# Endangered Species Management Plan for the Indiana Bat, *Myotis sodalis*, and Northern Long-Eared Bat, *Myotis septentrionalis*

## Iowa Army Ammunition Plant
## Des Moines County, Iowa

## July 2015

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AMC | U.S. Army Materiel Command |
| AR | U.S. Department of the Army Regulation |
| BA | Biological assessment |
| BCM | Bat Conservation and Management Inc. |
| BO | Biological opinion |
| CEC | Copperhead Environmental Consulting Inc. |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| dB | Decibel |
| dbh | Diameter at breast height |
| EIS | Environmental impact statement |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESMP | Endangered species management plan |
| EVE | EarthView Environmental LLC/Inc. |
| FR | Federal Register |
| Hz | Hertz |
| IAAAP | Iowa Army Ammunition Plant |
| IDNR | Iowa Department of Natural Resources |
| INRMP | Integrated natural resources management plan |
| lb | Pound |
| LOE | Level of effort |
| mm | Millimeters |
| NMFS | National Marine Fisheries Service |

| | |
|---|---|
| Stantec | Stantec Consulting Service Inc. |
| Tetra Tech | Tetra Tech EM Inc. |
| USACE | U.S. Army Corps of Engineers |
| USGS | U.S. Geological Survey |
| USFWS | U.S. Fish and Wildlife Service |
| WNS | White-nose Syndrome |

## EXECUTIVE SUMMARY

Background: U.S. Department of the Army Regulation (AR) 200-1, "Environmental Protection and Enhancement", requires installations to implement programs and develop endangered species management plans (ESMP) to protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the Endangered Species Act of 1973, as amended (ESA). The federally listed endangered Indiana bat (*Myotis sodalis*) and the federally listed threatened northern long-eared bat (*Myotis septentrionalis*) are the only federally listed species known to occur at the Iowa Army Ammunition Plant (IAAAP). A biological survey conducted at IAAAP in 1998 by Tetra Tech EM Inc. (Tetra Tech) captured and radio-tracked two lactating Indiana bats. Their study indicated that Indiana bats forage and potentially roost at the installation. One northern long-eared bat was also captured during this survey. In 2003, an additional survey was conducted by Bat Conservation and Management Inc. (BCM). BCM captured six Indiana bats, and radio-tracking recorded the bats day roosting in trees at IAAAP. BCM also captured five northern long-eared bats. Although foraging and potential roosting habitat at IAAAP may comprise only a relatively small fraction of the Indiana bat and northern long-eared bat's total summer ranges and is not considered to be "critical" (i.e., not listed in the September 24, 1976 Federal Register (FR) (41 FR 41914) as habitat essential to the conservation of the species and requiring special management considerations or protection) the U.S. Army understands that this habitat is important to the local population and potentially to the long-term survival of these species. This ESMP has been prepared to support IAAAP in meeting AR 200-1 requirements. The management prescriptions presented in this document are consistent with AR 200-1, current management guidelines for the Indiana bat and northern long-eared bat, and the installation's military mission. In addition, this ESMP is a component of IAAAP's integrated natural resources management plan (INRMP) (IAAAP 2013).

Current Species Status: The Indiana bat was first listed as a federal endangered species throughout its range on March 11, 1967 (32 FR 4001), under the Endangered Species Preservation Act of 1966. Researchers have primarily attributed the decline of the Indiana bat population to direct and indirect actions of humans and to natural hazards. Based on censuses taken at hibernation sites, the total known population of the Indiana bat is estimated to have declined from 550,000 in 1980 and 1981 to 353,185 in 1997. However, recent hibernacula census data estimated the range-wide Indiana bat population at 534, 239 individuals.

On April 2, 2015, the U.S. Fish and Wildlife Service (USFWS) published a final rule in the Federal Register designating the northern long-eared bat as a threatened species under the ESA throughout its geographic range (50 CFR Part 17). The listing and associated 4(d) rule became effective on May 4, 2015. No critical habitat is designated at this time (50 CFR Part 17). The decline of the northern long-eared bat population is primarily attributed to the spread of White-nose Syndrome (WNS). Direct and indirect actions of humans may have also attributed to this species decline. Based on various surveys, the northern long-eared bat population has declined between 93 to 99 percent.

Habitat Requirements and Limiting Factors: The Indiana bat and northern long-eared bat require two distinct types of habitat: (1) winter hibernation sites and (2) summer roosting sites and foraging areas. During the winter, both species of bats generally hibernate in caves, although abandoned mines have also been used. During the summer, the Indiana bat and northern long-eared bat roost beneath slabs of loose bark of trees in wooded areas in upland and bottomland forests. The Indiana bat has been observed to occupy two types of maternity roosts: primary (more than 30 bats) and alternate (fewer than 30 bats). Northern long-eared bat maternity roosts typically comprise less than 60 individuals. Both species forage in upland, floodplain, and riparian forest or in open areas. The diets of the Indiana bat and northern long-eared bat primarily consist of small, soft-bodied insects such as small moths (Lepidoptera), flies (Diptera), caddis flies (Trichoptera), beetles (Coleoptera), and true bugs (Hemiptera). The Indiana bat's diet also includes bees and wasps (Hymenoptera), stoneflies (Plecoptera), and lacewings (Neuroptera); while northern long-eared bats also prey on spiders (Arachnid). Insufficient data are currently available to conclude whether lack of summer habitat availability is a limiting factor to the recovery of the Indiana bat. Until such information is obtained, recovery guidelines include a conservative approach to evaluating the potential effects of land use practices on the summer habitat of the species.

Management Objectives and Conservation Goals: The primary objectives of this ESMP are to identify the ecosystem elements present at IAAAP that support the Indiana bat and northern long-eared bat and to present management practices that are important to the local Indiana and northern long-eared bat populations and potentially to the long-term survival of these species. Therefore, the following conservation goals have been established at IAAAP:

- Continue to conserve existing Indiana bat foraging and summer maternity roosting habitat at IAAAP and begin conserving foraging and roosting habitat for the northern long-eared bat.

- Continue to monitor trends in the Indiana bat population and implement monitoring for the northern long-eared bat population at IAAAP.

- Continue to educate individuals who have a potential impact on the Indiana bat regarding the species and its presence at IAAAP and begin educating individuals who have a potential impact on the northern long-eared bat.

- Continue communicating with the USFWS regarding the status of the Indiana bat at IAAAP and begin communicating with USFWS about the status of the northern long-eared bat.

Compliance with this ESMP is consistent with principles of ecosystem management used at IAAAP and supports applicable conservation goals outlined in the USFWS Indiana bat recovery plan and the USFWS northern long-eared bat planning guidance.

Actions Needed: The following general actions encompass the management prescriptions detailed in the ESMP portion of the document and are consistent with the conservation goals listed above.

- Incorporate Indiana bat habitat conservation guidelines and northern long-eared bat conservation measures into existing IAAAP activities that might impact the Indiana bat and northern long-eared bat, including agricultural management; construction, demolition, and environmental remediation; training exercises; hunting and other outdoor recreation; operating contractor activities; and test firing. Management prescriptions in the ESMP will primarily affect these activities from April 1 through September 30.

- Implement a species and habitat monitoring program at IAAAP for the northern long-eared bat and continue the species and habitat monitoring program at IAAAP for the Indiana bat.

- Implement an awareness program for IAAAP employees and visitors to promote conservation of the northern long-eared bat and its roosting and foraging habitat and continue the awareness program for the Indiana bat.

- Report findings of species and habitat monitoring activities to the USFWS Region 3 Rock Island Field Office.

For activities that IAAAP is considering undertaking, funding, permitting, or authorizing that are outside the scope of management prescriptions or have a potential impact on the Indiana bat or northern long-eared bat, IAAAP will engage in necessary ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office.

Total Estimated Cost of Conservation Actions: The total estimated cost of conservation actions over the next five years of this ESMP is presented in the table below. Table 1 of the ESMP provides a more detailed description of the time, costs, and personnel needed to implement each management prescription.

| Fiscal Year | Estimated Annual Cost |
|---|---|
| 2015 | 5,700 |
| 2016 | 55,200 |
| 2017 | 5,200 |
| 2018 | 5,200 |
| 2019 | 6,200 |
| 5-Year Total | 77,500 |

This ESMP represents the U.S. Army's commitment to Indiana bat and northern long-eared bat conservation. Beneficial impacts of implementing the management prescriptions include conservation of existing Indiana bat and northern long-eared bat foraging and summer maternity roosting habitat, gathering of additional scientific data on the Indiana bat and northern long-eared bat during monitoring, and sharing of information among all responsible and interested parties.

# 1.0 INTRODUCTION

This endangered species management plan (ESMP) details management prescriptions for conservation of the federally listed endangered Indiana bat (*Myotis sodalis*) and the federally listed threatened northern long-eared bat (*Myotis septentrionalis*) at the Iowa Army Ammunition Plant (IAAAP) located in Des Moines County, Iowa. This document was prepared in accordance with the "Manual for the Preparation of Installation Endangered Species Management Plans" (U.S. Army Environmental Center 1995) and is organized in the following sections:

- Section 1.0, Introduction, discusses the goals and policies associated with this ESMP and responsible and interested parties.
- Section 2.0, Background Information, describes IAAAP and its military mission as well as the affected environment at the installation.
- Section 3.0, Species Information, provides information on the Indiana bat and northern long-eared bat, including their physical descriptions, distributions, habitat and behaviors, and life histories; the reasons for their decline; conservation measures; and their status at IAAAP.
- Section 4.0, IAAAP Conservation Goals, summarizes the installation's goals as they relate to protecting the Indiana bat and northern long-eared bat and their habitat at IAAAP.
- Section 5.0, Management Prescriptions, presents management prescriptions that will be implemented at IAAAP to meet its conservation goals.
- Section 6.0, ESMP Implementation, discusses how IAAAP will implement the plan in terms of compliance review; ESMP review; and time, costs, and personnel.
- Section 7.0, References, lists the sources of information used to prepare this ESMP.

The following appendixes are included to supplement the ESMP:

- Appendix A, Glossary, defines key terms used in this ESMP.
- Appendix B, Persons Consulted During ESMP Preparation, lists the individuals who provided information for this ESMP.
- Appendix C, IAAAP ESMP Annual Compliance Checklist, presents a questionnaire for IAAAP to use in evaluating its compliance with the management prescriptions.

## 1.1 GOALS AND POLICIES

U.S. Department of the Army Regulation (AR) 200-1, "Environmental Protection and Enhancement" (U.S. Army 2007), requires installations to implement programs that protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the Endangered Species Act of 1973, as amended (ESA). Specifically, Chapter 4-3 of AR 200-1 requires that an installation prepare ESMPs for listed threatened and endangered species on the installation. The Indiana bat, a federally listed endangered species, has been determined to be foraging and potentially roosting at IAAAP. The northern long-eared bat, a federally listed threatened species, was also recorded at IAAAP (Tetra Tech EM Inc. [Tetra Tech] 1998; Chenger 2003). As a result, this ESMP has been prepared to support IAAAP in meeting the requirements of AR 200-1. The management prescriptions presented in this document are consistent with AR 200-1, current management guidelines for the Indiana bat and northern long-eared bat, and the installation's military mission. In addition, this ESMP incorporates IAAAP's principles of ecosystem management, the objectives of which are to restore ecosystems where practical and create optimum habitat for all wildlife species, including the Indiana bat and northern long-eared bat. Specifics regarding these objectives are presented in IAAAP's integrated natural resources management plan (INRMP; IAAAP 2013) and this ESMP is incorporated into that document.

## 1.2 REPONSIBLE AND INTERESTED PARTIES

Successful implementation of the management prescriptions outlined in this document requires a cooperative effort among various parties. IAAAP is the party directly responsible for implementing the ESMP. Specifically, the commanding officer is directly responsible for overall management of IAAAP and is legally liable for complying with the laws associated with implementing the ESMP. The natural resources manager is the individual primarily responsible for implementing the plan. The natural resources manager is also responsible for the following programs:

- Forestry management
- Agricultural outlease management
- Pest management
- Fish and wildlife management
- Threatened and endangered species management
- Cultural resources management
- Wetland management

Major partners in implementing the ESMP include the following parties:

- The U.S. Army Materiel Command (AMC), which oversees the natural resource management activities of AMC installations, including IAAAP, across the country.
- The U.S. Army Joint Munitions Command (JMC), a major subordinate command of AMC which is the first line of support for IAAAP and provides IAAAP with natural resources support, guidance, and expertise.
- The U.S. Fish and Wildlife Service (USFWS), the regulatory authority under the ESA that provides regulatory and technical guidance concerning conservation and protection of Indiana bat and northern long-eared bat habitat at IAAAP.
- The U.S. Army Corps of Engineers (USACE), which assists IAAAP with natural and cultural resource issues and guidance needs. USACE provides agricultural leasing services and monitors the lease provisions for the natural resources manager at IAAAP. USACE also provides contractual support to the installation.
- The Iowa Department of Natural Resources (IDNR), which provides assistance to IAAAP associated with wildlife management, forest management, threatened and endangered species management, and regulatory enforcement.
- Contractors that IAAAP uses for many activities associated with munition production and natural resources.

# 2.0 BACKGROUND INFORMATION

This section describes IAAAP and its military mission as well as the affected environment addressed in this ESMP. Additional details about the affected environment at IAAAP are presented in the INRMP (IAAAP 2013).

## 2.1 IAAAP DESCRIPTION AND MILITARY MISSION

IAAAP is located approximately 5 miles west of Burlington and immediately south of Middletown in Des Moines County, Iowa. The installation occupies approximately 19,024 acres, most of which is fenced (IAAAP 2013). IAAAP is bordered by U.S. Highway 34 and State Highway 79 to the north and Skunk River Road to the south (see Figure 1).

The installation's main features include more than 1,000 buildings; several "yards" containing munition storage magazines and igloos; leased agricultural land; more than 222 miles of roads and railroads; three major creeks; and extensive woodlands. About 7,500 acres of the installation is comprised of agricultural outlease which include row crop, hay, and grazing leases. There are approximately 100 acres of improved grounds at IAAAP. These grounds require annual maintenance and include administrative lawns, ball fields, drill fields, and cemeteries. Approximately 7,766 acres of the installation is classified as semi-improved grounds. These grounds require little to no maintenance and are mainly forest lands. There are approximately 3,758 acres of unimproved grounds, most of which consist of "temporary use" lands, pavement, buildings and structures, and ammunition storage (IAAAP 2013).

From September 1941 until August 1945, IAAAP produced artillery rounds, ammunition components, and large, aerial bombs. At the end of World War II, installation work was limited to long-term storage surveillance, renovation, demilitarization, and reconditioning of wartime munitions. Conventional and nuclear weapons were produced at IAAAP during the Korean War. Installation production and the number of personnel present tapered off from the end of that war until the mid-1960s. The Vietnam War renewed installation production of artillery rounds, grenade components, demolition blocks, antipersonnel mines, and mortar rounds. This production continued through the 1970s. Installation buildings were upgraded and modern production facilities and equipment were added in the 1980s. In the early 1990s, demilitarization of conventional ammunition became an additional mission of the installation.

Currently, IAAAP's military mission consists of demilitarizing conventional ammunition, producing and storing ammunition, performing research, and developing warheads and large-caliber projectiles.

In addition to the activities required to support this mission, the installation supports such activities as cattle grazing and row cropping; and outdoor recreation, including hunting and fishing.

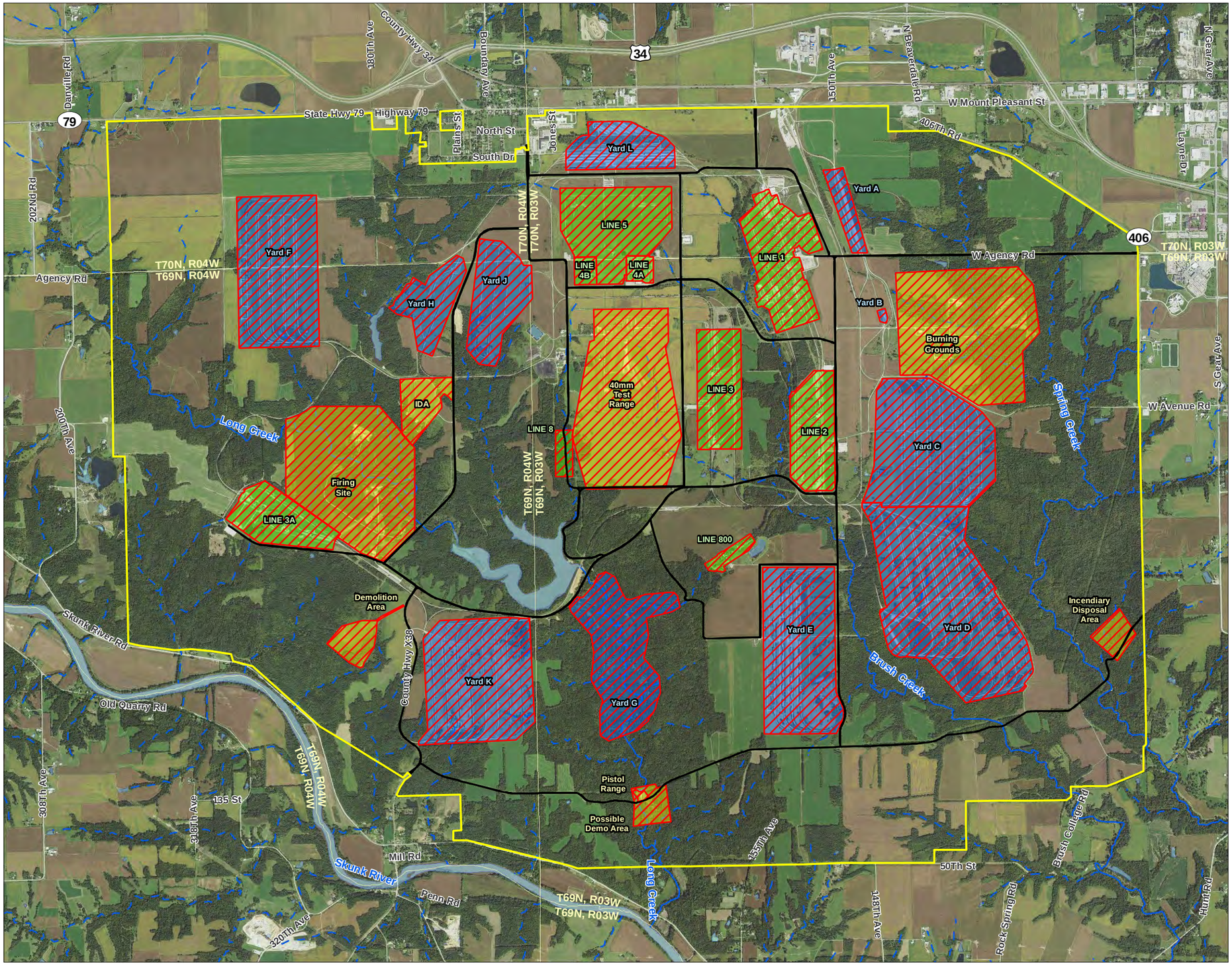



Figure No.
1

Title
Installation Layout

Client/Project
American Ordnance, LLC
Iowa Army Ammunition Plant

Project Location
Adams Co., IA

193703389
Prepared by JD on 2015-01-26
Technical Review by SF on 2015-01-26
Independent Review by SV on 2015-03-04

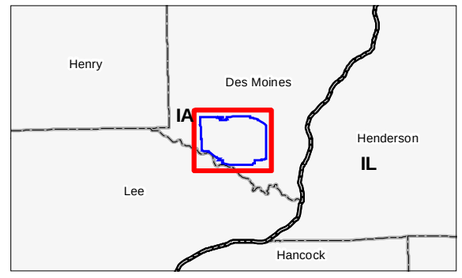
0 1,750 3,500 Feet

1:42,000 (At original document size of 11x17)

N

Legend
- Perimeter Fence
- Restricted Areas
- Roads
- Production Lines
- Storage Areas
- Misc Areas

National Hydrography Data
- Perennial Stream
- Intermittent Stream
- Waterbody




Notes
1. Coordinate System: NAD 1983 StatePlane Iowa South FIPS 1402 Feet
2. Data Sources Include: Stantec, Adams LLC, USGS, Esri
3. Orthophotography: 2014 NAIP

Stantec

## 2.2 AFFECTED ENVIRONMENT

The installation contains approximately 20 miles of streams. The following three major watersheds drain IAAAP: (1) Spring Creek, (2) Brush Creek, and (3) Long Creek. These three creeks flow year-round, generally from the northwest to the southeast and typically average less than 16 feet wide and 6 inches deep. Spring Creek flows directly into the Mississippi River, which is about 8 miles east of IAAAP. Brush Creek empties into the Skunk River, a major tributary of the Mississippi River. Long Creek flows into Mathes Lake before leaving IAAAP on the southern boundary and joining the Skunk River. A fourth watershed contains six intermittent streams along the southwestern perimeter of the installation; the six streams are tributaries of the Skunk River (IAAAP 2013). Currently, there are three reservoirs at the installation: Mathes Lake, Stump Lake, and an emergency water reservoir. Mathes Lake was created by damming Long Creek in 1940 and Stump Lake was created by damming an unnamed tributary of Long Creek in 1957 (Horton et al. 1996). The emergency water reservoir was created in the 1940's and was used to supply emergency shutdown water for the boilers the main heating and power plant.

Approximately 7,800 acres of woodland are managed at IAAAP, 95 percent of which is hardwood forest (IAAAP 2013). Upland areas at IAAAP are characterized by oak and hickory forests and are generally dominated by northern red oak (*Quercus rubra*), white oak (*Quercus alba*), shagbark hickory (*Carya ovata*), and bitternut hickory (*Carya cordiformis*). Other tree species present in upland areas at IAAAP include box elder (*Acer negundo*), shingle oak (*Quercus imbricaria*), burr oak (*Quercus macrocarpa*), chinquapin oak (*Quercus muehlenbergii*), black oak (*Quercus velutina*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), white ash (*Fraxinus americana*), wild black cherry (*Prunus serotina*), basswood (*Tilia americana*), and slippery elm (*Ulmus rubra*). Sugar maple (*Acer saccharum*) has been observed in the understory (Horton et al. 1996).

