Roby 2017). In 2015, research on the Shoal Creek bat community expanded to acoustic surveys and a pilot survey using mist netting and tagging (i.e., radio transmitters) to identify new roost locations. Although six northern long-eared bats (NLEB) were captured and tagged and new roost trees were identified, no Indiana bats were captured. Many acoustic survey data samples from 2015 are still pending analysis, but Indiana bat signatures appear to be present at some locations.

Members of the Alabama Bat Working Group surveyed 36 caves in Alabama from February 2 to March 21, 2016, to conduct bat inventories and surveillance for WNS and for bat presence/probable absence. A new Indiana bat hibernaculum of 93 individuals was discovered at Stanley-Carden Cave in Fort Payne, DeKalb County. This is now the largest and the third known Indiana bat hibernaculum in Alabama. Unfortunately, WNS was confirmed in DeKalb County during this survey period. A fourth Indiana bat hibernaculum of 70 individuals was discovered at Lake Purdy Corkscrew Cave in 2020.

Sauta Cave in Jackson County, Alabama is the other known hibernaculum, and it has consistently harbored the largest numbers of Indiana bats. In 2022, 78 individuals were documented. Prior to the discovery of WNS in 2014, surveys were conducted annually from 1995 to 2013, excluding 2003, and population counts ranged from 129 to 307. Surveys conducted in 2014, 2015, 2017, 2019, and 2022 documented population counts ranging from 13 to 78 individuals. Sauta Cave is managed by the Service as part of the Sauta Cave National Wildlife Refuge. Indiana bats have been documented hibernating in Fern Cave and subsequently captured in mist nets outside the cave in October.

In recent years, new maternity colonies have been located in the southern portion of the Indiana bat's range (i.e., AL, GA, KY, MS, and TN). Tennessee investigations concerning the migratory paths and summer range of Indiana bats led to the discovery of maternity colonies in Alabama (Roby 2012). This led to the desire to launch the same investigations in Alabama. Understanding this species' habitat use/needs in the Southeast Region during the critical spring/summer months is essential for future protection and conservation of important resources needed for the continuing survival of the Indiana bat.

Several Indiana bat spring migration projects over the last few years have resulted in the location of three previously unknown maternity areas in Alabama, all on the Talladega NF including: SCRDR, Fivemile colony on the Oakmulgee Ranger District (ORD), and Payne Lake colony on the ORD (Culbertson and Roby, 2017; Eschler and Roby, 2019; Torrey, 2018). Follow-up mist-netting and tracking after May 15<sup>th</sup> was conducted on the SCRDR to confirm that the location represented a maternity colony (Birdsall and Roby 2021). However, the ORD colonies that were identified through the 2017 spring migration study were located in 2018. A follow up survey was conducted in 2019, but no maternity colonies were located. No subsequent surveys have been conducted to confirm maternity use in these areas. Additional mist-netting, tracking or acoustic surveys are needed within this maternity area (S. Holbrook, pers. comm. 2019)

### ***Distribution Within the State of Georgia***

The forests of North Georgia represent a portion of the southern edge of the range of Indiana bat, and summer roosting/possible maternity habitat in this region differs from summer habitat in the core of the range. In the southern portion of its range, both males and females of this species prefer pine snags (with loose bark patches) for roosting (Hammond et al., 2016). Preferences for open-canopied, patchy stands with pine snags have been documented within this region. The typical roost tree is a large pine snag on a southern aspect, with an open canopy above the roost location, at an advanced stage of decay (i.e., most bark already gone; Hammond et al., 2016).

This species had been documented in Georgia from only two caves in Dade County in the northwestern part of the state in the 1960's, but these have been classified as Priority 4 caves (i.e., low priority for protection; USFWS, 2007).