Common tree species found in lowland floodplain forests at IAAAP include eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), green ash (*Fraxinus pennsylvanica*), honey locust (*Gleditsia triacanthos*), American sycamore (*Platanus occidentalis*), northern hackberry (*Celtis occidentalis*), and black walnut. Ohio buckeye (*Aesculus glabra*) has also been identified along streams and creeks in a few areas (Horton et al. 1996).

The ecosystems bordering IAAAP consist of wetlands, relic tallgrass prairie, agricultural land, and eastern deciduous forest. The land surrounding the installation is primarily agricultural and is used for cattle grazing, row cropping, and cattle and hog production. Small businesses, such as general stores and gasoline stations, and rural homes are located around the periphery of the installation.

# 3.0 SPECIES INFORMATION

This section provides an overview of current biological and ecological information on the Indiana bat and northern long-eared bat, including their physical characteristics and distinguishing features, distributions, summer and winter habitat requirements, and life histories. Also discussed are reasons for their decline and conservation measures taken by various agencies and organizations. Finally, current statuses at IAAAP on the Indiana bat and northern long-eared bat are summarized. In general, additional study is needed to further delineate these species' distributions as well as to further define their summer habitat requirements.

## 3.1 INDIANA BAT PHYSICAL DESCRIPTION

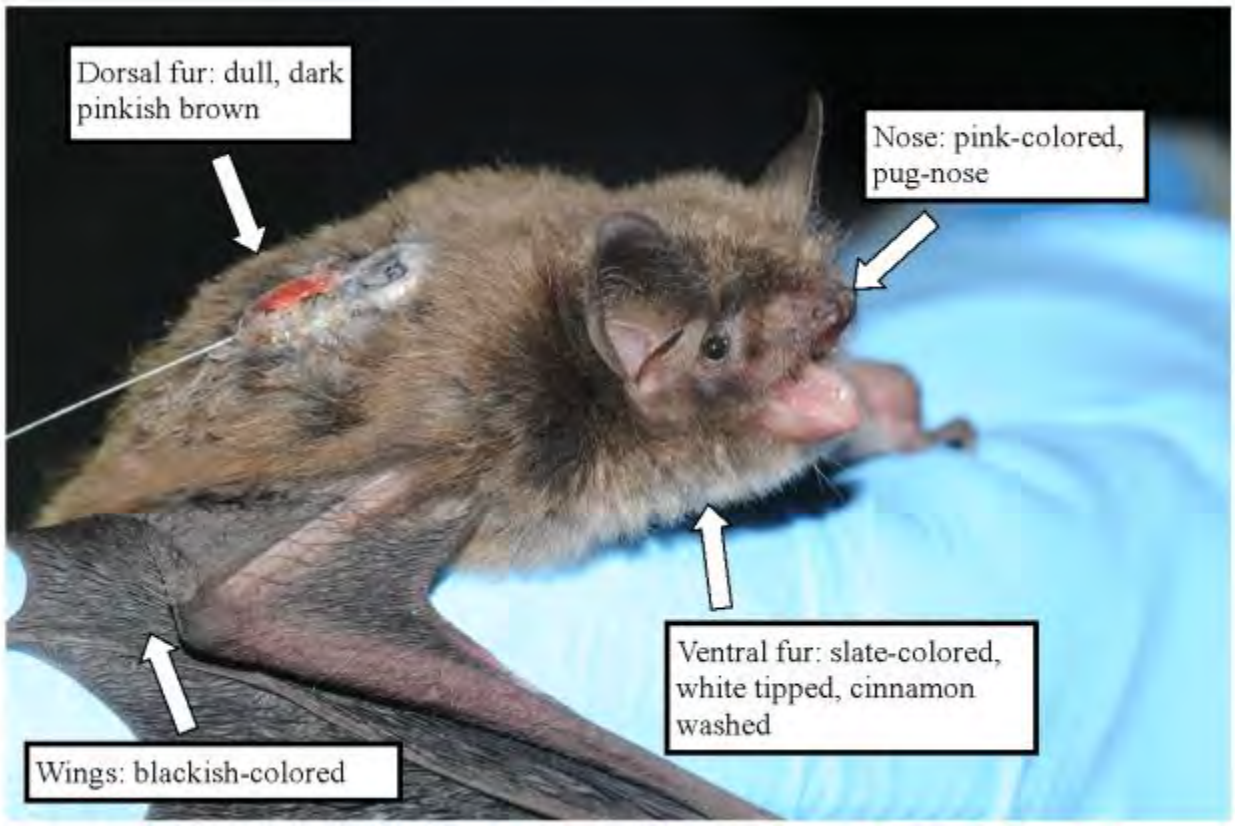
The Indiana bat's strong resemblance to the little brown bat (*Myotis lucifugus*) prevented it from being described as a separate species until 1928 when Miller and Allen (1928) formally described it as a new species from a specimen collected in 1904 at Wyandotte Cave, Crawford County, Indiana. The Indiana bat is a small, brownish bat with blackish wings (Kurta 1995); however, albino and partially white bats have been encountered in some of the larger hibernacula (Brack et al. 2005a). Dorsally, its fur is usually dull, dark pinkish brown. Ventrally, its fur is slate-colored basally; has grayish-white tips; and is washed heavily with cinnamon brown, particularly at its flanks. The Indiana bat is similar in appearance to the little brown bat and the northern long-eared bat. The Indiana bat can be distinguished from these two species based on the following characteristics: (1) the Indiana bat has smaller feet and shorter hairs on its toes (the hairs do not extend beyond the toenails); (2) the Indiana bat has a distinct keel on the calcar, a spur on the membrane between the foot and the tail; and (3) the Indiana bat has a pinkish colored pug-nose (Mumford and Whitaker 1982; Whitaker and Hamilton 1998). An illustration of the Indiana bat and its distinguishing features is presented in Figure 2.

Male and female Indiana bats measure between 1.6 to 1.9 inches from head to tail, have a typical wingspan of 9.4 to 10.5 inches, and a forearm length between 1.4 to 1.6 inches. The average weight of a female is 0.26 ounce; males are slightly smaller and average 0.25 ounce in weight (Thomson 1982).

## 3.2 INDIANA BAT DISTRIBUTION AND POPULATION

The Indiana bat is a migratory species found throughout much of the eastern half of the U.S. It occurs from Iowa, Oklahoma, Wisconsin; northeast to Vermont; and south to northwestern Florida and northern Arkansas (Barbour and Davis 1969; USFWS 2007).

**FIGURE 2 ILLUSTRATION OF THE INDIANA BAT**



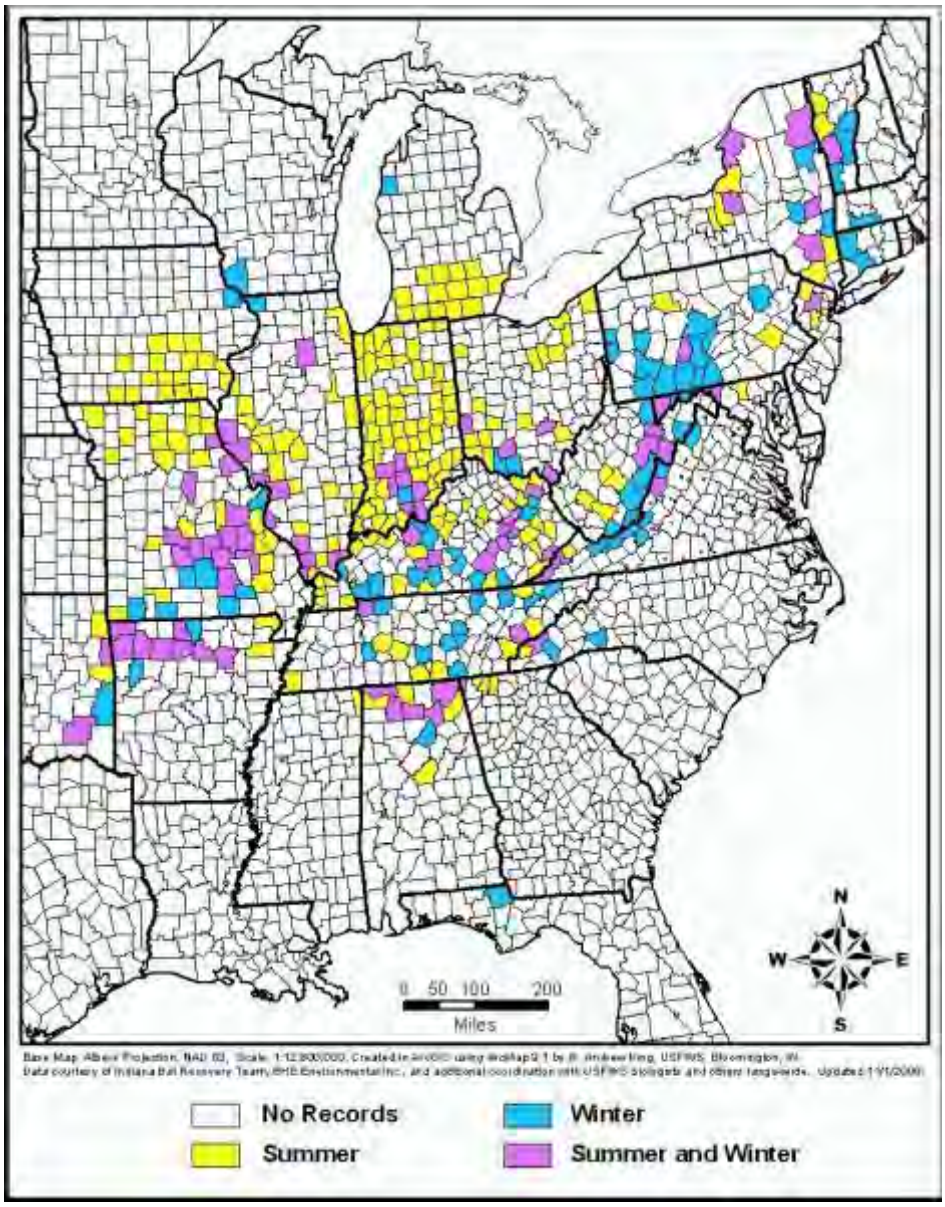

(Photo source: J. Kiser, Stantec Consulting Services Inc. [Stantec])

Figure 3 presents the range of the Indiana bat over its winter and summer range. In winter, the majority of the Indiana bat population occurs within the limestone cave region of Indiana, Kentucky, and Missouri. However, some large colonies have been found in abandoned underground mines in Illinois, Missouri, New Jersey, New York, and Ohio. Smaller hibernating populations and individual Indiana bats have been reported in Alabama, Arkansas, Connecticut, Florida, Georgia, Iowa, Maryland, Massachusetts, Michigan, North Carolina, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin (USFWS 2007). As of 2006, the Indiana bat was known from approximately 281 different hibernacula located in 19 states, including 23 Priority 1 hibernacula (i.e., sites that currently and/or historically contain winter populations having 10,000 or more Indiana bats) (USFWS 2007). Priority 1 hibernacula are located in seven states, including one site each in Illinois, Tennessee, and West Virginia; two sites in New York; five sites in Kentucky; six sites in Missouri; and seven sites in Indiana. In 2005, more than 80 percent of the Indiana bat population hibernated in the 23 Priority 1 sites (USFWS 2007). Based on 2013 hibernacula census data, the current estimated range-wide Indiana bat population is 534, 239 individuals (USFWS 2013a). Approximately 37 percent or 197,707 of these Indiana bats occur within the Ozark-Central Recovery Unit which contains the states of Missouri and Iowa, including the IAAAP (USFWS 2013a).

As of 2007, only two winter hibernation sites, both having less than five Indiana bats, are known to occur in Iowa, and both sites are caves located in Dubuque County (USFWS 2007). The closest known extant Indiana bat winter hibernation site to IAAAP is believed to be White Bear Quarry, a mine in Marion County, Missouri; this hibernaculum is about 100 miles southwest of IAAAP (Tetra Tech 2000; USFWS 2007). As of 2007, this hibernaculum was considered a Priority 4 site containing a maximum population of only 15 Indiana bats.

Summer distribution of the Indiana bat occurs throughout a wider geographic area than the winter distribution. The core summer range includes southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio. Population distribution during the summer is poorly known because of wide gaps between the known maternity colonies and an unknown amount of movement between roost sites. Summer distribution of Indiana bats occurs as far north as Michigan, New York, and Vermont; as far south as Alabama, Georgia, and Mississippi; and as far west as Iowa, Missouri, and Arkansas. Although Indiana bat maternity colonies occur throughout the densely forested mountains of the mid-eastern U.S., the species appears to be relatively less abundant, and/or less frequently documented than in the Midwest or central portion of its range (USFWS 2007). Several maternity colonies are known to occur within or nearby IAAAP in Des Moines County, Iowa (Tetra Tech 1998;

**FIGURE 3 DISTRIBUTION OF THE INDIANA BAT (WINTER AND SUMMER RANGES COMBINED)**




(USFWS 2007)

Chenger 2003; Kiser et al. 2012). In 1998, Tetra Tech captured two female Indiana bats on Brush Creek within IAAAP, but roost trees were never located for the bats. A follow-up survey conducted by Bat Conservation and Management Inc. (BCM) in 2003 captured 77 total Indiana bats, including 47 females, of which six bats were radio-tracked to five different roost sites, including a barn constructed in the 1800's. In addition to surveys completed on IAAAP, three Indiana bats were captured and tracked on Huron Island located in the Mississippi River northeast of Burlington, Iowa (Kiser et al. 2012). Thirteen Indiana bats were captured and tracked at four sites along U.S. Highway 61 north of Burlington, including nine lactating females, two post-lactating females, and two non-breeding females (Carlson et al. 2012a).

As of October 2006, the USFWS is aware of 269 maternity colonies located in 16 states that are considered to be locally extant and of these colonies 54 percent (n=164) have been found during mist net surveys since 1996 (USFWS 2007). Additionally, several new maternity colonies have been found each year since 2006, including new sites in Alabama, Georgia, Iowa, Kentucky, Ohio, and Tennessee. With the arrival of White-nose Syndrome (WNS), a deadly fungus responsible for killing millions of cave-dwelling bats, the status of most maternity colonies is unknown. In the northeastern U.S. where WNS has been present since the winter of 2007 the population of hibernating Indiana bats has declined from 70,269 individuals to 22,870 individuals, representing a 68 percent decline in the regional population (USFWS 2007 and 2013a). It is reasonable to assume that loss of such a large percentage of the wintering population would have an effect on summer maternity colonies in areas affected by WNS.

## 3.3 INDIANA BAT HABITAT REQUIREMENTS

The Indiana bat requires two distinct types of habitat: (1) winter hibernation sites (hibernacula) and (2) summer roosting sites and foraging areas.

During the winter, the Indiana bat generally hibernates in caves, although abandoned mines, abandoned railroad tunnels, and even a hydroelectric dam have also been used (USFWS 2007). The Indiana bat favors walls and ceilings in portions of the hibernaculum where temperatures are stable and between 37.4 to 45.0 °F (Tuttle and Kennedy 2002). However, other studies have reported that temperatures below 41.0 °F were too cold because higher concentrations of Indiana bats were found at sites with mid-winter temperatures of 42.8 to 44.6 °F (Brack et al. 2005b). Stable low temperatures allow Indiana bats to maintain a low rate of metabolism and conserve fat reserves through the winter until spring emergence when outside temperatures have increased and insects (food) are more abundant (Humphrey 1978; Richter et al. 1993). As with cave temperature, relative humidity in the cave also determines hibernation

site suitability for Indiana bats. According to Hall (1962), Humphrey (1978), and LaVal et al. (1977), humidity at roost sites during hibernation is usually above 74 percent, but below saturation. Cave configuration determines internal environments and larger more complex cave systems having multiple entrances are more likely to provide suitable habitat for the Indiana bat (Tuttle and Stevenson 1978; LaVal and LaVal 1980). Depending on cave environments, the Indiana bat may hibernate near the entrance where cool air seeps in from outside or deeper in the cave where cold air is trapped in a sink.

During the summer, the Indiana bat roosts beneath slabs of loose bark in trees in upland and bottomland forests or in open areas (Tetra Tech 1999b). Important roost tree characteristics include the tree's (1) condition (dead or alive), (2) species, (3) diameter, (4) exposure to the sun and location in relation to other trees, (5) proximity to water sources and foraging areas, and (6) quantity of exfoliating bark (Rommé et al. 1995). The most suitable roost sites are beneath the exfoliating bark of dead trees and have adequate space for air to circulate and for bats to change their position on the trunk (Garner and Gardner 1992). Over 30 species of tree have been documented as maternity roosts, but 87 percent of these are various ashes (*Fraxinus* spp.), elms (*Ulmus* spp.), hickories (*Carya* spp.), maples (*Acer* spp.), poplars (*Populus* spp.), and oaks (*Quercus* spp.) (Kurta 2005). Most trees used by reproductive females are deciduous, but eastern hemlock (*Tsuga canadensis*) and pitch pine (*Pinus rigida*) have been used in western North Carolina and eastern Tennessee, and white pine (*Pinus strobus*) has been used in Vermont (Britzke et al. 2003; J. Kiser, pers. obs. 2004). Additionally, various yellow pines, including loblolly (*Pinus taeda*), shortleaf (*Pinus echinata*), and pitch, have been used as summer roost trees in southern states. Even though some species of trees seem to be used at a greater frequency than others, it appears as more research is completed on roost trees, the characteristics of individual trees appear to be more important than the species. These trees typically exhibit exfoliating bark when they are senescent, severely damaged, or dead. The Indiana bat has also been observed roosting in hollow portions of tree trunks and limbs (Kurta et al. 1993a and 1993b) and in cavities (seams and splits) of lightning-struck and damaged trees (Tetra Tech 1999a). No Indiana bats are known to have been found roosting in downed trees (Tetra Tech 1999b).

The Indiana bat has been observed to occupy two types of maternity roosts: primary and alternate (Callahan et al. 1997). Primary maternity roosts are those used by more than 30 bats on more than one occasion; all other roosts are considered to be alternate maternity roosts. Differences in patterns of use between primary and alternate roosts are apparently influenced by weather conditions, with increased use of alternate maternity roost trees during periods of elevated temperature and precipitation. Live shagbark hickories have been identified as exhibiting favorable temperatures for roosting bats during cool periods

because of their relatively large thermal mass and their effective protection from precipitation because of the structural characteristics of their bark (Humphrey et al. 1977). In one study, it was observed that (1) the number of primary maternity roosts per colony ranged from one to three and (2) the radius of the smallest circle that would encompass all maternity roost trees for each maternity colony ranged from 0.5 to 0.9 mile (Callahan et al. 1997). Primary maternity roost trees have been observed to range in size from 12.2 to 29.9 inches diameter at breast height (dbh) (Callahan 1993). Alternate maternity roost trees range in size from 7.1 to 43.3 inches dbh (Garner and Gardner 1992; Callahan et al. 1997).

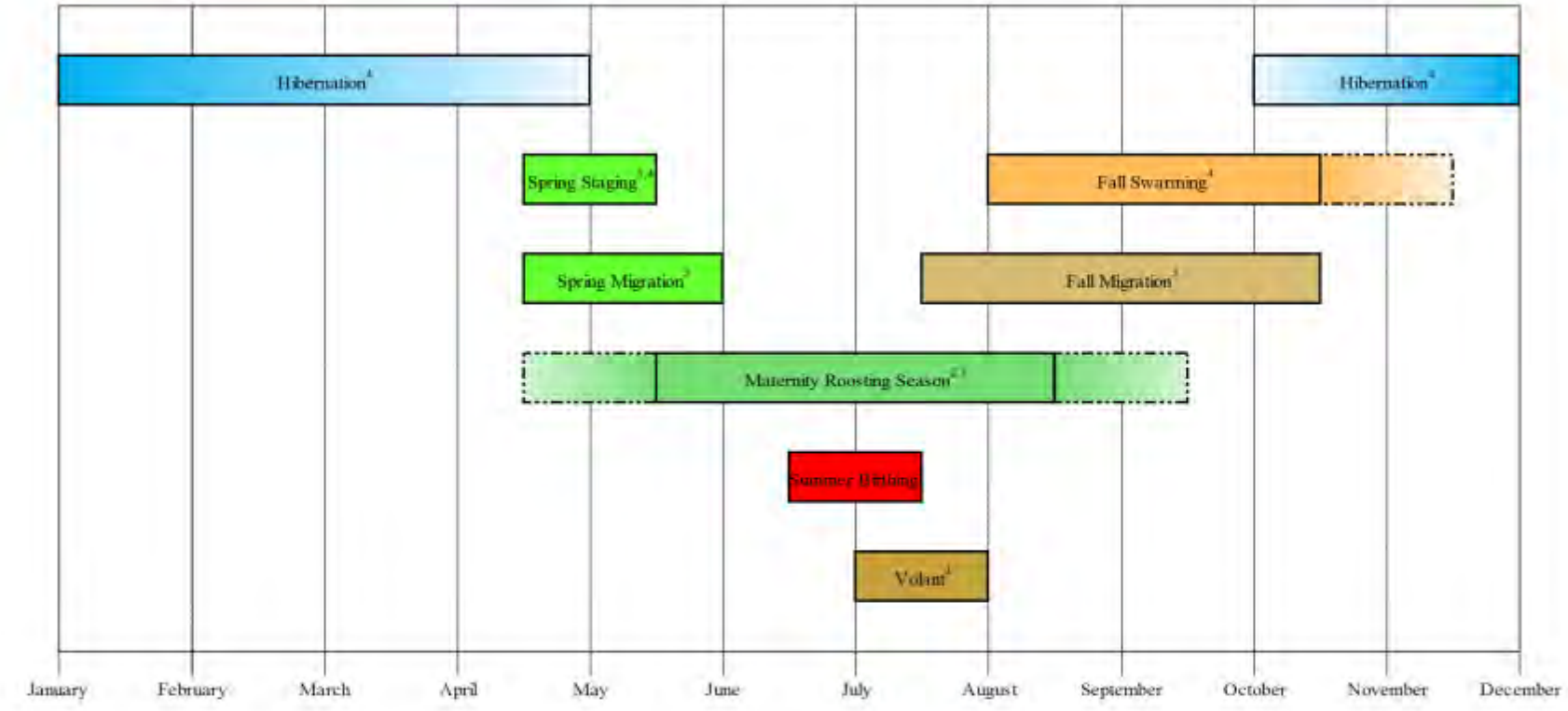
The Indiana bat forages in upland, floodplain, and riparian forested areas. Streams, associated floodplain forests, and impounded bodies of water are the preferred foraging habitat (Gardner et al. 1991). They may also forage within the canopy of upland forests, in clearings, along the borders of croplands, along wooded fencerows, and over farm ponds in pastures (Clark et al. 1987; Gardner et al. 1991). The Indiana bat usually forages and flies from 6.6 to 98 feet above ground level (Humphrey et al. 1977). The distance between maternity roosts and the geometric center of foraging areas used by pregnant Indiana bats has been observed to average 0.7 mile (Garner and Gardner 1992) and to extend up to 3.1 miles (Whitaker and Hamilton 1998).

## 3.4 INDIANA BAT LIFE HISTORY

The Indiana bat annually repeats a cycle of six life history events: (1) spring "staging" period upon its emergence from hibernation, (2) spring migration, (3) summer birthing, (4) fall migration, (5) fall "swarming" prior to hibernation, and (6) hibernation. Along with the Indiana bat's foraging habits, these events are described below and are illustrated in Figure 4.

The Indiana bat emerges from hibernation from March through May and engages in spring staging before migrating to its summer habitat. Timing of spring emergence varies depending on the hibernaculum's location and local weather conditions (Hall 1962). Spring emergence at hibernacula in the southern portion of the Indiana bat's range is earlier than at northern sites. Female bats start to leave hibernacula in late March – early April and peak emergence occurs in mid-April with few or no females remaining in early May; while most males leave the hibernacula by mid-May (Cope and Humphrey 1977; LaVal and LaVal 1980). During the spring staging period, the bats begin their feeding forays, and some copulation may also occur (Whitaker and Hamilton 1998). Female Indiana bats initiate spring staging in April while most males remain in hibernation.

**FIGURE 4 LIFE CYCLE OF THE INDIANA BAT[1]**




Notes:

1 The Indiana bat life cycle is estimated based in information available in literature.
2 This represents the Indiana bat maternity roosting season as defined by USFWS (Tetra Tech 1998; USFWS 2007).
3 Indiana bat life cycle events likely to occur at IAAAP.
4 Indiana bat life cycle likely to occur outside of IAAAP.

During spring emergence and staging, some roosting by the Indiana bat occurs outside the hibernaculum. Spring emergence roosting refers to roost sites used by the Indiana bat during the period when bats exit hibernacula and establish maternity colonies. Such roosting behavior can be exhibited during migration as observed in Pennsylvania and Tennessee, or it can occur once the bat reaches their presumed summer habitat as exhibited by bats leaving hibernacula in eastern New York (Butchkoski et al. 2006; Britzke 2003; CEC 2014). Weather conditions and distance to presumed summer habitat from hibernacula are factors that determine how many emergence/migration roost trees are used by individual bats. While tracking Indiana bats in Tennessee, Copperhead Environmental Consulting Inc. (CEC 2014) found that cold temperatures and rainfall events would force bats to stopover during long migration bouts and roost from one to several days in trees. Roost trees used by adult female Indiana bats during mid-spring period in Lake Champlain Valley of New York and Vermont are similar to those used during the summer in terms of species, size, and structure (Britzke 2003; Britzke et al. 2006). Spring roost trees used in Lake Champlain Valley include shagbark hickory, American elm, quaking aspen (*Populus tremuloides*), sugar maple, black locust (*Robinia pseudoacacia*), white ash, American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), and eastern hemlock.

Historically, spring migration of Indiana bats was thought to occur in a northerly direction, with the bats flying up to several hundred miles from hibernacula to summer maternity roosts (Barbour and Davis 1969; Whitaker and Hamilton 1998). More recently spring emergence/migration studies in New York, Pennsylvania, and Tennessee have shown bats migrating eastward and southward from their hibernacula (Butchkoski et al. 2006; Britzke 2003; Britzke et al. 2006; CEC 2014). Eighteen of 24 Indiana bats tracked from a hibernaculum in Adirondack Mountains of New York migrated quickly, within one night, for a short distance eastward to Lake Champlain Valley to their presumed summer habitat (Britzke et al. 2006). Whereas, Indiana bats from a Pennsylvania hibernaculum traveled southward to Maryland and roosted in two different trees, 83.9 miles and 91.9 miles from the mine used for hibernation (Butchkoski et al. 2006). Southerly migration patterns have been exhibited by some bats hibernating in central Tennessee as they traveled to summer habitats located in Alabama, Georgia, and Mississippi (CEC 2014). Indiana bats are known for their long migrations between winter and summer habitat. Some of the longest migration distances were documented from a summer colony in Michigan where 12 female Indiana bats migrated an average distance of 296 miles to their hibernacula in Indiana and Kentucky, with a maximum distance of 357 miles (Winhold et al. 2005; USFWS 2007).

Pregnant females segregate from males in the summer, forming small maternity colonies at summer roosting sites (Humphrey et al. 1977). Summer (maternity) colonies roost primarily under the sloughing bark of dead, dying, or live trees, and occasionally in narrow cracks of trees in both upland and riparian habitats (Gardner et al. 1991; Callahan 1993; Kurta et al. 1993b; Kiser et al. 1998; Carter 2003; Britzke et al. 2006). However, some colonies have been found in artificial roost sites. Ritzi and others (2005) have found adult females in a crevice in a utility pole and in bird-house-style bat boxes in Indiana. A rocket-style bat box was used by a group of females after the reproductive period in Illinois (Carter 2003). More recently, a large number of bats including reproductive Indiana bats have been found to use artificial bark (Brandenbark™) in Kentucky (Gumbert et al. 2013). Several colonies of reproductive Indiana bats have been found in buildings, including an abandoned church in Pennsylvania (Butchkoski and Hassinger 2002), two houses in New York (USFWS 2007), and a barn located near the IAAAP in Iowa (Chenger 2003). In comparison more than 400 roost trees have been documented for female Indiana bats (USFWS 2007).

Indiana bat maternity roost trees have been described as either primary or alternate depending on the number of bats in a colony consistently occupying the roost site (Kurta et al. 1996; Callahan et al. 1997; Kurta et al. 2002). In Missouri, Callahan (1993) defined primary roost trees as those with exit counts of more than 30 bats on more than one occasion; however, this number may not be applicable to small-to-moderate sized maternity colonies (Kurta et al. 1996). A single maternity colony typically consists of 25 to 100 bats, but can contain as many as 384 individuals (Kiser et al. 2002). Due to the differences in colony sizes across the species range, Kurta et al. (1996) used the number of "bat days" over one maternity season (one bat day = one bat using a tree for one day) to distinguish primary from alternate roosts. Primary roost trees are almost always located in either open canopy sites or in the portion of the tree used that is above the canopy cover of the adjacent trees (Kurta et al. 1996; Callahan et al. 1997; Kurta et al. 2002). Alternate roost trees can occur in either open or closed canopy habitats. Maternity colonies may use between 10 and 20 trees per year, but usually only one to three of these are considered primary roost where the majority of bats roost some or all of the summer (Callahan 1993; Callahan et al. 1997). Conversely, alternate roost trees represent the majority of trees used by a colony. These trees are typically used by individuals or small groups for only one or a few days. On the average, Indiana bats typically switch roosts every two to three days with reproductive condition of the female, roost type and weather conditions, and time of the year affecting the switching behavior (Kurta et al. 2002; Kurta 2005). Indiana bats have shown site fidelity to summer colony areas, individual roost trees (if they remain suitable), travel corridors, and foraging areas (Winhold et al. 2005; Kurta et al. 2002; Garner and Gardner 1992).

Roost trees used by Indiana bats vary in size. The minimum tree size (dbh) reported for a male roost is 2.5 inches (Gumbert 2001) and 4.3 inches for an individual female roost (Britzke 2003). Primary maternity roosts are always found in larger diameter trees usually greater than 8.7 inches dbh (Kurta 2005). Larger diameter trees provide thermal advantages to reproductive females and their pups and give them more room to move around while locating appropriate temperatures.

Some males may remain near the hibernacula throughout the year, move short distances to other caves or mines, fan out into the surrounding forest, or migrate to distant areas (Hall 1962; Whitaker and Brack 2002). Males and most often nonbreeding females roost individually or form smaller bachelor colonies apart from pregnant females (Whitaker and Hamilton 1998). When roosting in trees, male Indiana bats typically roost individually or in small groups. Males have been found roosting in early successional wetlands, riparian forest, and forest on lower and upper slopes during the summer (Brack et al. 2004; Whitaker and Brack 2002; Kiser et al. 1998). Male Indiana bats often select smaller roost trees than females and have been found roosting in trees 3.14 inches dbh during the summer, which is similar to Gumbert's (2001) autumn roost trees having a dbh of 2.5 inches. According to the USFWS (2007), the mean dbh for roost trees used by male Indiana bats is 13 inches. Unlike females, males are more tolerant of shade and have been found roosting in an early successional green ash and American elm dominated wetland in Indiana (Kiser et al. 1998). They also seem more tolerant of disturbed areas, possibly due to the unlimited potential of dead and damaged small trees that are typical of such sites. A male was tracked to a metal support bracket on a utility pole in Arkansas (Harvey 2002) and a male tracked on the Hoosier National Forest, Indiana, actually roosted in the right-of-way of Interstate 64. Male Indiana bats seem to switch roosts frequently and bats tracked during the summer in the Wayne National Forest, Ohio, switched roost trees every 2.3 days on average (Schultes and Elliott 2002).

Indiana bats may travel several miles from day roosts to foraging areas. Gardner et al. (1991) found that individuals from an Illinois maternity colony traveled 2.5 miles to foraging areas. In fragmented habitat, bats will use hedge rows and other features on the landscape as travel ways between foraging areas and day roosts (Murray and Kurta 2004). Rather than crossing open habitats (e.g., pasture land, open water, agricultural fields) Indiana bats increased their travel distance by 55 percent in Michigan to take advantage of the protective cover of tree-lines (Murray and Kurta 2004). Indiana bats will

forage in both upland and floodplain forest (Brack and LaVal 1985; Humphrey et al. 1977; LaVal and LaVal 1980; Gardner et al. 1991; Kiser and Elliott 1996).

In a study area where over 60 percent of the landscape was either agricultural fields or urbanized areas Kurta et al. (2002) found 12 of 13 foraging sites used by a colony to be dominated by forest. Forested habitats are very important for foraging bats, but old fields and agricultural areas seem to also be somewhat important habitats in studies completed in Indiana (USFWS 2007). Sparks et al. (2005) found Indiana bats spending nearly 50 percent of their time foraging over agricultural fields. Indiana bats, using open habitats for foraging, are probably utilizing forest-field edges and crowns of large scattered trees within the open canopy habitats. Visual observations by Brack (1983) found Indiana bats foraging over open fields and bodies of water located more than 150 feet from a forest edge, but this type of habitat was used less frequently than the forested habitats and forest edges. Forest cover is clearly important for both roosting and foraging and the loss of such habitat has been cited by numerous authors as part of the decline of Indiana bats (USFWS 1983; Gardner et al. 1990; Garner and Gardner 1992; Drobney and Clawson 1995; Whitaker and Brack 2002). However, forest cover varies widely at the scale of individual maternity sites in some states (i.e., Indiana); where land cover within 2.5 miles of the primary roosts of known maternity colonies range from 9 percent to over 80 percent forested (USFWS 2007).

Because Indiana bats exhibit strong site fidelity to their summer roosting and foraging habitat, summer sites are essential to the reproductive success of local populations (Humphrey et al. 1977). In general, the non-hibernating roosting season occurs between April 1 and September 30 (Tetra Tech 1999c), but can extend to October 31 if in close proximity to hibernacula.

Female Indiana bats give birth in late June or early July after they have grouped into maternity colonies (USFWS 1983). Each female Indiana bat usually bears one pup per year, although two pups have occasionally been reported (Cope and Humphrey 1977). After the young are born, maternity colonies can consist of up to 130 bats (Humphrey et al. 1977). Young Indiana bats are volant, or capable of flight, within a month of their birth. Early-born young may be flying as early as the first week of July (Clark et al. 1987); however, most young probably begin flying in mid to late July. After the young bats gain their independence, migration back to the hibernacula begins; the males tend to precede the females (Whitaker and Hamilton 1998). Females can live at least 15 years, and males can live at least 14 years (Cope and Humphrey 1977).

Indiana bats begin to arrive at their hibernacula in late July. The number of bats arriving at the hibernacula peaks in September and October, with the numbers of males and females arriving about equal (Whitaker and Hamilton 1998). Upon arriving at the hibernacula, Indiana bats engage in a behavior known as fall swarming. Swarming is characterized by large numbers of Indiana bats coming together in a mating frenzy at the entrances of hibernacula before hibernating. Sperm is transferred to the females during swarming, but ovulation and fertilization of eggs are delayed until after the end of hibernation in spring. By late September, many females begin hibernation, and swarming bats are predominantly male. Males continue swarming until mid-October or later in an apparent effort to breed with late-arriving females (Cope and Humphrey 1977). During swarming, Indiana bats day roost under sloughing bark of trees near the cave and travel to the entrance each night (Kiser and Elliott 1996). Roost trees used during autumn, range from 4.6 to 25 inches dbh and occur primarily on ridge-tops and upper slopes (Kiser and Elliott 1996). As with summer roosts, site fidelity to autumn roosting areas is exhibited by male Indiana bats (Gumbert et al. 2002). Male Indiana bats typically remain active longer during autumn than do females. Once arriving at hibernacula, females may only remain active for a few days where as males remain active, seeking mates, into late October and early November.

In general, the Indiana bat hibernates from October through April, depending on local weather conditions (Hall 1962; LaVal et al. 1977). Both sexes are found in hibernating groups, usually in tightly packed clusters of 300 to 350 bats per square foot on walls and ceilings (Hofmann 1996). They are often clustered to the extent that only their faces, ears, and wrists are visible (Whitaker and Hamilton 1998).

When the Indiana bat is not hibernating, it is nocturnal, usually foraging for one to two hours after sunset and before sunrise (Hofmann 1996). Clark et al. (1987) reported mist netting Indiana bats as early as 14 minutes after sunset and as late as 22 minutes before sunrise. Foraging activity is usually interrupted by periods of rest, referred to as night roosting. Most Indiana bats apparently use trees as night roosts (Butchkoski and Hassinger 2002; Murray and Kurta 2004), although they do occasionally utilize bat boxes (Butchkoski and Hassinger 2002), and concrete bridges (Kiser et al. 2002). Night roosting is considered to be any time a bat stops flying during the night. The purpose of night roosts is to provide bats a resting place between foraging bouts; promote digestion and energy conservation; provide retreats from predators and inclement weather; provide places to ingest food transported from

nearby feeding areas; function as feeding perches for sit-and-wait predators; and serve as a place to promote social interactions and information transfer (Ormsbee et al. 2007).

The Indiana bat is an opportunistic forager, feeding on a variety of small insects. The diet of Indiana bats varies between habitats, geographic locations, season, sex, and age of bats (Kurta and Whitaker 1998; Brack and LaVal 1985; Belwood 1979). Sparks and Whitaker (2004) summarized food habit studies conducted over 30 years and determined that Indiana bat's diet consisted primarily of insects belonging to the orders Diptera (flies), Lepidoptera (moths) and Coleoptera (beetles), but when locally abundant, Trichoptera (caddisflies) and Hymenoptera (wasps and ants) may be the predominant food. Several pest species including mosquitoes (Diptera:Culicidae), Asiatic oak weevil (*Cyrtepistomus castaneus*), spotted cucumber beetle (*Diabrotica undecimpunctata*), and Hessian fly (*Mayetoila destructor*) are also consumed by Indiana bats when locally abundant (Sparks and Whitaker 2004; Kurta and Whitaker 1998; Kiser and Elliott 1996). The Indiana bat captures and consumes prey during flight by using echolocation, during which the bat emits high-frequency sound waves that bounce off potential prey. From the speed and direction of the returning sound waves, the bat can determine the location, the size, and potentially the identity of an insect (Ohio Division of Wildlife 1996).

## 3.5 REASONS FOR INDIANA BAT DECLINE

Researchers have attributed the overall decline of the Indiana bat population primarily to direct and indirect actions of humans and to natural hazards. Human causes of the population decline include (1) hibernacula disturbance and vandalism, (2) elimination of forest cover, and potentially (3) pesticide poisoning. Long-term data and documentation for population decline causes are not available or are limited for most populations of Indiana bats; however, habitat modification has been the primary reason for declines. Modifications at winter hibernacula have affected the thermal regime of many caves; thus, resulting in the inability of the cave to support hibernating Indiana bats. Most of these modifications were human induced for either commercialization of the cave, to control cave access, or for mining. Improper gating and other structures have rendered many historical hibernacula unavailable to Indiana bats. Other documented threats involving hibernacula include human disturbance, vandalism, indiscriminate collecting, handling and/or banding of hibernating bats, flooding of caves, and destruction by limestone quarries. Recreational cave explorers and researchers who disturb hibernacula are believed to cause bats to exhaust their limited fat reserves before spring, resulting in mortality. Vandalism and destruction of hibernacula and their occupants have also been

documented (USFWS 1983). Natural alterations of hibernacula can include flooding, entrance and passage collapse, and blocked sinkholes, which can all alter the temperature regime within the cave and even prevent entry by bats. Natural and human-induced changes to hibernacula can alter the climate required by the Indiana bat, which adversely affects the population. The fact that the Indiana bat hibernates in large clusters in a few caves makes it especially vulnerable, as an extreme disturbance can destroy a significant percentage of the total species population (Mumford and Whitaker 1982; Whitaker and Gammon 1988).

Summer habitat modification is also suspected to have contributed to the decline of Indiana bat population. Forests used by foraging and roosting Indiana bats during spring, summer, and autumn have changed dramatically from pre-settlement conditions. The forests have been fragmented in areas; fire has been suppressed; and much of the vegetation in flatter terrain has been converted for agricultural purposes. Summer habitat can include small woodlots connected by hedgerows or extensive forests. The removal of such habitats is occurring rapidly in some portions of the Indiana bat's range due to urban development, mining, and other infrastructure, including roadways and utility corridors.

Although pesticide-related mortality has not been documented for the Indiana bat, several researchers regard agricultural pesticides as a possible cause of the decline in this species in certain regions (Evans et al. 1998; Garner and Gardner 1992). The correlation of acute or chronic toxicity to population declines is still unknown and further research is needed.

More recently, climate change has been suggested as a cause of population shift from southern hibernacula to northern hibernacula (Clawson 2002). According to the USFWS (2007), hibernacula in the southern region in 1965 contained 79 percent of the range-wide population, but as of 2005 (pre-WNS) they only constituted 40 percent of the range-wide populations. During this time period, hibernacula in New York more than doubled in population, increasing from 20,200 bats to 41,702 bats (USFWS 2007). However, this trend quickly reversed after 2007 when WNS, was identified in a cave in New York. The disease is named for the white fungus, *Pseudogymnoascus destructans*, which infects the skin of the muzzle, ears, and wings of hibernating bats. WNS is a newly emergent disease of hibernating bats that has spread from the northeastern to the central U.S. In the northeastern U.S. where WNS has been present since the winter of 2007 the population of hibernating Indiana bats has declined from 70,269 individuals to 22,870 individuals; 68 percent decline in the

regional population. Currently, WNS is known from 25 states, including Iowa, and five Canadian Provinces and is expected to continue to move westward.

## 3.6 INDIANA BAT CONSERVATION MEASURES

The Indiana bat was first listed as a federal endangered species throughout its range on March 11, 1967 (32 Federal Register [FR] 4001), under the Endangered Species Preservation Act of 1966 (80 stat. 926; 16 U.S. Code 668aa[c]). A recovery plan for the Indiana bat was developed by a USFWS-sponsored recovery team in 1983 and is currently being revised (USFWS 1983 and 2007). The recovery plan identifies the following goals to meet the primary objective of removing the Indiana bat from its endangered status:

- Preventing disturbance to hibernacula.
- Preventing the spread of WNS.
- Maintaining, protecting, and restoring foraging and summer maternity roosting habitat.
- Monitoring population trends and educating the public.
- Conducting research.

To date, conservation efforts have primarily featured protection of hibernacula and research into the life history of the Indiana bat. On September 24, 1976, the 11 caves and two mines listed below were designated as "critical" habitat for the Indiana bat (41 Federal Register [FR] 41914): Critical habitat is defined as being essential to the conservation of the species and requiring special management considerations or protection (USFWS and NMFS 1998).

- Big Wyandotte Cave in Crawford County, Indiana
- Ray's Cave in Green County, Indiana
- Blackball Mine in LaSalle County, Illinois
- Bat Cave in Carter County, Kentucky
- Coach Cave in Edmonson County, Kentucky
- Cave 021 in Crawford County, Missouri
- Cave 009 in Franklin County, Missouri
- Cave 017 in Franklin County, Missouri
- Bat Cave in Shannon County, Missouri
- Cave 029 in Washington County, Missouri

- Pilot Knob Mine in Iron County, Missouri
- White Oak Blowhole Cave in Blount County, Tennessee
- Hellhole Cave in Pendleton County, West Virginia

Critical habitat is defined as being essential to the conservation of the species and requiring special management considerations or protection (USFWS and NMFS 1998). No other hibernacula have been added to the critical habitat list since September 24, 1976. Nevertheless, state and federal agencies have acquired several Indiana bat hibernacula for protection purposes; for example, 54 of the 127 caves and mines (43 percent) with populations of more than 100 bats are publicly owned, and 46 caves (36 percent), most of which are on public land, are gated or fenced (USFWS 2007).

Insufficient data are currently available to conclude whether lack of summer habitat availability is limiting Indiana bat recovery. Until enough data are obtained to reach a conclusion, conservation measures include continued research into the summer habitat needs of the Indiana bat and a conservative approach during evaluation of the potential effects of land use practices on summer habitat.

Various population trends observed throughout the range of the Indiana bat suggest that the protective measures taken to date have not resulted in the recovery of the species. Therefore, USFWS is currently revising its recovery plan for the Indiana bat (USFWS 2007).