Prior to 2012, no summer or maternity habitat utilization had been documented in Georgia, and no Indiana bats had been captured during mist-netting efforts in the state. In April 2012, a radio-tagged female Indiana bat was aerially tracked from a hibernaculum in White County, Tennessee, to state property near Ellijay, Georgia (Gilmer County). The female bat and 12-15 unknown others were documented roosting under loose bark in shortleaf pine (*Pinus echinata*) snags and one eastern white pine (*Pinus strobus*) snag for approximately 10 days in April-early May. This indicates that suitable summer/maternity habitat is likely to be present in north Georgia, but the extent of this is unknown. Following this occurrence, a study funded by the Georgia Department of Transportation at the University of Georgia focused on capturing Indiana and NLEB bats in North Georgia for the purpose of identifying roost locations and completing a habitat suitability model (Grider, 2023). No Indiana bats were captured during the four-year study.

In 2016, one Indiana bat was observed hibernating in a cave on National Park Service land in Walker County. Two contemporary observations of Indiana bats have been documented in Dade County caves in 2016 (NatureServe, 2023). Two Indiana bats were observed hibernating in a large box culvert under an interstate highway in Carroll County, Georgia, in 2019 (NatureServe, 2023).

### ***Distribution Within the Commonwealth of Kentucky***

Kentucky lies near the center of Indiana bat's range, and numerous records of the species occupying summer and winter habitat exist. Occurrences of the species are clearly tied to the availability of suitable summer and winter habitat. Potential winter habitat is static (assuming no anthropogenic alterations occur) in the landscape because the caves and other underground features the species relies on for winter habitats do not change locations. However, the species will move from one winter habitat area to another to take advantage of better conditions or to abandon habitat that humans disturbed or other factors have altered.

There are 108 known Indiana bat hibernacula within Kentucky. Five of these are Priority 1 hibernacula (i.e., defined as harboring current or historic winter populations greater than 10,000 individuals and not identified as an ecological trap) (USFWS, unpublished data 2023) located

within Kentucky, and three of these are designated as critical habitat (USFWS, 2007). In addition, there are 43 known hibernacula located within twenty miles of the border of Kentucky, and five of these hibernacula are Priority 1. Indiana bats utilizing these hibernacula as winter roosting habitat may utilize forested habitat in Kentucky for swarming and summer roosting. These ten Priority 1 hibernacula had a combined estimated population of 214,620 in 2022, which represent approximately 37 percent of the range-wide estimated population (582,601). In 2022, 49,498 Indiana bats were observed hibernating within Kentucky (USFWS, unpublished data 2023).

Fifty-one of the 108 hibernacula in Kentucky occur in areas of existing public or private conservation ownership, including the Daniel Boone National Forest, managed by the U.S. Forest Service, Mammoth Cave National Park and Cumberland Gap National Park that are managed by the National Park Service, Carter Caves State Resort Park that is managed by the Kentucky Department of Parks, and several parcels along Pine Mountain in Kentucky that are owned by a variety of state agencies and land trusts.

Summer records for the species occur across Kentucky, and at least 73 maternity areas have been documented along with several locations for solitary males and non-reproductive females. Like the hibernacula, these known maternity colonies are scattered throughout the state with notable clusters of maternity colonies occurring near the Fort Knox Military Reservation, Mammoth Cave National Park, Daniel Boone National Forest, Pine Mountain, the coalfields of eastern Kentucky, and along the lower Ohio River floodplains.

In general, the habitat availability at known maternity sites appears to reflect the overall distribution of forest cover for the state. Outside of the maternity colonies found on Fort Knox Military Reservation and Mammoth Cave National Park, those maternity areas with an availability of at least 80 percent forest cover occur in the eastern third of the state where forestland cover frequently exceeds 75 percent. Similarly, in the western third of the state where the percent of land in forest is typically below 50 percent, the availability of forested habitat for known Indiana bat maternity colonies is also below 50 percent. Based on the wide distribution and availability of summer habitat across the Kentucky, Indiana bats can be expected to occur at any location where its habitat needs can be met. Summer presence/probable absence surveys for the Indiana bat within Kentucky have found an average occupancy rate of 1.1 percent for survey sites in potential maternity habitat (2005-2021). Given this occupancy rate and the regular discovery of new maternity colonies, the Service believes there are more maternity colonies within Kentucky than are currently documented.