## 3.7 INDIANA BAT STATUS AT IAAAP

The results of the 1998 Tetra Tech, 2003 BCM, 2010 through 2014 EarthView Environmental LLC/Inc. (EVE), and 2014 Kingner & Associates, P.C biological surveys at IAAAP indicate that the installation currently meets the summer habitat needs of a local Indiana bat population (Tetra Tech 1998; Chenger 2003; EVE 2010a, 2010b, 2010c, 2012, 2013, 2014; Kingner & Associates, P.C 2014). Pursuant to AR 200-1, Tetra Tech and BCM conducted surveys to determine whether the Indiana bat roosts or forages in the natural habitat at IAAAP. Figure 5 shows the Indiana bat capture location and radio-tracking locations

During the nights of June 16 through 23, 1998, Tetra Tech conducted mist netting at the three major watersheds that drain IAAAP (Spring Creek, Brush Creek, and Long Creek) and the unnamed creek in the southwestern portion of the installation, for a total of 24 net nights. Of the 16 bats captured during the

survey, which included two pregnant female Indiana bats, one northern long-eared bat, seven red bats (*Lasiurus borealis*), four big brown bats (*Eptesicus fuscus*), one little brown bat, and one hoary bat (*Lasiurus cinereus*), at least two bats were captured in the area of each major watershed and the unnamed creek. These 16 bats included six of the nine bat species with seasonal ranges that extend into Iowa (Tetra Tech 1988).

Transmitters were attached to the two female Indiana bats, and Tetra Tech attempted to track them using radio-telemetry. A signal from one of the two bats was picked up during radio-tracking; however, the exact location of the bat could not be determined. Factors inhibiting radio-tracking likely included the

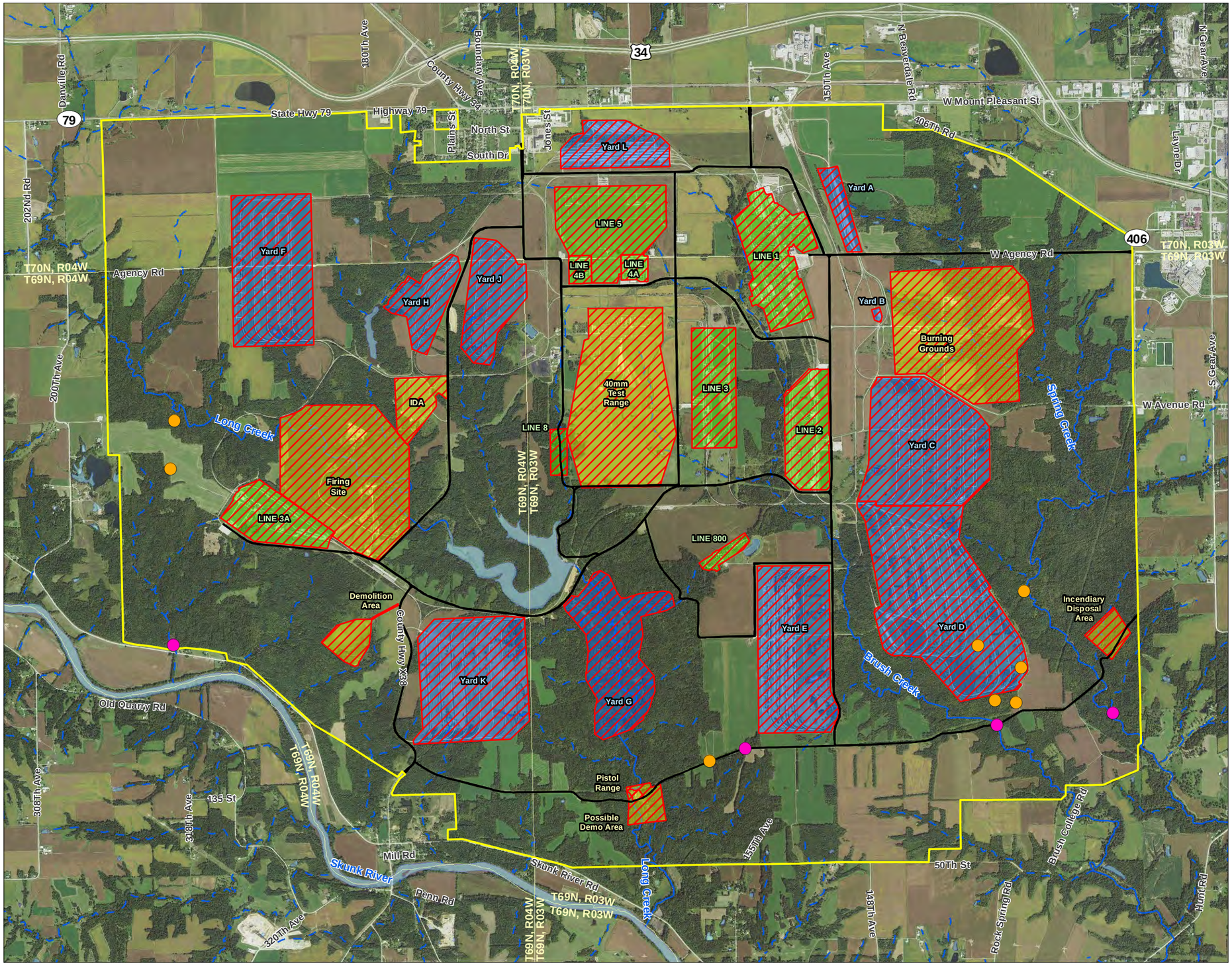



Figure No.
5

Title
Indiana Bat Capture Sites and Radio-tracking Locations

Client/Project
American Ordnance, LLC
Iowa Army Ammunition Plant

Project Location
Adams Co., IA

193703389
Prepared by JD on 2015-01-26
Technical Review by SF on 2015-01-26
Independent Review by SV on 2015-03-04

0 1,750 3,500 Feet

1:42,000 (At original document size of 11x17)

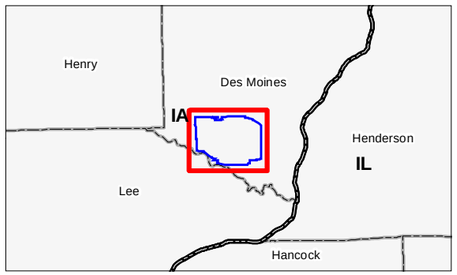
N

Legend

- Capture Sites
- Radio-tracking Locations
- Perimeter Fence
- Restricted Areas
- Roads
- Production Lines
- Storage Areas
- Misc Areas

National Hydrography Data

- Perennial Stream
- Intermittent Stream
- Waterbody




Notes
1. Coordinate System: NAD 1983 StatePlane Iowa South FIPS 1402 Feet
2. Data Sources Include: Stantec, Adams LLC, USGS, Esri
3. Orthophotography: 2014 NAIP

Stantec

Page 1 of 1

installation's topography and artificial obstructions. This biological survey marked the first occasion that the presence of the Indiana bat had been documented at IAAAP (Tetra Tech 1998).

During the nights of July 8 through 20, 2003, BCM mist netted at four locations at IAAAP; a woodlot along K Road, Brush Creek, Spring Creek, and the unnamed tributary to the Skunk River in the southwestern corner of the property. They also tracked two Indiana bats to an additional site, an 1800's barn, on private property west of IAAAP. BCM mist netted for a total of 33 net nights. The 161 bats captured during this survey included 77 Indiana bats, five northern long-eared bats, 45 red bats, 19 big brown bats, nine little brown bats, two tri-colored bats (*Perimyotis* [*Pipistrellus*] *subflavus*), two evening bats (*Nycticeius humeralis*), and two unknown bats. These 161 bats included seven of the nine bat species with seasonal ranges that extend into Iowa (Chenger 2003).

Six of the Indiana bats were radio-tracked (two males and four females) and BCM was able to track all six bats using radio-telemetry. Several day roosts were observed being used by the tracked bats including an 1800's era barn on private property which was also used as a maternity colony. BCM suggested this barn may be the largest known maternity colony of Indiana bats in the world due to the large number of Indiana bats observed there in 2003 (Chenger 2003).

The results of the biological surveys indicated that the Indiana bat forages on IAAAP property. Based on the foraging habits of this species, both surveys identified potential foraging areas along field edges and in riparian corridors of creeks within forested areas near the locations where the bats were captured. In addition, the bats probably use upland forests, forest and crop edges, and cropland areas for foraging (Garner and Gardner 1992).

The results of the surveys also suggest that the Indiana bat roosts on IAAAP property in the vicinity of the capture sites. This assumption is supported by previous research conducted by Garner and Gardner (1992), which showed that the distance of maternity roosts from the geometric center of foraging areas used by pregnant Indiana bats averaged 0.7 mile. In addition, during radio-tracking efforts, both surveys were able to determine the general daytime locations of Indiana bats on installation property.

Additional habitat assessments for Indiana bats were conducted by EarthView Environmental LLC/Inc. (EVE) between 2010 and 2014. The assessments were performed to determine if suitable summer habitat for the bats existed within various areas throughout IAAAP property.

In 2010, 650 acres were proposed for a test fire site for 40 millimeter (mm) grenades. The proposed test site encompassed line 6 and the areas that were line 9 and line 7 (see Figure 1). The assessment indicated that 15.6 acres of suitable Indiana bat summer habitat was found within the proposed test site, and that 18 potential roost trees (dead American elm trees with greater than 10 percent peeling bark) were located within the test site (EVE 2010a). Additional assessments were conducted in 2010 for a route of a proposed 57,000 linear feet water-line corridor and a total of 10 potential roost trees were identified along and within the corridor (EVE 2010b). A proposed alternative for a section of the water-line was also surveyed and six additional potential roost trees were identified (EVE 2010c).

EVE also conducted assessments in the vicinity of the Mathes Lake Dam in 2012 and four potential root trees were identified (EVE 2012). EVE also conducted an Indiana bat summer habitat assessment in 2013 along 12.5 miles of overhead power line corridors. The area of the study encompassed a corridor approximately 80 feet wide that ranged throughout IAAAP property. A total of 96 potential roost trees were identified (EVE 2013).

An Indiana bat summer habitat assessment was conducted in 2014 by EVE along a 0.43 mile-long proposed corridor for agricultural access. Potential foraging and roosting habitat for the Indiana bat and northern long-eared bat was identified within the corridor. Several shagbark hickories, large white oaks with creviced bark, dead standing elms with loose bark, and dead standing snags with peeling bark or crevices were observed (EVE 2014). An additional habitat assessment for the Indiana bar was conducted in 2014 by Kingner & Associates, P.C. (2014). The assessment was performed over 841.7 acres of a proposed industrial park in the northeast section of IAAAP. The survey indicated that suitable habitat may be present.

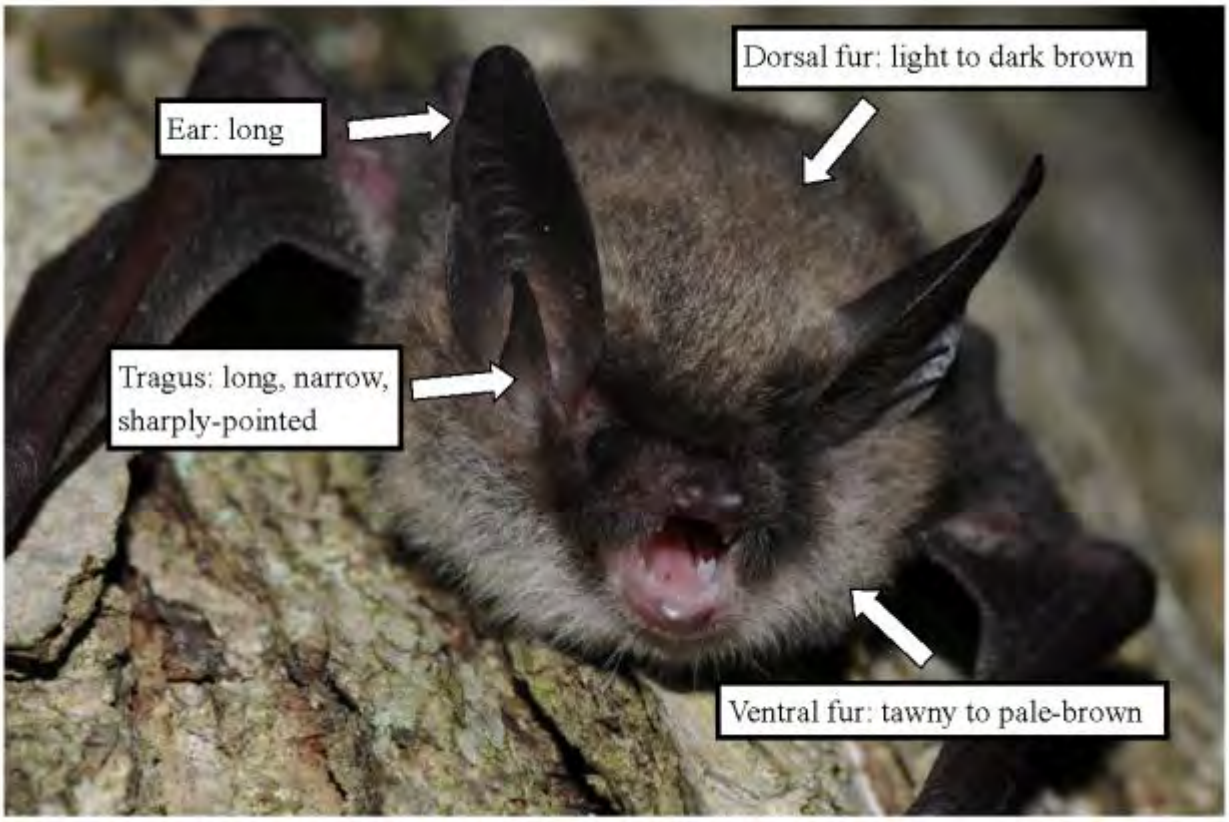
As part of the determination for project implementation, IAAAP implemented avoidance measures and habitat mitigation for the Indiana bat.

No Indiana bat hibernacula have been found at IAAAP or in Des Moines County (Tetra Tech 2000, USFWS 2007). As discussed in Section 3.2, the Indiana bat hibernaculum closest to IAAAP is believed to be White Bear Cave in Marion County, Missouri, approximately 100 miles southwest of IAAAP (Tetra Tech 2000; USFWS 2007).

## 3.8 NORTHERN LONG-EARED BAT PHYSICAL DESCRIPTION

Once considered a subspecies of the Keen's bat (*Myotis keenii*), northern long-eared bats are similar in appearance to other *Myotis* species that inhabit the eastern U.S., including little brown bats, eastern small-footed bats (*Myotis leibii*), and Indiana bats. With light to dark brown fur, medium-sized bodies, and weighing from 0.17 to 0.28 ounce, these bats share many common features (Caceres and Barclay 2000). The northern long-eared bat has brown, non-glossy fur, a calcar that is not keeled, and forearm length that ranges between 1.3 to 1.5 inches. The northern long-eared bat's long ears are the most prominent physical feature that differentiates it from the other *Myotis* species: the ears will typically extend beyond the end of the nose when folded forward (Caceres and Barclay 2000). Additionally, the long, narrow, sharply-pointed tragus located inside each ear is also unique to the northern long-eared bat (Barbour and Davis 1969). An illustration of the northern long-eared bat and its distinguishing features is presented in Figure 6.

**FIGURE 6 ILLUSTRATION OF THE NORTHERN LONG-EARED BAT**




(Photo source: J. Kiser, Stantec)

## 3.9 NORTHERN LONG-EARED BAT DISTRIBUTION AND POPULATION

The northern long-eared bat is a relatively wide-ranging bat, but it appears to be patchily distributed and found in low numbers in both summer roosts and hibernacula (Griffin 1945; Barbour and Davis 1969; Caire et al. 1979; Amelon and Burhans 2006; ASRD and ACA 2009). The species ranges across much of eastern and north-central North America. In Canada, the range includes all provinces west to the southern Yukon Territory and eastern British Columbia (USFWS 2013b). In the U.S. this bat is found in 39 states and ranges from Maine west to Montana; south to eastern Kansas, eastern Oklahoma, and Arkansas; and east to the Florida panhandle (USFWS 2013b). USFWS categorizes the U.S. range of the species in four parts: eastern, Midwestern, southern, and western populations (USFWS 2013b).

Based on Amelon and Burhans (2006), the northern long-eared bat was historically less common in the southern and western portions of its range than in the northern portion. However, this was based on data collected from winter hibernacula. More than 780 hibernacula are known to occur throughout the species' range in the U. S., but most contain only a few (one to three) individual bats (Whitaker and Hamilton 1998). Due to the infrequency the northern long-eared bat is encountered in hibernacula and the large number historically captured during summer surveys, the population size is more difficult to ascertain than for the Indiana bat, little brown bat, and gray bat (*Myotis grisescens*).

No hibernacula are currently known to exist on IAAAP, or in Iowa, but numerous sites occur in neighboring Illinois (n=36), Missouri (n=111), and Wisconsin (n=45) (USFWS 2013b). Although northern long-eared bat maternity colonies occur more frequently in the north and eastern portion of their range, the species is still commonly encountered in forested habitats in Iowa.

Northern long-eared bats have been captured within or nearby IAAAP during several surveys conducted in Des Moines County, Iowa, sometimes in large numbers (Tetra Tech 1998; Chenger 2003; Carlson et al. 2012a, 2012b; Kiser et al. 2012). In 1994, the northern long-eared bat was captured along the southern portion of Long Creek within IAAAP. During slightly more effort in 1998, Tetra Tech captured only one northern long-eared bat within IAAAP. A follow-up survey specifically designed to capture the Indiana bat was conducted by BCM (2003), and resulted in the capture of five male northern long-eared bats at two locations at IAAAP. In addition to surveys completed on IAAAP, 21 adult northern long-eared bats, including 13 reproductive females, were captured on Huron Island located approximately 20 miles northeast of IAAAP in the Mississippi River, Des Moines County, Iowa (Kiser et al. 2012) and 47 adult northern long-eared bats were captured during surveys along U.S.

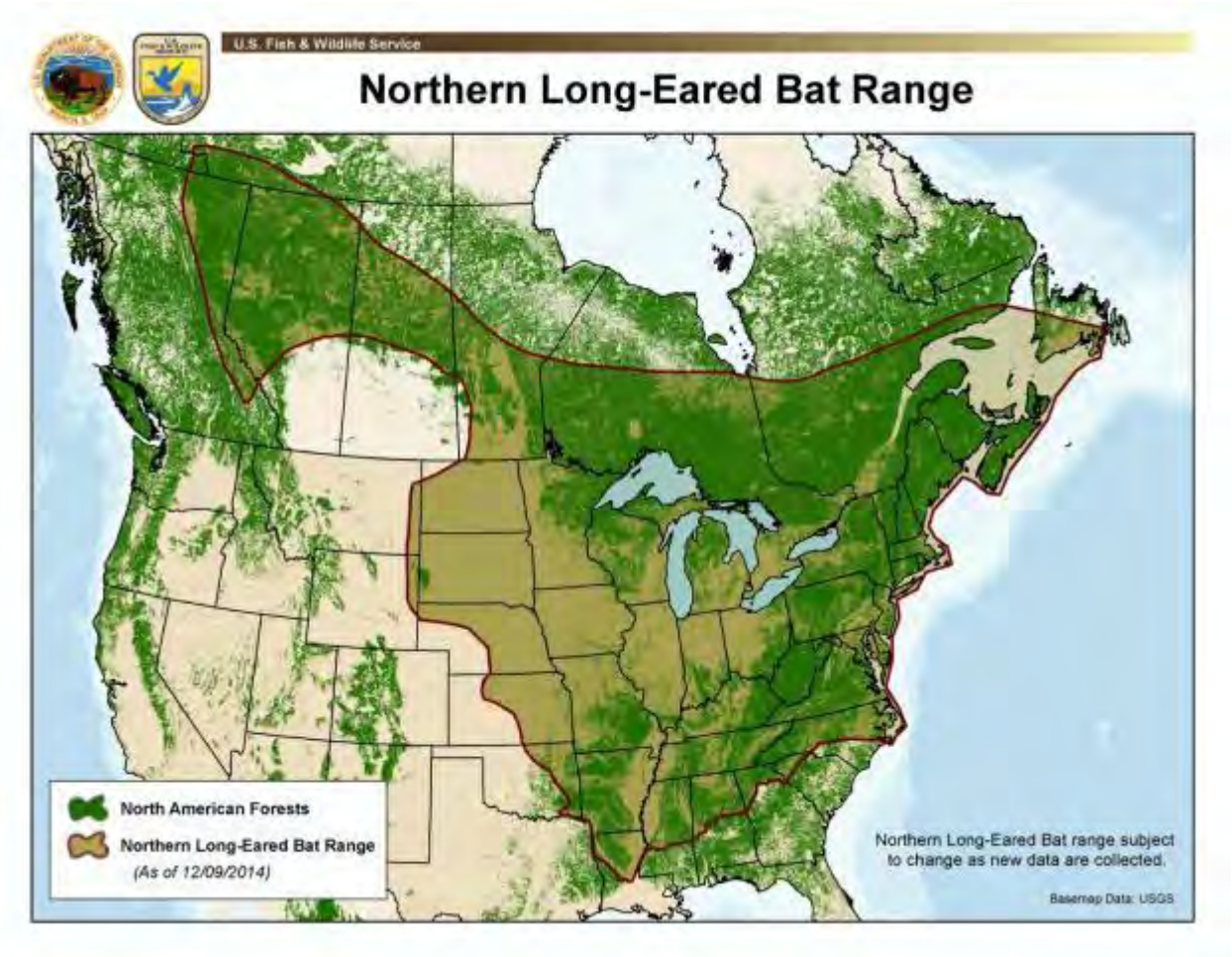
Highway 61 between Burlington and Wapello (Carlson et al. 2012a and b). Figure 7 presents the range of the northern long-eared bat over its winter and summer habitat.

## 3.10 NORTHERN LONG-EARED BAT HABITAT REQUIREMENTS

During the winter, the northern long-eared bat hibernates in caves, abandoned mines, railroad tunnels, dry wells, and World War II bunkers (Griffin 1945; USFWS 2013b). The northern long-eared bat shows a preference for hibernacula that offer specific temperature and moisture conditions which allow bats to hibernate through the winter while expending minimal energy reserves. Hibernacula used by this bat are typically large, with large passages and entrances and have relatively constant, cooler temperatures (32 to 48$^{o}$ F) and high humidity with no air currents (Raesly and Gates 1987; Caceres and Pybus 1997; Brack et al. 2005b). Researchers in New Brunswick surveyed conditions at the most populated hibernacula and found a preference for caves with only one entrance, no running water, and an average temperature between 39.2 and 41°F (Vanderwolf et al. 2012).

During the summer, northern long-eared bats typically roost in trees or manmade structures. When selecting a tree roost the bats do not appear to prefer specific tree species, and over 35 trees species have been documented as roosts (USFWS 2014a), including American beech, maple (*Acer* spp.), birch (*Betula* spp.), big-tooth aspen (*Populus grandidentata*), black cherry, black locust, eastern hemlock, white ash, elm (*Ulmus* spp.), silver maple (*Acer saccharinum*), and green ash (Owen et al. 2002; Mumford and Cope 1964; Clark et al. 1987; Sasse and Pekins 1996). Preference appears to be for trees with cracks or flaking bark that offer suitable roosting conditions (Foster and Kurta 1999). A telemetry study from the White Mountain region of New Hampshire documented the use of snags and, to lesser extent, living trees of northern hardwood species. This study also found that northern long-eared bats selected roosts trees that were taller, larger diameter, less decomposed, and were within stands with greater than 75 percent canopy cover (Sasse and Pekins 1996). Similar studies concluded that northern long-eared bats would select roost trees that are larger in diameter than the average surrounding stand (Lacki and Schwierjohann 2001). Despite the apparent preference for larger than average diameter roost trees, northern long-eared bats are flexible in roost selection, making it difficult to narrowly define a suitable dbh range. This wide range in roost preferences prompted the USFWS to recommend a minimum dbh of 3 inches to avoid excluding any potential roost (USFWS 2014a).

**FIGURE 7 DISTRIBUTION OF THE NORTHERN LONG-EARED BAT (WINTER AND SUMMER RANGES COMBINED)**




(USFWS 2014b)

The northern long-eared bat also frequents man-made structures where they have been found using rocket-style bat boxes, abandoned houses, concrete bridges, deer stands, barns, hays sheds, and garages in Kentucky and Tennessee (J. Kiser, Stantec, unpublished data). The number of northern long-eared bats using a rocket style bat house in the Daniel Boone National Forest in Kentucky was so great that at least dozen bats were hanging exposed on the house's support post (J. Kiser, Stantec, unpublished data). In Ohio, this species have been found to roost underneath the protective plastic wrapping on utility poles (J. Brown, Stantec, unpublished data). Based on the types of natural and manmade roost sites used by the northern long-eared bat it appears the species is somewhat opportunistic when locating roost sites.

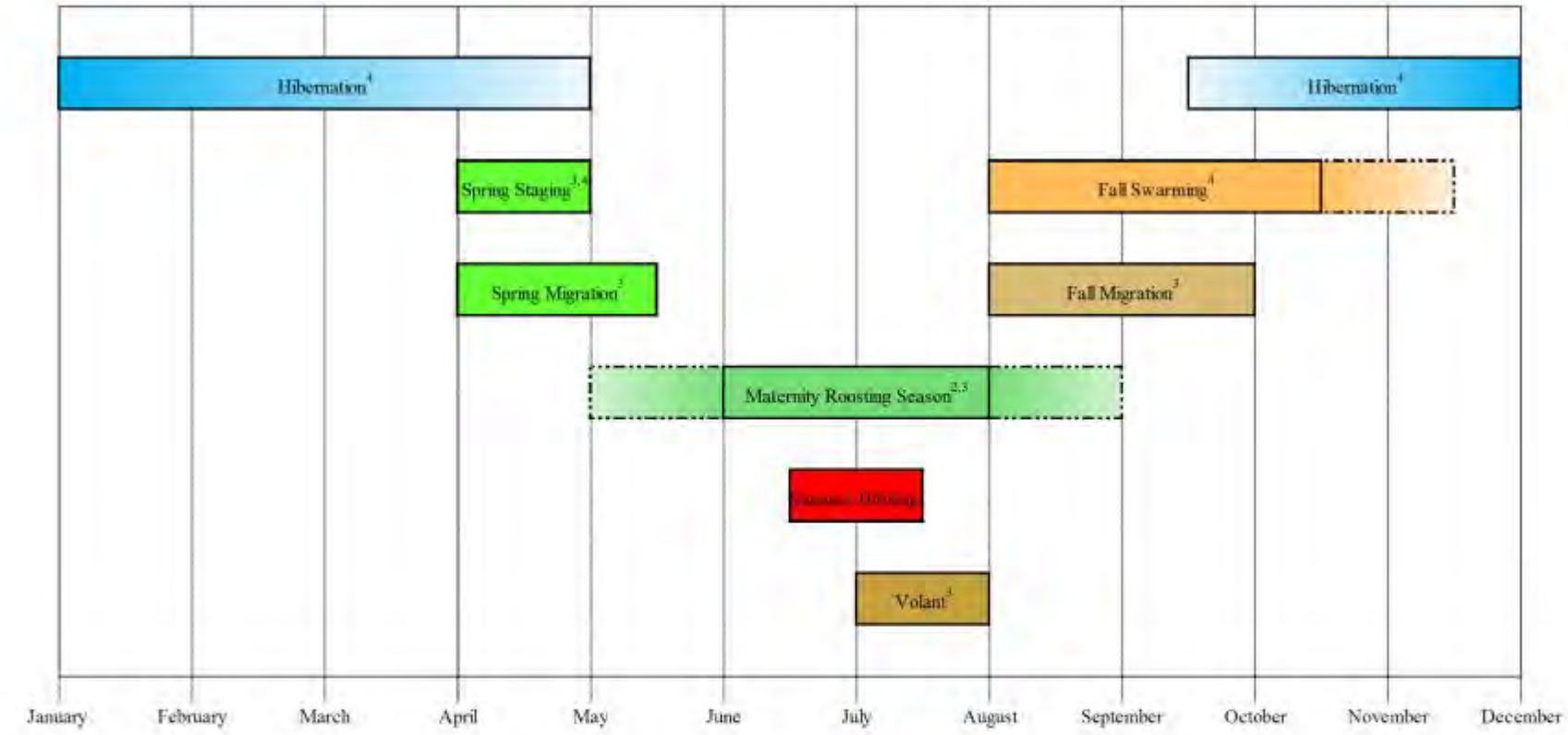
## 3.11 NORTHERN LONG-EARED BAT LIFE HISTORY

Like the Indiana bat, the northern long-eared bat also has six life history events: (1) spring "staging" period upon its emergence from hibernation, (2) spring migration, (3) summer birthing, (4) fall migration, (5) fall "swarming" prior to hibernation, and (6) hibernation. Along with the northern long-eared bat's foraging habits, these events are described below and are illustrated in Figure 8.

The Northern Long-eared Bat Interim Conference and Planning Guidance (USFWS 2014), lists a variety of hibernation seasons, depending on location: hibernation generally begins between October 1 and December 1 and concludes between March 15 and May 15. In Iowa, the hibernation season has been identified as November 1 through March 31.

Northern long-eared bats typically do not form the large obvious clusters that some other species exhibit when hibernating; instead, they will form smaller clusters, or roost alone in narrow spaces on cave walls or ceilings, with only a portion of their bodies' visible (Barbour and Davis 1969 as cited in Langwig et al. 2012; USFWS 2013b). Roosting in narrow cracks may help maintain higher humidity, but their cryptic roosting habits likely result in undercounting their numbers during winter hibernacula surveys (USFWS

**FIGURE 8 LIFE CYCLE OF THE NORTHERN LONG-EARED BAT[1]**




Notes:

1 The northern long-eared bat life cycle is estimated based in information available in literature.
2 This represents the northern long-eared bat maternity roosting season as defined by USFWS (USFWS 2014a).
3 Northern long-eared bat life cycle events likely to occur at IAAAP.
4 Northern long-eared bat life cycle likely to occur outside of IAAAP.

2013b). Unpublished USFWS data suggest that hibernacula counts rarely yield more than 100 individuals (USFWS 2014a).

Timing of northern long-eared bat's spring emergence varies throughout its range. Central and southern states commonly list April 1 as the beginning of the spring staging season (USFWS 2014a); however, observations of early season emergence are common in WNS infected areas. Northern long-eared bats have been recorded migrating from 5 to 169 miles between winter hibernation sites and summer roosting habitat (Griffin 1945).

Maternity period also varies across the range of this species, but most northern states, including Iowa, list the maternity season between April 1 and September 30; southern states list the maternity season as May 15 to August 15 (USFWS 2014a). Breeding occurs the previous year during late summer when males begin to swarm at hibernacula. Females then store sperm during hibernation and delayed fertilization occurs after spring emergence (Caceres and Barclay 2000), resulting in a single pup that is flying in approximately 21 days (Krochmal and Sparks 2007). Juvenile northern long-eared bats have been documented flying in late-July and early-August, indicating that pups were born in early July (Sasse and Pekins 1996); other studies have found that northern long-eared bats give birth in mid-July (Broders et al. 2006).

In Nova Scotia, Garroway and Broders (2008) found that lactating northern long-eared females roost higher in tall trees under relatively open forest canopy in stands with lower stem density, while post-lactating females were less selective of roost height and solar exposure. Males and non-reproductive females may use lesser quality roosts because of their ability to compensate for the lack of solar exposure by going into torpor, a strategy that is too energetically expensive for nursing females. Maternity roosts typically comprise less than 60 individuals (Caceres and Barclay 2000). Roost counts conducted in New Hampshire found most roosts contain fewer than 10 individuals, and 36 was the largest emergence count from a single roost in that study (Sasse and Pekins 1996).

Bat colonies can overlap with other colonies (Johnson et al. 2012), but each remains fairly distinct throughout the maternity period based on matrilinear associations (Patriquin et al. 2013). Matrilinear association is a genetic relationship linking individuals through the mother's bloodline. Colonies can withstand loss of roost trees with minimal disturbance to colony integrity, but estimates indicate that a disturbance of greater than 20 percent of roost trees may have a detrimental impact to a colony (Silvis et al. 2014).

Roost switching is a common strategy among bat species and may be an evolutionary adaption to avoid parasite infestation and predation (Lewis 1996; Reckardt and Kerth 2006). The use of multiple roosts also allows bats to overcome the loss of a roost. Northern long-eared bats switch roosts every two to three days (Sasse and Perkins 1996; Foster and Kurta 1999; Owen et al. 2002). Research found well established colonies of bat roost trees that may comprise a dominant roost tree surrounded by a network of smaller roost trees or a system of roosts of equal quality (Barclay and Kurta 2007).

The home range or network of roost trees and foraging areas used by the northern long-eared bat is most likely dependent on the land use of a particular area and the time of year studies are completed. In predominantly forested areas of Kentucky, the home range for females was found to be between 47 and 425 acres, whereas in West Virginia Owen et al. (2003) documented a maternal home range of 161 acres. The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 2,034 feet (Sasse and Perkins 1996). Recent work completed in Tennessee near the end of maternity season found a female northern long-eared bat roosting 3.5 miles from its capture site (Stantec, unpublished data). Foraging habitat consists of forests of various ages in riparian and upland situations. The northern long-eared bat is often captured in nets during the summer which are located over upland water sources (e.g., road-ruts, ponds) in hardwood forest and mixed pine-hardwood forests containing trees of mixed ages and conditions.

The northern long-eared bat's diet is diverse and variable depending on the geographic location and season. Its diet consists of a variety of Lepidoptera (moths), Diptera (flies), Hemiptera (leafhoppers), Trichoptera (caddisflies), and Coleoptera (beetles), but the most frequent prey are moths, beetles, and Arachnids (spiders) (Nagorsen and Brigham 1993; Brack and LaVal 1985; Griffith and Gates 1985; Feldhamer et al. 2009). The northern long-eared bat's long ears and long, narrow, sharply-pointed tragus located inside each ear allow the species to successfully forage for prey in a cluttered forest environment (Caceres and Pybus 1997). While foraging, they exhibit call characteristics that include shorter, higher frequency calls with a greater bandwidth than little brown bats (Faure et al. 1993). These distinct call parameters likely return a stronger, more detailed echo of prey, making it easier to distinguish from a background cluttered with vegetation. Similar to little brown bats, northern long-eared bats will "hawk" prey from the air, but their long ears also provide an advantage when passively listening for insects to glean from surrounding vegetation (Ratcliff and Dawson 2003). The flexibility in feeding methods allows northern long-eared bats to be prey generalists.

## 3.12 REASONS FOR NORTHERN LONG-EARED BAT DECLINE

Disease is the principle factor currently affecting the population status of northern long-eared bats throughout their range in the U.S. and Canada (Frick et al. 2010; USFWS 2013b). WNS has caused precipitous and widespread decline of once common cave-dwelling bats in the northeast. Currently, the transmission of WNS has affected approximately 40 percent of northern long-eared bat range. Within four years of initial WNS detection, northern long-eared bats have been documented to experience up to 100 percent decline at some hibernacula (Turner et al. 2011). Other factors like habitat loss and modification, wind farm and urban development, and disturbance at hibernacula likely also impact northern long-eared bats, but no other single factor has had the profoundly devastating impact to northern long-eared bat populations as WNS.

Prior to the spread of WNS, northern long-eared bats were a relatively common species in northeastern North America, with a range extending from west to east through the lower Canadian provinces and south to Alabama, and included several unconfirmed records as far south as Florida (Whitaker and Hamilton 1998; Caceres and Barclay 2000; BCI 2015). In 2006, WNS was first detected in New York state and has since been confirmed in 25 U.S. states, including Iowa, and five Canadian provinces, all of which fall within the range of the northern long-eared bats. The USFWS (2013b) estimates that WNS will eventually spread throughout the entire known North American population of northern long-eared bats, and they estimate that impacts from WNS could lead to extinction of northern long-eared bats by 2026.

On October 2, 2013, the USFWS announced a 12-month finding on a petition to list the northern long-eared bat as endangered or threatened under the Endangered Species Act of 1973, as amended, and to designate critical habitat (78 FR 61046 – 61080; USFWS 2013b). After review of the best available scientific and commercial information, the USFWS proposed to list the northern long-eared bat as endangered throughout its range, which does include Iowa and the IAAAP. No critical habitat was designated at that time (2013b).

On April 2, 2015, the USFWS published a final rule in the Federal Register designating the northern long-eared bat as a threatened species under the ESA throughout its geographic range (50 CFR Part 17). The listing and associated 4(d) rule became effective on May 4, 2015. No critical habitat is designated at this time (50 CFR Part 17). The threatened listing provides the USFWS with the ability to provide some flexibility in implementation of the ESA by tailoring prohibitions under an interim 4(d) rule. A "4(d) rule" is intended to lessen restrictions that do not provide a conservation benefit for the NLEB. By

making the 4(d) rule interim, USFWS has some time to clarify the language of the rule and what kinds of take exemptions are appropriate. The final decision for the 4(d) rule is expected by the end of 2015.

Although originally proposed to be listed as endangered, the USFWS acknowledges that the ongoing scientific review of threats to the northern long-eared bat led to a final listing determination of threatened rather than endangered.

## 3.13 NORTHERN LONG-EARED BAT CONSERVATION MEASURES

Although northern long-eared bats have not been impacted as greatly by wind energy development as other migratory species, this development may still negatively affect the species, through loss of potential habitat if not through more direct means. The USFWS, State agencies, and wind energy industry representatives are developing the Midwest Wind Energy Multi-Species Habitat Conservation Plan, which will address protection of covered species through avoidance, minimization of take, and mitigation to offset effect of ‘‘take’’ (e.g., habitat preservation, habitat restoration, habitat enhancement) to help ameliorate the effect of wind development (USFWS 2013b).

While in hibernation, bats rely on stored energy reserves to survive through the winter months. Disruptions, in the form of noise, light, or touch, cause bats to wake from torpor and deplete the energy reserves they need to survive through the winter. Blocking or gating cave entrances attempts to prevent vandalism to hibernacula with cave-roosting bats, and may limit winter disturbance to populations already stressed by WNS.

Researchers who need access to hibernacula must do research in a controlled manner so as not to spread WNS or disturb bats. Winter hibernacula surveys provide an opportunity to assess population trends of cave-roosting bat species. Since most cave-roosting bats are not long-distance migrants, winter data may provide an accurate assessment of regional population status. Northern long-eared bat hibernation habits (small clusters, roosting in crack and crevices) may impact the ability for hibernacula surveys to yield an accurate population estimate, but trends may be observable.

In 2008, several State and Federal agencies initiated a national plan that details the elements critical to investigating and managing WNS (USFWS 2011). The agencies also created decontamination protocols (USFWS 2012), for both mist netting surveys and caving activities, in order to limit human to bat transmission of WNS fungal spores. The USFWS also called for a voluntary moratorium on all caving

activity in hibernacula known to be infected by WNS (USFWS 2009), and many National Forests and state agencies have closed their caves and mines to limit the spread of WNS.

Researchers in Vermont are finding a few apparently uninfected *Myotis* surviving the winter months in infected hibernacula (S. Darling, Vermont Agency of Natural Resources, personal communication), and there are indications that some colony numbers may be increasing (Reichard 2015). Despite the possible signs of immunity in a few individuals, low fecundity (one pup per female per year) poses a significant challenge to restoring northern long-eared bats to their pre-WNS population levels.

Northern long-eared bats are not currently listed as threatened or endangered in Iowa, but are considered protected nongame, and the bat is considered a Species of Greatest Conservation Need in Iowa's Wildlife Action Plan (IDNR 2012). Impacts within the IAAAP to this species will be similar to those already found for the Indiana bat, such as coming in contact with soil contaminants indirectly via the ingestion of insect prey that have been impacted by contaminated soils (USACE 2011). No recovery plan exists yet for the northern long-eared bat; however a planning guidance with conservation measures was issued by USFWS in 2014 for the northern long-eared bat (USFWS 2014a).

Despite the current lack of official state protection, the Iowa Department of Transportation has decided to require only winter clearing on all projects, effective October 2014 (Solberg 2014). This will limit any potential disturbance to maternity colonies, and will minimize direct effects on females and juveniles.

## 3.14 NORTHERN LONG-EARED BAT STATUS AT IAAAP

The results of the 1998 Tetra Tech, 2003 BCM, and 2014 EVE biological surveys at IAAAP, discussed in Section 3.7, indicate that the installation currently meets the summer habitat needs of a local northern long-eared bat population (Tetra Tech 1998; Chenger 2003, EVE 2014).

In a 1994 survey, five northern long-eared bats were captured along the southern portion of Long Creek within IAAAP. During the 1998 Tetra Tech survey, one northern long-eared was captured. Five male northern long-eared bats were captured during the 2003 BCM survey. No transmitters were attached and no radio-tracking efforts occurred for the captured northern long-eared bats during any of the three surveys. The 2014 EVE survey identified potential foraging and roosting habitat for the northern long-eared bat. The survey recorded several shagbark hickories, large white oaks with creviced bark, dead standing elms with loose bark, and dead standing snags with peeling bark or

crevices. Figure 9 shows the northern long-eared bat capture locations from the 1998 and 2003 survey.

No northern long-eared bat hibernacula have been found at IAAAP or in Iowa. As discussed in Section 3.9, numerous hibernacula sites occur in the neighboring states of Illinois, Missouri, and Wisconsin.

Figure No.
9

Title
# Northern Long-Eared Bat Capture Sites

Client/Project
American Ordnance, LLC
Iowa Army Ammunition Plant

Project Location
Adams Co., IA

193703389
Prepared by JD on 2015-01-26
Technical Review by SF on 2015-01-26
Independent Review by SV on 2015-03-04

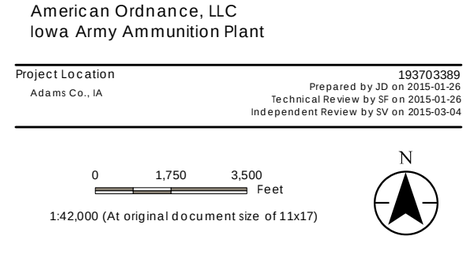
0 1,750 3,500 Feet

1:42,000 (At original document size of 11x17)

N

Legend
- Capture Sites
- Perimeter Fence
- Restricted Areas
- Roads
- Production Lines
- Storage Areas
- Misc Areas

National Hydrography Data
- Perennial Stream
- Intermittent Stream
- Waterbody




Notes
1. Coordinate System: NAD 1983 StatePlane Iowa South FIPS 1402 Feet
2. Data Sources Include: Stantec, Adams LLC, USGS, Esri
3. Orthophotography: 2014 NAIP

Stantec

# 4.0 IAAAP CONSERVATION GOALS

Natural resources at IAAAP are managed based on the principles of ecosystem management, the objectives of which are to restore ecosystems where practical and to create optimum habitat for all wildlife species, including the Indiana bat and northern long-eared bat. Specifics regarding these objectives are presented in IAAAP's INRMP (IAAAP 2013).

The 1983 recovery plan and 2007 revised draft recovery plan for the Indiana bat as well as the 2014 planning guidance for the northern long-eared bat establish the following goals to meet the primary objective of removing the Indiana bat and the northern long-eared bat from their endangered or threatened status: preventing disturbance to hibernacula; maintaining, protecting, and restoring foraging and summer maternity roosting habitat; monitoring populations; educating the public; preventing the spread of WNS; and conducting research (USFWS 1983, 2007, and 2014a).

As discussed in Sections 3.13 and 3.6, no designated critical habitat for the Indiana bat or the northern long-eared bat exists at or near IAAAP. However, as discussed in Sections 3.14 and 3.7, the Indiana bat and northern long-eared bat have been found to forage and potentially to roost at the installation; to date, only day roost trees within IAAAP property boundaries have been documented for the Indiana bat. A possible maternity roost was located on private property near IAAAP in 2003 (Chenger 2003). No roosts have been documented for the northern long-eared bat due to a lack of radio-tracking studies of this species at IAAAP. Although the foraging and roosting habitat at IAAAP is not considered to be critical to conservation of the Indiana bat or northern long-eared bat and may make up only a relatively small fraction of the bats' total summer range, the U.S. Army understands that this habitat is important to local bat populations and potentially to the long-term survival of these species. Therefore, the following conservation goals have been established at IAAAP:

- Continue to conserve existing Indiana bat foraging and summer maternity roosting habitat at IAAAP and begin conserving foraging and roosting habitat for the northern long-eared bat.
- Continue to educate individuals who have a potential impact on the Indiana bat regarding the species and its presence at IAAAP and begin educating individuals who have a potential impact the northern long-eared bat.
- Continue communicating with USFWS regarding the status of the Indiana bat and of the northern long-eared bat.