### ***Distribution Within the State of Mississippi***

The historical distribution and abundance of the Indiana bat in Mississippi is poorly documented. In Mississippi, this species has only been documented in Tishomingo and Benton Counties (Mississippi Natural Heritage Program [MNHP], 2016; P. Roby, pers. comm. 2015). The only known historical summer roost for this species in Mississippi is in Tripoli Chalk Mine, located in Tishomingo County (MNHP, 2016). It is likely that the mine was a maternal site due to the number of individuals captured on two separate occasions (A. McCartney, pers. comm. 2023). Twelve Indiana bat voucher specimens were collected in 1937, and six were collected in 1939 at the mine (MNHP, 2016). This species has not been documented at the mine since 1939 although

numerous surveys have been conducted from 2004–present (K. Shelton, pers. comm. 2014; A. McCartney, pers. comm. 2023). This abandoned mine is currently visited frequently by residents as apparent by heavy vandalism including graffiti and evidence of campfires. Public visitation is quite possibly the reason it was abandoned after the late 1930s (P. Roby, pers. comm. 2015).

Currently, two maternal/summer roost sites have been documented for this species in Benton and Tishomingo Counties (MNHP, 2016; P. Roby, pers. comm. 2015). In April of 2013, one female Indiana bat was tracked from the Rose Cave hibernaculum in White County, TN to a suspected maternity roost tree within a beaver pond on the Holly Springs Ranger District in Benton County, MS. The straight-line distance from the Rose Cave hibernaculum to the maternity site in Benton County is 367 km (228 mi). There are no known winter hibernacula in Mississippi. In 2013, the exact tree roost within the beaver pond could not be located during surveys conducted by Copperhead Environmental Consulting. The beaver pond is surrounded by a bottomland hardwood forest dominated by white oak (*Quercus alba*), sweetgum (*Liquidambar styraciflua*), and red maple (*Acer rubrum*). In 2015, a radio-tagged Indiana bat was tracked to a loblolly pine tree located in an upland area just above the beaver pond (Roby, pers. comm. 2015).

On August 5, 2022, ten Indiana bats were found roosting together under a bridge in Tishomingo County. The bridge is 450 feet long and 35 feet wide and is surrounded by a tupelo brake on the north side and mixed hardwoods on the south side. Six were captured with standard measurements taken along with wing punch and guano samples. All six individuals were identified as juvenile females. Samples were submitted to Northern Arizona University for genetic analysis. Results were obtained on September 25, 2022, confirming the identification. This is the third occurrence record in Mississippi for Indiana bats. This is also the first bridge roost documented for this species in the state (A. McCartney, pers. comm. 2023).

### ***Distribution Within the State of North Carolina***

North Carolina (NC) supports Indiana bats during the summer months with capture records or documented roosts from Clay, Cherokee, Graham, Haywood, and Swain Counties. Summering Indiana bats are also considered present in Macon and Jackson Counties given proximity of capture records to the county boundaries and the availability of suitable habitat. The species also potentially occurs in Buncombe County. There are no known Indiana bat hibernacula in NC, though there are historic winter records of individual Indiana bats from four caves or mines in Avery, Haywood, Jackson, and Rutherford Counties.

It is difficult to estimate population numbers for Indiana bats in NC as no known Indiana bat hibernacula are present in the state; however, the closest Indiana bat hibernaculum to NC is found in the Great Smoky Mountains National Park outside of NC and approximately 5.5 miles from the Swain County border. The most recent population estimate at this hibernaculum is 541 bats (Service, 2023). The Appalachia Recovery Unit has a population estimate of 1,464 bats based on region-wide hibernacula surveys; down from a high of 32,465 bats in 2009 before drastic population declines caused by white-nose syndrome.