Compliance with the ESMP is consistent with principles of ecosystem management used at IAAAP and supports applicable conservation goals outlined in the Indiana bat recovery plan and revised draft plan (USFWS 1983 and 2007) and the northern long-eared bat planning guidance (USFWS 2014a). Although compliance with the ESMP will contribute to the success of the Indiana bat and northern long-eared bat populations at IAAAP as well as the overall recovery of these species, it is important to consider that certain negative impacts may occur that are beyond the control of the installation. For example, harm to the bat populations may occur at the hibernacula located outside of IAAAP, during spring or fall migration, or at IAAAP as a result of activities on surrounding properties outside the control of IAAAP.

Specific management prescriptions that will be implemented to support IAAAP's conservation goals for the Indiana bat and northern long-eared bat are discussed in Section 5.0. Conservation goals and management prescriptions in the ESMP will be reviewed by IAAAP's natural resources manager on an annual basis and updated, if necessary. As discussed in Section 3.6, USFWS is currently revising its recovery plan for the Indiana bat (USFWS 2007). When the finalized revised recovery plan is available, or at such time that a northern long-eared bat recovery plan is available, conservation goals and management prescriptions in the ESMP will be reviewed to assess their consistency with the current recovery plan(s).

# 5.0 MANAGEMENT PRESCRIPTIONS

This section discusses management prescriptions that will be implemented by IAAAP to meet the conservation goals set forth in Section 4.0. To facilitate implementation of these prescriptions, they are categorized according to general types of ongoing and future IAAAP activities that are most likely to impact the Indiana bat and northern long-eared bat. If a new installation activity is initiated that may impact the Indiana bat and northern long-eared bat, IAAAP will review and update the ESMP as necessary and will engage in ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office. In addition, other management prescriptions that are not directly related to an ongoing or future IAAAP activity will be implemented by IAAAP to meet the conservation goals set forth in Section 4.0.

## 5.1 MANAGEMENT PRESCRIPTIONS FOR IAAAP ACTIVITIES

In the interest of conserving existing Indiana bat and northern long-eared bat summer foraging and roosting habitat, this section presents prescriptions for activities that take place at IAAAP that might impact the Indiana bat and northern long-eared bat. These activities include agricultural management; construction, demolition, and environmental remediation; training exercises; hunting and other outdoor recreation; operating contractor activities; and test firing. For activities that IAAAP is considering undertaking, funding, permitting, or authorizing that are outside the scope of the prescriptions, and have a potential impact on the Indiana bat and northern long-eared bat at the installation, IAAAP will engage in necessary ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office.

### 5.1.1 Forest Management

Forest harvest at IAAAP has been inactive for the last 15 years. However, if forest management activities are employed again in the future, the practices will reflect USFWS Indiana bat and northern long-eared bat guidelines for forest management and, if applicable, ESA Section 7 consultation will take place. Based on the fact that the Indiana bat and northern long-eared bat forage, and possibility roosts at IAAAP, forest management prescriptions and actions that will be implemented by the IAAAP natural resources manager to preserve summer habitat for the Indiana bat and northern long-eared bat are described below.

- Tree cutting will not occur at IAAAP during the Indiana bat and northern long-eared bat maternity roosting season (April 1 through September 30) unless it is necessary to maintain forest health or safety conditions (i.e., control of a disease or insect outbreak or removal of storm damage). Any tree cutting activities during the summer maternity season, or activities

determined by IAAAP to have a potential impact on the Indiana bat and northern long-eared bat, will be coordinated with the USFWS Region 3 Rock Island Field Office and will undergo any necessary ESA Section 7 consultation in order to avoid and minimize impacts on the Indiana bat and northern long-eared bat and on potential maternity roost trees. As part of ESA Section 7 consultation, a detailed description of any trees to be removed, including the species, dbh, overall condition, bark condition, presence of cavities or crevices, and presence of dead limbs, along with an explanation of the need to remove the trees will be provided to the USFWS Region 3 Rock Island Field Office by the IAAAP natural resources manager. Based on this information, a determination will be made as to whether the trees are suitable as Indiana bat or northern long-eared bat roosts.

If it is determined that a tree provides suitable bat roosting habitat, the tree will be monitored for the presence of bats prior to its removal. Tree removal will take place immediately after two consecutive nights of emergence counts in which no bats are observed. If tree removal is not practical immediately after the second emergence count, IAAAP will conduct a pre-dawn count using an acoustic bat detector on the next day to verify that bats are not roosting in the tree, and the tree will be removed on that day. If bats are present, the need for an incidental take permit will be evaluated.

- Forest management will promote diversity of age and size classes with emphasis on retention of adequate stocks of large, mature and overmature trees in each stand. The range of acreage of stands at IAAAP is presented in the forest management section of the INRMP. As individual trees in the overmature age class die and become snags (i.e., trees with less than 10 percent live canopy), they will provide a continuing supply of potential maternity roost trees for Indiana bats and northern long-eared bats. Reforestation efforts will favor planting tree species native to regional ecological communities and, where practical, those species that have been documented to have been used as Indiana bat or northern long-eared bat roosts.

  The following forest management prescriptions will be implemented to maintain a suitable component of habitat for the Indiana bat and northern long-eared bat at IAAAP. Because of heterogeneity both within and between stands, not all the conditions noted are necessarily evenly distributed across the landscape or currently present in each stand. Therefore, attainment of habitat management goals will be evaluated on an average (per acre), standwide basis, and these goals will be attained through the life-cycle of forest management activities in each stand.

  - An average of at least one live, potential maternity roost tree per 5 acres with a dbh greater than 20 inches will be maintained in the stand.
  - An average of at least six live, potential maternity roost trees per 5 acres with a dbh greater than 9 inches will be maintained in the stand.
  - If the stand does not contain trees with a dbh larger than 20 inches, the two largest live, potential maternity roost trees per 5 acres with a dbh greater than 14 inches will be maintained in the stand.

- Hickory trees, particularly shagbark hickory and shellbark hickory (*Carya laciniosa*), are recognized for their high value as potential maternity roost trees. Harvesting of these species may be allowed (1) to address density thresholds that would otherwise inhibit their reproduction and (2) in compliance with other forest management prescriptions described in the ESMP.

- Canopy cover will equal or exceed 60 percent in each forest stand after forest management activities. The percentage of canopy cover will be evaluated on an average stand basis, not as continuous cover.

- Snags will not be removed except where they pose a threat to safety or forest health (e.g., a threat of disease or insect outbreak). In the event that snag removal is necessary during the Indiana bat and northern long-eared bat maternity roosting season (April 1 through September 30), the removal will take place immediately after two consecutive nights of emergence counts in which no bats are observed. If snag removal is not practical immediately after the second emergence count, a pre-dawn count using an acoustic bat detector will be performed on the next day to verify that bats are not roosting in the snag, and the snag will be removed on that day. If bats are present, IAAAP will engage in ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office to evaluate the need for an incidental take permit. Where practical, snags will be retained in groups with live trees to prevent wind-throw.

- Tree cutting within 100 feet on both sides of perennial streams and within 50 feet on both sides of intermittent streams will be limited to activities that maintain or improve the quality of Indiana bat and northern long-eared bat habitat and that are in accordance with other forest management prescriptions described in the ESMP.

- If active maternity roost trees are identified at IAAAP, they will be protected until they no longer serve as maternity roosts (e.g., because of loss of exfoliating bark or cavities, blow-down, or decay).

- Only U.S. Environmental Protection Agency (EPA)-approved pesticides will be used, and their application will be avoided in forested areas during the summer maternity season (April 1 through September 30). IAAAP will engage in ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office if pesticide application in forested areas is determined to be necessary during this period and will have a potential impact on the Indiana bat or northern long-eared bat.

- Prescribed burning of woodlands will not occur during the Indiana bat and northern long-eared bat summer maternity season (April 1 through September 30).

### 5.1.2 Agricultural Management

Agriculture is the major commercial land use at IAAAP. The area used for explosive buffers is leased for cattle grazing (816 acres) and hay baling, row cropping, and beekeeping (6,684 acres). IAAAP issues agricultural leases on 5-year terms. As of 2015, IAAAP had 11 cattle grazing or hay production leases and 35 row crop leases under which lessees have the option to use the area for either grazing or hay cutting and baling. The primary Indiana bat and northern long-eared bat management concern related to agricultural management is the potential impact of pesticides on the bats' prey resources at IAAAP.

To minimize the impact of pesticides on the Indiana bat and northern long-eared bat prey resources, IAAAP will continue legally acceptable and scientifically based pesticide applications in support of

agricultural operations on the installation. However, to enhance integrated pest management and reduce the need for pesticide use, all agricultural crop leases will institute rotation periods, which diminish the opportunity for pest populations to become established. Other agricultural management practices that offer the opportunity to reduce insect and weed pests will be continually reviewed. The IAAAP natural resources manager and the USACE Omaha District will inspect lessee activities for compliance with lease agreements on an annual basis (IAAAP 2012).

Only pesticides approved by EPA will be used at the installation, and the method and rate of each such chemical's application will be consistent with provisions presented on the container label. In addition to the leasing protocols discussed above, the management prescriptions presented below will be implemented to minimize the impact of pesticides on the Indiana bat and northern long-eared bat.

- Pesticides will be applied only after use of other integrated pest management techniques has been considered and only when the potential for economic loss from crop damage is evident. This management prescription does not preclude use of pre-emergent pesticides.
- Consideration will be given to rotation of pesticide classes from application to application in order to reduce pest resistance.
- Precision farming using variable-rate technology will be employed whenever possible to adjust the percentage of active pesticide ingredient used based on the soil type or the location of pests in a field.
- Pesticides will be applied in accordance with container label provisions as required by federal law.
- Pesticide application will be limited to the period between 30 minutes after sunrise and 30 minutes before sunset.
- Pesticide application in gusty winds or when the wind speed exceeds 10 miles per hour will be avoided.

These agricultural management prescriptions will be included in agricultural lease agreements, tract management plans, and land use regulations. Compliance with these prescriptions will be monitored by the USACE Omaha District during its annual inspections.

Aerial application of pesticides currently does not occur at IAAAP. In accordance with the pest management plan for the installation, aerial application of pesticides by lessees is prohibited (IAAAP 1998 and 2013). The US Army will prepare an aerial validation plan if aerial pesticide application is

deemed necessary at IAAAP. Any aerial validation plan will be developed in cooperation with the USFWS Region 3 Rock Island Field Office as part of ESA Section 7 consultation.

### 5.1.3 Construction, Demolition, and Environmental Remediation

IAAAP will engage in ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office for all major construction, demolition, and environmental remediation activities that may impact the Indiana bat and northern long-eared bat, especially those planned for forested areas that are suitable Indiana bat and northern long-eared bat foraging or roosting habitat. Such activities include, but are not limited to, construction and demolition of dams, buildings, pipelines, and roads; water resource development; and remediation of areas that may pose risk to the environment or human health. Regarding environmental remediation, IAAAP is currently evaluating potential impacts on the Indiana bat and northern long-eared bat associated with installation contamination as part of an ongoing ecological risk assessment. The USFWS Region 3 Rock Island Field Office has been and will continue to be an active participant in the development and review of the risk assessment. IAAAP will determine the need for ESA Section 7 consultation with regard to construction, demolition, and environmental remediation activities.

### 5.1.4 Training Exercises

IAAAP is not used intensively for training exercises. Routine training exercises conducted at IAAAP include internal 9 mm pistol and M16 rifle refresher training at the small arms range (see Figure 1) for about 50 security guards employed by the installation. The refresher training is conducted twice per year. IAAAP security guards also conduct various emergency response training exercises, primarily in nonforested areas along patrol roads. These exercises are not likely to impact the Indiana bat and northern long-eared bat.

The installation also permits local National Guard and U.S. Army Reserve units to periodically conduct land navigation, vehicle maneuvering, and road maintenance exercises outside the quantity distance arcs in the southeastern corner of the installation. These exercises are not likely to impact the Indiana bat and northern long-eared bat.

The IAAAP natural resources manager will determine whether training exercises are becoming more intensive at IAAAP and will engage in necessary ESA Section 7 consultation with the USFWS Region 3

Rock Island Field Office regarding any training exercises that are likely to impact the Indiana bat and northern long-eared bat.

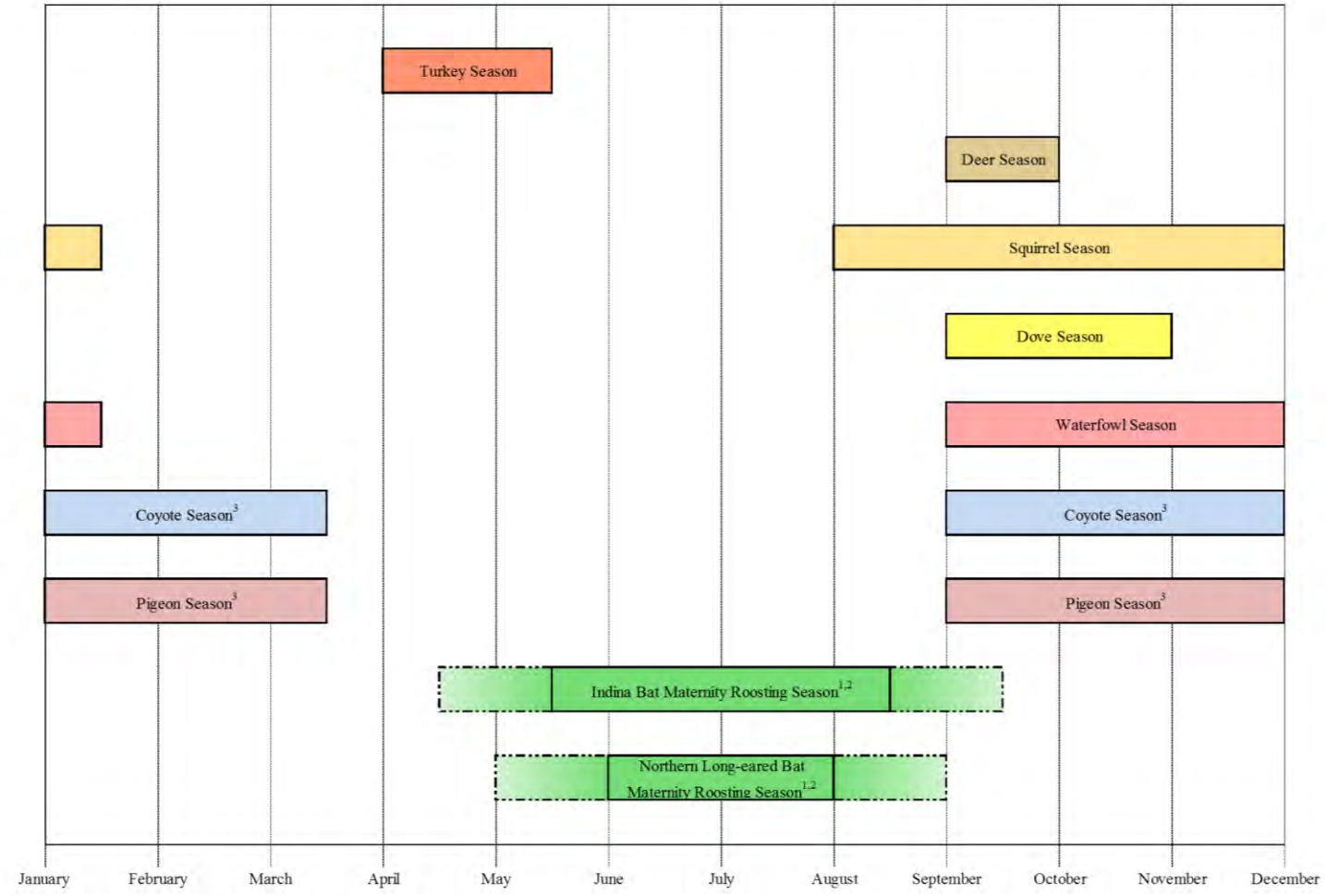
### 5.1.5 Hunting and Other Outdoor Recreation

Hunting of wild turkey (*Meleagris gallopavo*), white-tailed deer (*Odocoileus virginianus*), fox squirrel (*Sciurus niger*), eastern gray squirrel (*Sciurus carolinensis*), American crow (*Corvus brachyrhynchos*), rock pigeon (*Columbia livia*), mourning dove (*Zenaida macroura*), Eurasian collared dove (*Streptopelia decaocto*), common raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), and various waterfowl species is allowed on IAAAP property. The approximate hunting seasons at the installation are presented in Figure 10. As shown in this figure, the hunting seasons for turkey (spring season), youth and disabled deer, squirrel, coyote, and pigeon overlap with the maternity roosting season (April 1 through September 30) for the Indiana bat and northern long-eared bat. The hunting season for each of these animals is provided below (IDNR 2015).

- Spring turkey hunting season begins in early April with the youth season and ends in mid- May.
- Youth and disabled deer hunting season begins mid-September and runs through early October.
- Squirrel hunting season begins late August or early September and runs through late January.
- Dove hunting season begins in early September and runs through early November.
- Waterfowl hunting season begins in early September with the special September teal season and runs through mid-January.
- Coyote hunting season is continuous year round in Iowa; however at IAAAP hunting is only allowed from early September through mid-March.
- Pigeon hunting season is continuous year round in Iowa; however at IAAAP hunting is only allowed from early September through mid-March.

Hunting activities at the installation will be conducted in accordance with state law. The IAAAP natural resources manager will strictly enforce the hunting seasons at the installation. Therefore, hunting activities at IAAAP are not likely to impact the Indiana bat and northern long-eared bat.

**FIGURE 10 IAAAP HUNTING SEASONS IN RELATION TO MATERNITY ROOSTING SEASON OF THE INDIANA BAT AND NORTHERN LONG-EARED BAT**




Notes:

1 This represents the northern long-eared bat maternity roosting season as defined by USFWS (USFWS 2014a).
2 Northern long-eared bat life cycle events likely to occur at IAAAP.
3 IAAAP allowed hunting season

Other outdoor recreation activities at IAAAP include trapping, fishing, and boating, which should not have an impact on the Indiana bat and northern long-eared bat. However, under the awareness program described in Section 5.2.2, individuals who engage in these activities or in hunting will be advised to minimize disturbances to woodlots that comprise Indiana bat and northern long-eared bat summer foraging and maternity roosting habitat at IAAAP.

### 5.1.6 Operating Contractor Activities

Operating contractor activities at IAAAP include loading, assembly, and packing of a full range of munitions and high-explosive components; demilitarization services such as explosive projectile disassembly and decontamination; ammunition research and development; operation of the 500-acre test firing site that supports development of warheads and ammunition; and the 650-acre 40 mm test range (see Section 5.1.7). Daily production activities take place inside buildings located within large, unforested, fenced production yards (see Figure 1). Air and water emissions associated with daily production activities are monitored in accordance with EPA permit requirements. The operating contractor is also responsible for maintenance of utility corridors, roadways, walkways, buildings, and railways on the installation; these areas are not considered to be part of the forested areas that are managed under the prescriptions discussed in Section 5.1.1. Operating contractor maintenance activities typically include control and removal of brush and trees with a dbh of less than 9 inches and trimming or pruning of larger trees. These activities are not likely to impact the Indiana bat or northern long-eared bat.

Maintenance activities performed by the operating contractor also include removal of trees with a dbh greater than 9 inches during the maternity roosting season (April 1 through September 30). These activities may have an impact on the Indiana bat and northern long-eared bat. In the rare instance when such a tree poses an immediate safety risk because of its condition, location, and potential impact on property and human life, the tree will undergo emergency removal upon its discovery. If emergency removal of a tree with a dbh greater than 9 inches is necessary during the maternity roosting season, the operating contractor will monitor the tree for bats prior to its emergency removal when possible. The operating contactor will notify the USFWS Region 3 Rock Island Field Office prior to the tree removal, when possible, or within 24 to 48 hours after removal' and will engage in necessary ESA Section 7 consultation.

As discussed in Section 5.1.1, a tree that has a dbh greater than 9 inches provides potential roosting habitat, and does not pose an immediate safety risk will be monitored for the presence of bats prior to its removal during the Indiana bat and northern long-eared bat maternity roosting season. Tree removal will take place immediately after two consecutive nights of emergence counts in which no Indiana bats or northern long-eared bats are observed. If tree removal is not practical immediately after the second emergence count, IAAAP will conduct a pre-dawn count using an acoustic bat detector on the next day to verify that bats are not roosting in the tree, and the tree will be removed on that day. If bats are present, the need for an incidental take permit will be evaluated.

For activities performed by the operating contractor that may impact the Indiana bat or northern long-eared bat, the operating contractor will engage in necessary ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office. All such consultation will be documented and coordinated with the IAAAP natural resources manager, who will receive a copy of any ESA Section 7 consultation correspondence between the operating contractor and the USFWS Region 3 Rock Island Field Office.

### 5.1.7 Test Fire Sites

As stated in Section 2.1, IAAAP's military mission includes development of warheads and large-caliber blank ammunition rounds. To support this mission, IAAAP uses a 500-acre test fire area to perform static testing of warheads and to test fire blank ammunition rounds at fixed targets and a 650-acre test fire are to test 40 mm ammunition. As discussed below, these activities are not likely to impact the echolocation and auditory functions of the Indiana bat and northern long-eared bat.

Regarding bat echolocation, all test firing activities are performed within the test fire areas (see Figure 1). IAAAP does have a current need for limited test firing at the 40 mm test site during night time hours and USFWS has given approval of these nocturnal activities. Full production testing will be needed in 2015 and consultation is underway at this time.

BAs conducted at Fort Leonard Wood in Missouri (3D/International, Inc. 1996), Camp Atterbury in Indiana (Montgomery Watson and 3D/International, Inc., Environmental Group 1998), and IAAAP (Stantec 2010) support the conclusion that test firing activities at IAAAP will not likely impact the auditory functions of the Indiana bat and northern long-eared bat. The BAs were conducted at Fort Leonard Wood and Camp Atterbury to determine the impact on the Indiana bat of sounds and vibrations generated from military mission activities, which included firing of munitions similar to those test fired at

IAAAP. The findings of these two BAs indicated that mission activities at the two installations were not likely to generate sound frequencies within the peak auditory sensitivity range of the Indiana bat. Thus, there was a low probability that Indiana bats at the two installations would be exposed to sounds that could cause auditory damage. Also, it was determined that the intensity and duration of sounds generated by mission activities would not cause Indiana bats to permanently abandon suitable roosting or foraging habitat at the two installations. The third BA conducted at IAAAP also determined that mission activities were not likely to generate noise frequencies within the range of maximum sensitivity of the Indiana bat and are not likely to generate sound within the auditory range of the Indiana bat.