Summer maternity colonies are difficult to locate and not widely known, especially in the southernmost portion of the Indiana bat's range (Service, 2019). However, Britzke et al. (2003) found a maternity colony in the Nantahala National Forest, though researchers were unable to re-



locate it in subsequent years. This colony was the first documented in NC and at the highest recorded elevation. Numerous summer roosts were documented across four counties (Clay, Cherokee, Graham, and Swain Counties) from 2008-2012 during work by Indiana State University researchers (Hammond et al., 2016; O’Keefe and Loeb, 2017).

### ***Distribution Within the State of Tennessee***

In 2013, Indiana bat observations in Tennessee hibernacula were estimated at 13,047 individuals. The species has since experienced an 84% decline to less than 2,400 individuals. After the occurrence of WNS in Tennessee between 2014-2015, the Indiana bat population remains at a low density with slow, but continued, declines. Observations of Indiana bats in Tennessee hibernacula in 2017, 2019, and 2022 were reported as 2396, 2350, and 2130 respectively (Tennessee Wildlife Resources Agency, 2022).

## **EFFECTS ANALYSIS**

Qualifying projects typically involve some or all the stressors listed below. Because the project areas would not include hibernacula for the species, we only expect Indiana bats to potentially be affected during the timeframe when they are active outside of their hibernacula (approximately April 1 – November 14).

### ***Minor Noise and Vibration***

Minor noise and vibration produced by qualifying projects are typically produced temporarily during the construction phase (i.e., operation of construction equipment) or may be permanently produced during the operation phase (e.g., vehicular traffic). Indiana bats roosting in trees may be exposed to noise and vibration and respond by flushing from their roosts. Flushing requires extra energy expenditure and makes individuals more conspicuous to predators. An individual’s response to this stressor is dependent on the magnitude of the noise and vibration, the proximity of the individual to the source, and an individual’s level of habituation to the stressor. Indiana bats have been observed to abandon a roost tree in response to a bulldozer operating in proximity (Callahan, 1993). However, there are several examples of Indiana bats continuing to roost in areas where they are habitually exposed to noise and vibration, including that from a military installation (U.S. Army Garrison Fort Drum, 2011), an active timber harvest (Gardner et al., 1991), and an interstate highway and an airport (3D/International, Inc., 1996). Noise and vibration produced by construction equipment and vehicular traffic is localized. It is typically most severe in areas where the Indiana bat would be absent because there is no forested habitat available or where forested habitat has already been removed during site preparation. For these reasons, we expect Indiana bats to be minimally exposed to this stressor and do not expect them to respond by flushing from their roosts. We expect any effects to the Indiana bat from this stressor to be insignificant.

### ***Night Lighting***

Night lighting produced by qualifying projects is typically temporary during the construction phase and/or permanent during the operation phase (e.g., facility lighting). Bats could be exposed to this stressor at night while foraging and commuting. Some research suggests that the Indiana bat and the closely related species, little brown bat (*M. lucifugus*), avoid lit areas

(Alsheimer, 2011; Sparks et al., 2005). Night lighting produced during projects is localized. It is typically most severe in areas where the Indiana bat would be absent because there is no forested habitat available or where forested habitat has already been removed during site preparation. For these reasons, we expect Indiana bats to be minimally exposed to this stressor and to adjust their behavior to avoid these areas. We expect any effects to the Indiana bat from this stressor to be insignificant.

### ***Loss and Degradation of Aquatic Resources***

Indiana bats may be affected by a reduction in stream length over which they forage and by a reduction in habitat available for aquatic insects. Water quality degradation resulting from increased sedimentation during construction could reduce the densities of aquatic insects that bats consume. Bats may have to fly farther to access foraging resources. Best management practices (BMPs) associated with U.S. Army Corps of Engineers' (USACE) 404 Clean Water Act authorizations would limit impacts to streams on-site and to downstream aquatic resources. Therefore, the stream loss from any one project will be of relatively short length and would not likely fragment foraging habitat. Projects that will directly impact streams will require a permit or authorization from the USACE that is conditioned with BMPs to minimize sedimentation onsite and downstream. We expect the effects of sedimentation on aquatic resources to be temporary and minimal (insignificant) due to the scale of qualifying projects, the temporary nature of the activity, and the use of the BMPs.

### ***Tree Removal: Loss of Foraging and Commuting Habitat***

Some projects included in the Proposed Action will involve tree removal. Tree removal could affect Indiana bats by the loss and/or fragmentation of foraging and commuting habitat and the removal and loss of roost trees. Projects that implement the conservation measures for Indiana bats will not result in a gap in forested habitat of greater than 1,000 feet or isolate habitat. Due to the minimal scale of the removal, we expect any effects to the Indiana bat from loss of foraging and commuting habitat to be insignificant.

### ***Tree Removal: Loss of Roost Trees***

To avoid effects to Indiana bats while they are roosting in trees, suitable roost trees will only be removed during the unoccupied timeframe unless site-specific information (e.g., habitat model) demonstrates that they are not likely to be using the habitat in the Action Area. The potential for effects to Indiana bats from tree removal during the unoccupied timeframe is based on the well-documented knowledge that Indiana bats exhibit strong fidelity to their summer roosting areas and foraging habitat (Kurta et al., 2002; Garner and Gardner, 1992; USFWS, 2007). Indiana bats that return to their summer roosting area and find it removed must find new roost trees (Kurta and Rice, 2002), and potentially new foraging areas. This extra energy expenditure could detract from an individual's ability to carry out necessary functions after migration (e.g., thermoregulation during cool spring weather, gestation) or cope with other stressors (e.g., unseasonably cold temperatures, WNS; Kurta and Rice, 2002). Additionally, the removal of maternity roost trees can lead to the fragmentation or break up of the maternity colony (Sparks, 2003; Silvis et al., 2014).

Qualifying projects will not remove primary roost trees unless site-specific information (e.g., habitat model) demonstrates that Indiana bats are not likely to be using them. Some alternate roost trees may be removed. Maternity colonies typically use 10 to 20 trees each year, but only one to three of these are primary roosts used by most bats for some or all of the summer (Callahan, 1993; Callahan et al., 1997). The use of alternate roosts may be a way of discovering new primary roosts since Indiana bats must maintain an awareness of suitable replacements of their ephemeral roosts (Kurta et al., 2002, 1996). Colony dynamics are complex, and the importance of alternate roost trees is not well understood (Silvis et al., 2014). The conservation measures will minimize the indirect effects of alternate roost tree removal by limiting removal to areas that do not result in a gap in the canopy. This conservation measure reduces the potential number of alternate roost trees that may be removed, making it unlikely that any project would remove a significant portion of a colony's alternate roost trees.

Some trees used by summer roosting males may be removed. Males have been found roosting in smaller diameter trees than females and may be more tolerant of shaded sites (Kurta and Rice, 2002). Adult males of most species of bats likely enter torpor in summer more frequently than reproductive females, and hence, can likely use a wider range of roosting situations than females (Barclay and Kurta, in press). The current information suggests that males are more flexible in their summer roosting habitat requirements and could likely better adapt to tree removal than females.

Qualifying projects will not remove trees within 0.5 miles of a known Indiana bat hibernacula. Because of this, it is unlikely for spring staging habitat to be in a project area; however, some trees used by fall swarming bats may be removed while they are unoccupied. The limited studies on roosting habitats of Indiana bats in fall have shown that roost switching occurs every two to three days (Gumbert et al., 2002; Kiser and Elliot, 1996). The conservation measures limit the number of potential roost trees that may be removed, making it unlikely that any project would remove a significant portion of trees used during fall swarming.

Based on the information available to us about the roosting behaviors of Indiana bats and the limited amount of roost trees that would be removed by qualifying projects, we believe that any effects on the Indiana bat from tree removal associated with qualifying projects would be insignificant.

## **CONCLUSION**

The Indiana Bat Determination Key will provide the user with a conclusion for the Indiana bat. If the project would adhere to the species-specific conservation measures listed in the Proposed Action, the conclusion will state that the project is consistent with a “no effect” or a “may affect – not likely to adversely affect” determination for Indiana bat.

## **LITERATURE CITED**

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