Spectral energy diagrams produced as part of the noise analysis in the IAAAP BA for the 40 mm test range project indicated that peak energy produced by the 40 mm grenades occurs at frequencies less than 1000 hertz (Hz), and in most cases, less than 500 Hz. These frequencies are not within the range of the little brown bat, which has similar echolocation frequencies as the Indiana bat. Due to the similarity in call frequency and auditory morphology between the Indiana bat and the little brown bat, it is reasonable to conclude that the auditory sensitivity of the two species is similar, and therefore the 40 mm grenades used at the IAAAP 40 mm test range are not likely to generate frequencies within the range of maximum sensitivity of the Indiana bat (Stantec 2010).

The sound produced by detonation of the 40-pound (lb) explosive evaluated in the Camp Atterbury BA measured 193.3 decibels (dB) 100 feet from the source, whereas IAAAP's predicted sound level for a 40-lb explosive was 123.8 to 141.4 dB 3,250 feet from the source (American Ordinance 1998). The initial test firing of the 40-lb explosive was performed at IAAAP in 1993, and it was test fired in the following years at the rates indicated: 1994 (10 rounds), 1995 (10 rounds), 1996 (10 rounds), 1997 (3 rounds), 1998 (15 rounds), 2007 (33 rounds), 2008 (11 rounds), 2009 (3 rounds), 2010 (39 rounds), 2011 (12 rounds), 2012 (30 rounds), and 2013 (8 rounds). The largest explosive currently produced and tested at IAAAP is the 40-lb explosive. The Hellfire II is the second largest explosive produced and tested and weighs significantly less (13.6 lb) than the 40-lb explosive. The Hellfire II is produced and tested at infrequent intervals (American Ordnance 1998).

The USFWS biological opinion (BO) for the Camp Atterbury BA concluded that the installation's mission activities did not appear to startle or frighten Indiana bats or causes them to flee the area and that Indiana bats were still active and roosting on the installation. For these reasons, USFWS concluded that mission activities were not likely to adversely affect the Indiana bat (USFWS 1998).

In summary, test firing activities likely do not impact the Indiana bat or northern long-eared bat at IAAAP because (1) the test firing activities mainly occur during daylight hours with some test firing occulting at night, (2) the largest munition currently being test fired at IAAAP (Hellfire II) is smaller than those at other installations whose test firings are not believed to adversely affect the bats, and (3) a wide variety of bats, including the Indiana bat and northern long-eared bat, are active at IAAAP.

IAAAP will determine whether test firing activities are becoming more intensive at the installation and will engage in necessary ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office regarding any test firing activities that are likely to impact the Indiana bat or northern long-eared bat.

## 5.2 OTHER MANAGEMENT PRESCRIPTIONS

This section describes other management prescriptions that will be implemented by IAAAP to protect the Indiana bat and northern long-eared bat. These prescriptions, which are not directly related to ongoing or future IAAAP activities, include monitoring the Indiana bat and northern long-eared bat and their habitat, implementing an awareness program, and communicating with USFWS.

### 5.2.1 Monitoring of Indiana Bat and Northern Long-eared Bat and Habitat

The Indiana bat and its summer habitat will be monitored on the installation and IAAAP will begin monitoring the northern long-eared bat and its summer habitat. A biological survey that includes mist netting and radio-tracking will be conducted at least once every five to ten years to monitor Indiana bat and northern long-eared bat activity at IAAAP. At a minimum, the following information will be consistently recorded for each bat captured:

- Species
- Capture location
- Time of capture
- Gender
- Age class
- Reproductive condition (lactating or pregnant)
- Weight
- Flight direction
- Location of maternity roost site (if known)
- Evidence of WNS infection

Each biological survey will be conducted in accordance with USFWS mist netting guidelines and may include the use of radio-telemetry.

Compliance with the ESMP will contribute to the success of the Indiana bat and northern long-eared bat populations at IAAAP as well as the overall recovery of these species, certain negative impacts may occur that are beyond the control of the installation. For example, harm to the bat populations may occur at hibernacula located outside of IAAAP, during spring or fall migration, or at IAAAP as a result of activities on surrounding properties outside the control of IAAAP.

Additionally, in 2012 IAAAP installed 10 bat can-type roost structures but no usage of the structures by bats has been recorded by a single annual inspection.

### 5.2.2 Implementation of Awareness Program

IAAAP will provide fact sheets (USFWS 2006 and 2013c) to promote awareness of the presence and status of the Indiana bat and northern long-eared bat at the installation as well as the regulatory requirements driving their protection (see Appendix E). The IAAAP natural resources manager will be responsible for distributing the fact sheets to IAAAP facilities engineers, program managers, and other individuals whose activities may impact Indiana bat or northern long-eared bat foraging areas or potential maternity roost sites at the installation. The IAAAP natural resources manager will meet with installation supervisors and plant managers to discuss the fact sheets and to request that they disseminate information on the Indiana bat and northern long-eared bat to their staff as appropriate.

### 5.2.3 Communication with USFWS

The IAAAP natural resources manager will update USFWS on the status of the Indiana bat and northern long-eared bat at the installation by reporting the findings of species and habitat monitoring activities to the USFWS Region 3 Rock Island Field Office. As discussed in Section 5.1, IAAAP will also engage in ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office when necessary. IAAAP personnel will also continue to coordinate with USFWS the development and review of the installation's ecological risk assessment as discussed in Section 5.1.3.

# 6.0 ESMP IMPLEMENTATION

This section describes how IAAAP will implement the ESMP. Specifically, this section describes the process of complying with the ESMP; discusses the time, costs, and personnel needed to implement the ESMP; and describes the review process for the ESMP.

## 6.1 ESMP COMPLIANCE

To evaluate IAAAP compliance with the ESMP and the effectiveness of the ESMP itself, the IAAAP natural resources manager will complete an annual compliance checklist. This checklist addresses the management prescriptions presented in Section 5.0. The checklist, which is presented in Appendix C, is the primary tool used in assessing installation compliance with the ESMP.

The IAAAP natural resources manager will be responsible for completing the checklist during the fourth quarter of each calendar year. If the completed ESMP compliance checklist shows that IAAAP is not in full compliance with the ESMP or that the ESMP is not effective in meeting installation conservation goals, IAAAP will identify the deficiencies and develop recommendations for resolving them.

## 6.2 ESMP REVIEW

The IAAAP natural resources manager will review the ESMP annually and will update and revise it as necessary to meet conservation goals. This review will be conducted concurrently with preparation of the ESMP compliance checklist (see Appendix C).

The ESMP will be subject to major revision every five years in conjunction with major revision of the INRMP. If significant information becomes available during the 5-year period, the ESMP will be rewritten; otherwise, it will be revised as part of the annual updating process. As discussed in Section 3.6, USFWS is currently revising its recovery plan for the Indiana bat (USFWS 2007). The ESMP will also be revised as appropriate upon issuance of the new Indiana bat recovery plan and if and when a northern long-eared bat recovery plan is issued.

## 6.3 TIME, COSTS, AND PERSONNEL

Table 1 provides estimates of the time, costs, and personnel needed to implement the management prescriptions described in Section 5.0. The IAAAP commanding officer is responsible for ensuring that adequate professional personnel and funds are provided to implement the management prescriptions. The estimated overall cost of conservation actions over the next five years of the ESMP is presented in Table 2.

**TABLE 1**

**ESTIMATED LEVEL OF EFFORT AND COST BY MANAGEMENT PRESCRIPTION**

| Prescription Category | Annual Level of Effort (LOE) Required | Cost | Frequency |
|---|---|---|---|
| Future Forest management | If future forest management prescriptions are employed at IAAAP they are not expected to require additional LOE. The only additional cost will be for the purchase of a bat detector for pre-dawn counts. | Approximately $500 | One-time cost |
| Agricultural management | Agricultural management prescriptions will become part of IAAAP's existing agricultural management program and are not expected to require additional LOE. | $0 | NA |
| Construction, demolition, and environmental remediation | Additional LOE will likely be required to conduct ESA Section 7 consultation for proposed construction, demolition, and environmental remediation activities. It is assumed that such consultation will be required once per year. | $1,500 | Annual average (as required) |
| Training exercises | Prescriptions associated with training exercises are not expected to require additional LOE. | $0 | NA |
| Hunting and other outdoor recreation | Hunting and other outdoor recreation prescriptions are not expected to require LOE beyond that associated with routine natural resource management activities. | $0 | NA |
| Operating contractor activities | Additional LOE will likely be required to conduct ESA Section 7 consultation for tree removals by the operating contractor. It is assumed that such consultation will be required three times per year. | $1,500 | Annual average (as required) |

**TABLE 1 (Continued)**

**ESTIMATED LEVEL OF EFFORT AND COST BY MANAGEMENT PRESCRIPTION**

| Prescription Category | Annual Level of Effort (LOE) Required | Cost | Frequency |
|---|---|---|---|
| Test firing | Prescriptions associated with test firing are not expected to require additional LOE. | $0 | NA |
| Monitoring of Indiana bat and habitat | Conducting a mist net survey once every 5 years will require additional LOE and contractor costs. | $50,000 | 2016 & Once every 5 years |
| | Long-term monitoring of summer habitat conditions will become part of IAAAP's existing forest management program and is not expected to require additional LOE. | $0 | NA |
| Implementation of awareness program | Additional LOE will be required for activities associated with this program, including reproducing and distributing a fact sheet; training supervisors and plant managers; and participating in mandatory safety briefings. | $1,000 | Annual |
| Communication with USFWS | Additional LOE will be required for activities associated with this task. It is assumed that such ESA Section 7 consultation will take place once per year. | $200 | Annual |
| ESMP compliance and ESMP review | Additional LOE will be required for IAAAP's natural resources manager to complete the ESMP annual compliance checklist and minor updates to the ESMP. | $500 | Annual |
| | Additional LOE will be required to complete major revisions to the ESMP. | $1,000 | Once every 5 years (or as required) |

Note: NA - Not applicable

**TABLE 2**

**ESTIMATED OVERALL COST OF CONSERVATION ACTIONS**

| Fiscal Year | Estimated Annual Cost |
|---|---|
| 2015 | 5,700 |
| 2016 | 55,200 |
| 2017 | 5,200 |
| 2018 | 5,200 |
| 2019 | 6,200 |
| 5-Year Total | 77,500 |

## 7.0 REFERENCES

3D/International, Inc. 1996. Biological Assessment of the Master Plan and Ongoing Mission, U.S. Army Engineer Center and Fort Leonard Wood. Prepared for Kansas City Corps of Engineers.

Alberta Sustainable Resource Development and Alberta Conservation Association (ASRD and ACA). 2009. Status of the Northern *Myotis* (*Myotis septentrionalis)* in Alberta. Wildlife Status Report No. 3. Alberta Sustainable Resource Development, Edmonton, Alberta, Canada.

Amelon, S. and D. Burhans. 2006. Conservation assessment: *Myotis septentrionalis* (northern long-eared bat) in the eastern United States. Pages 69-82 in Conservation Assessments for Five Forest Bat Species in the Eastern United States (F.R. Thompson, III, ed.). General Technical Report NC-260, Technical Guide. U.S. Department of Agriculture, Forest Service, North Central Research Station, Columbia, Missouri, USA.

American Ordinance. 1998. Installation Compatible Use Zone (ICUZ) Study for the Iowa Army Ammunition Plant. November.

Bat Conservation International (BCI). 2015. BCI species profile: *Myotis septentrionalis*. http://www.batcon.org/resources/media-education/species-profiles/detail/2306 Accessed on 6 January 2015.

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

Barclay, R.M.R. and A. Kurta. 2007. Ecology and the behavior of bats roosting in tree cavities and under bark. Pages 17-60 in Bats in Forests: Conservation and Management (M. Lacki, J.P. Hayes, and A. Kurta,. eds.). Johns Hopkins University, Baltimore, Maryland, USA.

Belwood, J.J. 1979. Feeding ecology of an Indiana bat community with emphasis on the endangered Indiana bat, *Myotis sodalis*. Unpublished Master's Thesis, University of Florida, Gainesville.

Brack, V., Jr., R.K. Dunlap, and S.A. Johnson. 2005a. Albinism in the Indiana bat, *Myotis sodalis*. Bat Research News. 46:55-58.

Brack, V., Jr., S. Johnson, and C. Stihler. 2005b. Winter hibernacula temperatures used by Indiana bats in: (1) caves in Indiana; (2) a mine in Preble County, Ohio; (3) caves in West Virginia; and (4) caves in Bland County, Virginia. Prepared for the Indiana Bat Risk Assessment Workshop, Shepherdstown, West Virginia.

Brack, V., Jr., and R.K. LaVal, Jr. 1985. Food habits of the Indiana bat in Missouri. Journal of Mammalogy. 66:308-315.

Britzke, E.R. 2003. Spring Roosting Ecology of Female Indiana Bats *(Myotis sodalis*) in the Northeastern United States. Unpublished Report. United States Fish and Wildlife Service, New England Field Office, Concord, New Hampshire.

Britzke, E.R., M.J. Harvey, and S.C. Loeb. 2003. Indiana bat, Myotis sodalis, maternity roosts in the southern United States. Southeastern Naturalist. 2:235-242.

Britzke, E.R., A.C. Hicks, S.L. von Oettingen, and S.R. Darling. 2006. Description of spring roost trees used by female Indiana bats (*Myotis sodalis*) in the Lake Champlain Valley of Vermont and New York. American Midland Naturalist.155:181-187.

Broders, H.G., G.J. Forbes, S. Woodley, and I.D. Thompson. 2006. Range extent and stand selection for roosting and foraging in forest-dwelling northern long-eared bats and little brown bats in the Greater Fundy Ecosystem. New Brunswick. Journal of Wildlife Management. 70:1174-1184.

Butchkoski, C., J. Chenger, G. Turner, C. Sanders, and S. Wolbert. 2006. Abstract in the Proceedings of the 8th Annual Meeting of the Northeast Bat Working Group. Conference Hosted by Pennsylvania Game Commission, and East Stroudsburg University, East Stroudsburg, Pennsylvania.

Butchkoski, C.M. and J.M. Hassinger. 2002. Ecology of a maternity colony roosting in a building. Pp. 130-142 in The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Caceres, M.C., and R.M. Barclay. 2000. *Myotis septentrionalis*. Mammalian Species No. 634. American Society of Mammalogists, Lawrence, Kansas, USA. 12 May.

Caceres, M.C., and M.J. Pybus. 1997. Status of the Northern *Myotis* (*Myotis septentrionalis*) in Alberta. Wildlife Status Report No. 3. Alberta Environmental Protection, Wildlife Management Division, Edmonton, Alberta, Canada.

Callahan, E. 1993. Indiana bat summer habitat requirements. Master's Thesis, University of Missouri-Columbia. As Cited in Rommé and Others 1995.

Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. Journal of Mammalogy. 78:818-825.

Carlson, S.J., R. Benedict, J.G. Otten and T.J. VanDeWalle. 2012a. Endangered Resources Report, U.S. Highway 61 – Middle Segment, Louisa County, Iowa, Final report prepared by Stantec Consulting Services Inc. for the Iowa Department of Transportation, Ames, IA.

Carlson, S.J., R. Benedict, J.G. Otten and T.J. VanDeWalle. 2012b. Endangered Resources Report, U.S. Highway 61 – South Segment, Louisa and Des Moines Counties, Iowa, Final report prepared by Stantec Consulting Services Inc. for the Iowa Department of Transportation, Ames, IA.

Carter, T.C. 2003. Summer habitat use of roost trees by the endangered Indiana bat (*Myotis sodalis*) in the Shawnee National Forest of southern Illinois. Dissertation, Southern Illinois University, Carbondale, IL.

Chenger, J. 2003. Iowa Army Ammunition Plant 2003 Indiana Bat Investigation. Unpublished Report. Prepared by Bat Conservation and Management, Inc., Carlisle, PA. for Iowa Army Ammunition Plant, Middletown, IA.

Clark, B.K., J.B. Bowles, and B.S. Clark. 1987. Summer status of the endangered Indiana bat in Iowa. The American Midland Naturalist.118:32-39.

Clawson, R.L. 2002. Trends in population size and current status. Pp. 2-8 in The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Cope, J.B., and S. R. Humphrey. 1977. Spring and autumn swarming behavior of the Indiana bat, *M. sodalis*. Journal of Mammalogy. 58:93-95.

Copperhead Environmental Consulting (CEC). 2014. Spring migration tracking of female Indiana bats from Blowing Cave and Rose Cave in Central Tennessee. Presentation at Tennessee Bat Working Group Meeting, Fall Creek Falls State Park, Tennessee, November 20.

Council on Environmental Quality (CEQ). 2005. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. Reprint. 40 CFR Parts 1500-1508.

Drobney, R.D. and R.L. Clawson. 1995. Indiana Bats. Pp. 97-98 in Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems (E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds.). U.S. Department of the Interior, National Biological Service, Washington, DC.

EarthView Environmental LLC/Inc. (EVE). 2010a. Wetland Delineation and Threatened/Endangered Species Study, IAAAP 40 mm Test Range, Iowa Armory Ammunition Plant (IAAAP), Des Moines County, Iowa.

EVE. 2010b. Wetland Delineation and Threatened/Endangered Species Study, IAAAP South Water Main, Iowa Armory Ammunition Plant (IAAAP), Des Moines County, Iowa.

EVE. 2010c. Request of Addenda to Permit # CEMVR-OD-P-2011-124, South Water Line, South Loop Alternate Route & Stream Crossings, Iowa Armory Ammunition Plant (IAAAP), Des Moines County, Iowa.

EVE. 2012. Wetland Delineation, Mathes Lake Dam Wetland Delineation and Threatened/Endangered Species Study, Iowa Armory Ammunition Plant (IAAAP), Des Moines County, Iowa.

EVE. 2013. Wetland Delineation and Threatened/Endangered Species Study IAAAP Phase 2 Electrical Power Line Clearing, Iowa Armory Ammunition Plant (IAAAP), Des Moines County, Iowa.

EVE. 2014. Wetland Delineation and Preliminary Threatened & Endangered Species Report, IAAAP-010 Tract 28, Des Moines County, Iowa.

Evans, D.E., W.A. Mitchell, and R.A. Fischer. 1998. Species Profile: Indiana Bat (*Myotis sodalis*) on Military Installations in the Southeastern United States. U.S. Army Corps of Engineers (USACE) Waterways Experiment Station. Vicksburg, Mississippi. Technical Report SERDP- 98-3.

Faure, P.A., H.H. Fullard, and J.W. Dawson. 1993. The gleaning attacks of the northern long-eared bat, *Myotis septentrionalis*, are relatively inaudible to moths. Journal of Experimental Biology. 173-189.

Foster, R., and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy 80:659-672.

Frick, W.F., J.F. Pollock, A.C. Hicks, K.E. Langwig, D.S. Reynolds, G.G. Turner, C.M. Butchkoshi, and T.H. Kuntz . 2010. An emerging disease causes regional population collapse of a common North American bat species. Science. 329:679.

Garner, J. D., and J.E. Gardner. 1992. Determination of Summer Distribution and Habitat Utilization of the Indiana Bat (*M. sodalis*) in Illinois. Final Report: Project E-3. Endangered Species Act Section 6 Report, Illinois Department of Conservation.

Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1990. Combined Progress Reports: 1989 and 1990 Investigations of *Myotis sodalis* (Indiana Bat) Distribution, Habitat Use, and Status in Illinois. Unpublished Report to Region 3–U.S. Fish and Wildlife Service, Fort Snelling, MN and Illinois Department of Transportation, Springfield, IL.

Gardner, J.E., J.D. Garner, and J.E. Hofman. 1991. Summary of *Myotis sodalis* Summer Habitat Studies in Illinois. Illinois Natural History Survey, Illinois Department of Conservation. Champaign, Illinois. Final Report.

Garroway, C.J. and H.G. Broders. 2008. Day roost characteristics if northern long-eared bats (*Myotis septentrionalis*) in relation to female reproductive status. Ecoscience. 15:89-93.

Griffin, D.R. 1945. Travels of banded cave bats. Journal of Mammology. 26:15-23.

Gumbert, M.W. 2001. Seasonal roost tree use by Indiana bats in the Somerset Ranger District of the Daniel Boone National Forest, Kentucky. Master's Thesis, Eastern Kentucky University, Richmond, Kentucky.

Gumbert, M.W., J.M. O'Keefe, and J.R. MacGregor. 2002. Roost fidelity in Kentucky. Pp. 143-152 in The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Gumbert, M., P. Sewell, J. Adams, P. Roby, and J. Schwierjohann. 2013. BrandenbarkTM: Artificial bark designed for roost use by Indiana bats (*Myotis sodalis*). Proceedings of the 2013 International Conference on Ecology and Transportation, Scottsdale, Arizona, June 23-27.

Hall, J.S. 1962. A Life History and Taxonomic Study of the Indiana Bat (*Myotis sodalis*). Reading Public Museum and Art Gallery. Scientific Publications. 12:1-68. As Cited in U.S. Fish and Wildlife Service (USFWS) 1983.

Harvey, M.J. 2002. Status and ecology in the southern United States. Pp. 29-34. In The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Hofmann, J. 1996. Indiana Bats in Illinois. Center for Biodiversity. August. On-Line Address: http://www.inhs.uiuc.edu/chf/pub/surveyreports/mar-apr96/bats.html.

Horton, D., T. O'Brien, M. MacIndoe, K. Schmidt, R. Cruden, P. Rudolph, C. Rogers, N. Klaus, O.J. Goode, and K. Baker. 1996. An Assessment of the Natural Habitats and Biota of the Iowa Army Ammunition Plant, Middletown, Iowa. Submitted to Gary Reiners, Director, The Nature Conservancy Iowa Field Office, Des Moines, Iowa.

Humphrey, S R. 1978. Status and winter habitat, and management of the endangered Indiana bat, *Myotis sodalis*. Florida Scientist. 41:65-76.

Humphrey, S.R., A.R. Richter, and J.B. Cope. 1977. Summer habitat and ecology of the endangered Indiana Bat, *Myotis sodalis*. Journal of Mammalogy. 58:334-346.

Iowa Army Ammunition Plant (IAAAP). 2012. Pest Management Plan for Iowa Army Ammunition Plant, Middletown, Iowa.

IAAAP. 2013. Integrated Natural Resources Management Plan and Environmental Assessment 2013-2018. Prepared by Gene Stout and Associates and Blythe & Trousil, Inc.

Iowa Department of Natural Resources (IDNR). 2012. Securing a Future for Fish and Wildlife. A Conservation Legacy for Iowans (Iowa Wildlife Action Plan). Revised Version. Edited by Katy Reeder.

IDNR. 2015. Hunting. http://www.iowadnr.gov/Hunting.aspx Accessed 12 January 2015.

Johnson, J.B., W.M. Ford, and J.W. Edwards. 2012. Roost networks of northern *myotis* (*Myotis septentrionalis*) in a managed landscape. Forest Ecology and Management. 266:223-231.

Kiser, J.D., H.D. Bryan, G.W. Libby, and R.R. Kiser. 1998. Roost Trees and Radio-tracking of the Federally Endangered Indiana Bat (*Myotis sodalis*) at Camp Atterbury, Bartholomew, Brown, and Johnson Counties, Indiana. Final Report, Montgomery Watson, Novi, Michigan.

Kiser, J.D. and C.L. Elliot. 1996. Foraging Habitat, Food Habits, and Roost Tree Characteristics of the Indiana Bat, *Myotis sodalis*, During Autumn in Jackson county, Kentucky. Final Report, Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky.

Kiser, J.D., J.R. MacGregor, H.D. Bryan, and A. Howard. 2002. Use of concrete bridges as nightroosts. Pp. 208-215. In The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Kiser, J.D., H. Stoffs, and B. Karczewski. 2012. Indiana bat (Myotis sodalis) Survey For Huron Island Complex Habitat Rehabilitation and Enhancement Project, Mississippi River (RDB, RM 421.2 – 425.4), Des Moines County, Iowa (Contract #: W912EK-11-D-0002), Final report prepared by Stantec Consulting Services Inc. for U.S. Army Corps of Engineers, Rock Island District, Rock Island, IL.

Klingner & Associates, P.C. 2014. IAAAP Industrial Park Threatened & Endangered Species Study.

Krochmal, A.R., and D.W. Sparks. 2007. Timing of birth and estimation of age of juvenile *Myotis septentrionalis* and *Myotis lucifugus* in West-Central Indiana. Journal of Mammalogy. 88:649-656.

Kurta, A. 1995. Mammals of the Great Lakes Region. University of Michigan Press.

Kurta, A. 2005. Roosting ecology and behavior of Indiana bats (*Myotis sodalis*) in summer. Pp. 29-42 in Proceedings of the Indiana Bat and Coal Mining: A Technical Interactive Forum (K.C. Vories and A. Harrington, eds.). Office of Surface Mining, U.S. Department of the Interior, Alton, IL.

Kurta, A., J. Kath, E.L. Smith, R. Foster, M.W. Orich, and R. Ross. 1993a. A maternity roost of the endangered Indiana bat (*Myotis sodalis*) in an unshaded, hollow sycamore tree (*Platanus occidentalis*). American Midland Naturalist. 130:405-407. As Cited in Whitaker and Hamilton 1998.

Kurta, A., D. King, J.A. Teramino, J.M. Stribley, and K.F. Williams. 1993b. Summer roosts of the endangered Indiana bat (*Myotis sodalis*) on the northern edge of its range. American Midland Naturalist. 129:132-138. As Cited in Whitaker and Hamilton 1998.

Kurta, A., S.W. Murray, and D H. Miller. 2002. Roost selection and movements across the summer landscape. Pp. 118-129 in The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Kurta, A. and J.O. Whitaker, Jr. 1998. Diet of the endangered Indiana bat (*Myotis sodalis*) on the northern edge of its range. American Midland Naturalist. 140:280-286.

Kurta, A., K.J. Williams, and R. Mies. 1996. Ecological, behavioral, and thermal observations of a peripheral population of Indiana bats (*Myotis sodalis*). Pp. 102-117 in Bats and Forest Symposium (R.M.R. Barclay and R. M. Brigham eds.). British Columbia Ministry of Forests, Victoria, British Columbia, Canada.

Langwig, K.E., W.F. Frick, J.T. Bried, A.C. Hicks, T.H. Kuntz, and A.M. Kilpatrick. 2012. Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome. Ecology Letters. 15:1050–1057.

Lacki, M.J., and J.H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forest. Journal of Wildlife Management. 65:482-488.

LaVal, R.K., R.L. Clawson, W. Caire, L.R. Wingate, and M.L. LaVal. 1977. An Evaluation of the Status of Myotine Bats in the Proposed Meramec Park Lake and Union Lake Project Areas, Missouri. USACE St. Louis District. As Cited in USFWS 1983.

LaVal, R. K. and M. L. LaVal. 1980. Ecological studies and management of Missouri bats, with emphasis on cave dwelling species. Terrestrial Series 8. Missouri Department of Conservation, Jefferson City, Missouri.

Lewis, S. E. 1996. Low roost-site fidelity in pallid bats: associated factors and effect on group stability. Behavioral Ecology and Sociobiology. 39:335-344.

Miller, G.S., Jr. and G.M. Allen. 1928. The American bats of the genera *Myotis* and *Pizonyx*. Bulletin of the U.S. National Museum. 144.

Montgomery Watson and 3D/International, Inc., Environmental Group. 1998. Biological Assessment: Effects to Indiana Bats and Bald Eagles from Construction and Operation of the Proposed Multi-Purpose Training Range. August.

Mumford, R.E., and J.O. Whitaker, Jr. 1982. Mammals of Indiana. Indiana University Press.

Murray, S.W. and A. Kurta. 2004. Nocturnal activity of the endangered Indiana bat (*Myotis sodalis*). Journal of Zoology (London). 262:197-206.

Ohio Division of Wildlife. 1996. Wildlife Notes: Indiana Bat.

Ormsbee, P.C., J.D. Kiser, and S.I. Perlmeter. 2007. The importance of night roosts to the ecology of forest bats. Chapter 5 in Forests: Conservation and Management (M.J. Lacki, J.P. Hayes, and A. Kurta, eds). John Hopkins University Press, Baltimore, Maryland.

Owen, S.F., M.A. Menzel, W.M. Ford, J.W. Edwards, B.R. Chapman, K.V. Miller, P.B. Wood. 2002. Roost Tree Selection by Maternal Colonies of Northern Long-eared *myotis* in an Intensively Managed Forest. USDA Forest Service, General Technical Report NE-292, Northeastern Research Station, Newtown Square, PA, USA.

Patriquin, K.J., F. Palstra, M.L. Leonard, and H.G. Broders. 2013. Female northern *myotis* (*Myotis septentrionalis*) that roost together are related. Behavioral Ecology. Doi10.1093/behaveco/art012.

Ratcliff, J.M. and J.W. Dawson. 2003. Behavioral flexibility: the little brown bat, *Myotis lucifugus*, and the northern long-eared bat, *M. septentrionalis*, both glean and hawk prey. Animal Behavior. 66:847-856.

Reckardt, K., and Kerth, G. 2006. The reproductive success of the parasitic bat fly *Basilia nana* (Diptera : Nycteribiidae) is affected by the low roost fidelity of its host, the Bechstein's bat (*Myotis bechsteinii*). Parasitology Research. 98:237-243.

Reichard, J. 2015. Good News For Bats! Things Are Looking Up For Stemming Disease Spread {Radio broadcast]. 13 January 2015. North Country Public Radio.

Richter, A.R., S.R. Humphrey, J.B. Cope, and V.Brack, Jr. 1993. Modified cave entrances; thermal effect of body mass and resulting decline of endangered Indiana bat (*Myotis sodalis*). Conservation Biology. 7:407-415.

Rommé, R.C., K.Tyrell, and V. Brach, Jr. 1995. Literature Summary and Habitat Suitability Index Model: Components of Summer Habitat for the Indiana Bat, *Myotis sodalis*. Report Submitted to the Indiana Department of Natural Resources, Division of Wildlife, Bloomington, Indiana, by 3D/International, Inc., Environmental Group. Cincinnati, Ohio.

Sasse, D.B., and P.J. Pekins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. In Bats and Forests Symposium. British Columbia Ministry of Forests Working Paper 23:91-101.

Schultes, K.L and C. Elliott. 2002. Roost Tree Selection by Indiana Bats and Northern Bats on the Wayne National Forest, Ohio. Final report submitted to U.S. Fish and Wildlife Service, Reynoldsburg, OH.

Silvis, A., W.M. Ford, E.R. Britzke, J.B. Johnson. 2014. Association, roost use and simulated disruption of *Myotis septentrionalis* maternity colonies. Behavioral Processes. 103:283-290.

Solberg, M.K. 2014. Section 7 of the Endangered Species Act of 1973. Federal-Aid Overview Seminars. Powerpoint presentation. http://www.google.com/url?url=http://www.iowadot.gov/ole/OLESite/attachments/Federal_Aid_Seminars_2014.ppt&rct=j&frm=1&q=&esrc=s&sa=U&ei=-9qvVNejFqHesAT0z4LABw&ved=0CDwQFjAH&sig2=RyivY-

Pg8yGWGGYzpmeZbA&usg=AFQjCNGmAMNHjZDjXqFnOoJ5D-MECpEwWA Accessed 12 January 2015.

Sparks, D.W., C.M. Ritzi, J.E. Duchamp, and J.O. Whitaker, Jr. 2005. Foraging habitat of the Indiana bat, (*Myotis sodalis*) at an urban-rural interface. Journal of Mammalogy 86:713-718.

Sparks, D.W. and J.O. Whitaker, Jr. 2004. Foraging ecology of the Indiana bat. Pp. 15- 21 in Proceedings of Indiana Bat and Coal Mining: A Technical Interactive Forum (K. Vories and A. Harrington, eds). U.S. Department of Interior, Office of Surface Mining, Alton, Illinois.

Stantec Consulting Services, Inc. (Stantec). 2010. Biological Assessment on the Iowa Army Ammunition Pant (IAAAP) 40 mm Test Range, Des Moines County, Iowa. September.

Tetra Tech EM Inc. (Tetra Tech). 1998. Biological Survey of Federally Endangered Bats at the Iowa Army Ammunition Plant. Prepared for U.S. Army Materiel Command Installations and Services Activity. August.

Tetra Tech. 1999a. Record of telephone conversation regarding Indiana bat in Daniel Boone National Forest. Between Matt Schramm, Environmental Scientist, and John MacGregor, Wildlife Biologist, Daniel Boone National Forest. February 12.

Tetra Tech. 1999b. Record of telephone conversation regarding Indiana bat habitat. Between Jack Brunner, Environmental Scientist, and Lori Pruitt, USFWS Region 3 Bloomington Field Office. June 24.

Tetra Tech.1999c. Record of telephone conversation regarding status of the Indiana bat in Iowa. Between Jack Brunner, Environmental Scientist, and Joyce Collins, USFWS Region 3 Rock Island Field Office. September 21.

Tetra Tech. 2000. Record of telephone conversation regarding Indiana bat hibernacula. Between Eric Monschein, Environmental Scientist, and Bill Elliott, Missouri Department of Conservation. April 19.

Thomson, C. 1982. *Myotis sodalis*. Mammalian Species. 163:1-5.

Turner, G.G., D.M. Reeder, and J.T.H. Coleman. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look to the future. Bat Research News. 52:13-27.

Tuttle, M.D. and J. Kennedy. 2002. Thermal requirements during hibernation. Pp. 68-78 in The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

U.S. Army. 2007. Environmental Protection and Enhancement, AR 200-1, 13 December, Headquarters, Washington, D.C.

U.S. Army Corps of Engineers (USACE). 2011. FUSRAP Record of Decision for the Iowa Army Ammunition Plant. U.S. Army Corps of Engineers, Middletown, IA, Final, September.

U.S. Army Environmental Center. 1995. Manual for the Preparation of Installation Endangered Species Management Plans. Prepared by Science Applications International Corporation. March 13.

U.S. Fish and Wildlife Service (USFWS). 1983. Recovery Plan for the Indiana Bat.

USFWS. 1998. Draft Biological Opinion on the Construction and Operation of the Multi-Purpose Training Range (MPTR) at the Camp Atterbury Army National Guard Training Site. November.

USFWS. 2006. Indiana Bat Factsheet. https://www.fws.gov/midwest/endangered/mammals/inba/pdf/inbafctsht.pdf Accessed 21 January 2015.

USFWS. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. Region 3. Fort Snelling, Minnesota.

USFWS. 2009. WNS Cave Advisory – cave activity discouraged to help protect bats from deadly white-nose syndrome. 3/26/2009. http://caves.org/WNS/USFWS-WNS_cave_advisory_news_rls_2009-03-26_final-1.pdf Accessed 13 January 2015.

USFWS. 2011. White Nose Syndrome National Plan. https://www.whitenosesyndrome.org/national-plan/white-nose-syndrome-national-plan Accessed 13 January 2015.

USFWS. 2012. National White-Nose Syndrome Decontamination Protocol - Version 06.25.2012. https://www.whitenosesyndrome.org/sites/default/files/resource/national_wns_revise_final_6.25.12.pdf Accessed 13 January 2015.

USFWS. 2013a. 2013 Rangewide Population Estimate for the Indiana Bat (*Myotis sodalis*). U.S. Fish and Wildlife Service, Bloomington, Indiana.

USFWS. 2013b. Threatened wildlife and plants; 12-month finding on a petition to list the eastern small-footed bat and the northern long-eared bat as endangered or threatened species; listing the northern long-eared bat as an endangered species; proposed rule. Federal Register: 78:61046-61080. 2 October.

USFWS. 2013c. Northern long-eared bat factsheet. https://www.fws.gov/Midwest/endangered/mammals/nlba/pdf/NLBAFactSheet27Sept2013.pdf Accessed 21 January 2015.

USFWS. 2014a. Northern Long-eared Bat Interim Conference and Planning Guidance. Regions 2, 3, 4, 5, and 6. January 6.

USFWS. 2014b. Northern Long-eared Bat Range Map. https://www.fws.gov/Midwest/endangered/mammals/nlba/pdf/nlebRangeMapWForest14Jan2015.pdf Accessed 22 January 2015.

USFWS. 2015. Endangered and threatened wildlife and plants; listing the northern long-eared bat with a rule under Section 4(d) of the Act. Federal Register: 80:2371-2378. 16 January.

USFWS and National Marine Fisheries Service (NMFS). 1998. Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. Final Report. March.

Vanderwolf, K.J., D.F. McAlpine, G.J. Forbes, and D.Malloch. 2012. Bat populations and cave microclimate prior to and at the outbreak of white-nose syndrome in New Brunswick. Canadian Field-Naturalist. 126:125-134.

Whitaker, J.O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48-54 in The Indiana Bat: Biology and Management of An Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

Whitaker, J.O., Jr., and J.R. Gammon. 1988. Endangered and threatened vertebrate animals of Indiana: Their distribution and abundance. The Indiana Academy of Science. Indianapolis, Indiana.

Whitaker, J.O., Jr., and W.J. Hamilton, Jr. 1998. Mammals of the Eastern United States. Cornell University Press. Ithaca, New York. Third Edition.

Winhold, L., E. Hough, and A. Kurta. 2005. Long-term fidelity by tree-roosting bats to a home area. Bat Research News. 46:9-10.

**APPENDIX A**

**GLOSSARY**

(Three Pages)

# GLOSSARY

**Biological assessment**. Information prepared by or under the direction of a federal agency to determine whether a proposed action is likely to (1) adversely affect listed species or designated critical habitat, (2) jeopardize the continued existence of species that are proposed for listing, or (3) adversely modify proposed critical habitat. Biological assessments must be prepared for major construction activities. The outcome of a biological assessment determines whether formal consultation or a conference is necessary.

**Biological opinion**. A document that includes (1) the opinion of the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat, (2) a summary of the information upon which the opinion is based, and (3) a detailed discussion of the effects of the action on listed species or designated critical habitat.

**Calcar**. A spur of cartilage or bone that projects from the ankle of many bat species and helps support the tail membrane.

**Conservation**. Use of all methods and procedures necessary to bring a listed species to the point where it does not require special protection under the Endangered Species Act (ESA).

**Critical habitat**. The specific areas within a listed species' range that have physical or biological features essential to the conservation of the species and that potentially require special management conditions or protection.

**Day roost**. A shelter used during the day that provides bats with protection from predators and inclement weather.

**Echolocation**. Use of a reflected sound emitted from an animal and returned to its ears or other sensory receptors in order to locate objects. Most bat sounds are high-pitched and outside human hearing range.

**Emergence count**. Observation of a potential roost tree for emerging bats at dusk (from 1 hour before sunset to 0.5 hour after sunset).

**Endangered species**. Pursuant to the ESA, any species that is in danger of extinction throughout all or a significant portion of its range.

**Endangered Species Preservation Act**. The 1966 precursor to the ESA and the first federal act that declared a national policy to protect species threatened with extinction and that prohibited the taking of such species on federal lands.

**ESA Section 7 consultation**. Various processes carried out under Section 7 of the ESA, including formal and informal consultation.

**Family**. A taxonomic category within an order. A family consists of one or more genera.

**Formal consultation**. A process involving USFWS and another federal agency that (1) determines whether a proposed federal action is likely to jeopardize the continued existence of a listed species or to destroy or adversely modify designated critical habitat, (2) begins with a federal agency's written request and submittal of a complete initiation package, and (3) concludes with the issuance of a biological opinion by USFWS.

**Frequency**. The amplitude of sound waves measured in kilohertz.

**Hibernaculum** [plural **hibernacula**]. The resting place or shelter of an animal during periods of winter when the animal achieves a state of reduced activity and metabolism because of lowering of its body temperature.

**Informal consultation**. A process that includes all discussions and correspondence between USFWS and another federal agency before a formal consultation. Informal consultation is used to determine whether a proposed federal action may affect listed species or designated critical habitat. If a proposed federal action may affect a listed species or designated critical habitat, formal consultation is required.

**Intensity**. The loudness of sound measured in decibels.

**Intermittent stream**. A stream starting and stopping at intervals. An intermittent stream is identified by a dashed, blue line on U.S. Geological Survey (USGS) topographic maps.

**Keeled calcar**. A calcar with an obvious extension of membrane, or keel, between the calcar and the outside edge of the membrane.

**Listed species**. Any species of fish, wildlife, or plant that has been determined to be threatened or endangered under Section 4 of the ESA.

**Maternity roosting colony**. A group of female bats that live together to bear and raise their young.

**Maternity roosting season**. As defined by the USFWS, the period from April 1 through September 30 during which female Indiana bats congregate in maternity colonies at summer roost trees.

**Migration**. The process or act of moving periodically from one region or climate to another.

**Mist netting**. A field study technique that involves stretching thin, nylon nets between trees to catch bats or birds in flight.

**Night roost**. A shelter that provides bats with resting place between foraging bouts to promote digestion and energy conservation, provide retreats from predators and inclement weather, provide places to ingest food transported from nearby feeding areas, function as feeding perches for sit-and-wait predators, and serve as a place to promote social interactions and information transfer.

**Perennial stream**. A stream present in all seasons of the year. A perennial stream is identified by a solid, blue line on USGS topographic maps.

**Pre-dawn count**. Observation of a potential roost tree for emerging bats at dawn (from 1 hour before sunrise to 0.5 hour after sunrise).

**Radio-telemetry**. Use of radio transmitters and receivers to track the movements or determine the den locations of individual animals. A radio transmitter is affixed to an animal to be tracked.

**Recovery plan**. A document that delineates, justifies, and schedules research and management actions necessary to support the recovery of a species, including actions that, if successfully undertaken, are likely to permit reclassification or delisting of the species.

**Roost**. A perch or other place used by bats for hanging, resting, and lodging.

**Senescent**. The growth phase of a plant or plant part (as a leaf) from full maturity to death.

**Snag**. A tree with less than 10 percent live canopy.

**Species**. A group of interbreeding natural populations that is reproductively isolated from other such groups.

**Stand**. A contiguous area of woodland containing trees of similar species, sizes, and ages.

**Torpor**. A state of decreased physiological activity used to conserve energy that usually involves reduced body temperate and reduced metabolic rate.

**Tragus**. A spike of cartilage located at the base of a bat's ear that is used for echolocation purposes. Also used as an identification feature by biologists to determine the species of bat.

**Threatened species**. Pursuant to the ESA, any species that is likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future.

**Volant**. Capable of flight.

**White-nose Syndrome**. An emergent disease of hibernating bats caused by the white fungus *Pseudogymnoascus destructans*. The fungus infects the skin of bats' muzzles, ears, and wings and is responsible for millions of bat deaths since 2007.

## APPENDIX B

## PERSONS CONSULTED DURING ENDANGERED SPECIES MANAGEMENT PLAN PREPARATION

(One Page)

**PERSONS CONSULTED DURING ENDANGERED SPECIES MANAGEMENT PLAN PREPARATION**

The following individuals provided pertinent information and supporting material during the development of this and past ESMP documents.

| Name | Affiliation | Area of Interest |
|---|---|---|
| Joe Haffner | Iowa Army Ammunition Plant | Natural Resource Management |
| Kasi Dickerson | Iowa Army Ammunition Plant | Facilities Engineer |
| Brian Peck | U.S. Army Corps of Engineers Mobile District | Natural Resource Management |
| Mike Coffey | U.S. Fish and Wildlife Service Region 3 Rock Island Field Office | Contaminant Biologist |
| Joyce Collins | U.S. Fish and Wildlife Service Region 3 Crab Orchard National Wildlife Refuge | Wildlife Management |
| Kelly Poole | Iowa Department of Natural Resources | Natural Resource Management |
| Board Members | Iowa Army Ammunition Plant Restoration | Environmental Restoration |

**APPENDIX C**

**IOWA ARMY AMMUNITION PLANT ENDANGERED SPECIES MANAGEMENT PLAN ANNUAL COMPLIANCE CHECKLIST**

(Four Pages)

**IOWA ARMY AMMUNITION PLANT (IAAAP)**
**ENDANGERED SPECIES MANAGEMENT PLAN (ESMP)**
**ANNUAL COMPLIANCE CHECKLIST**

Completed by: _____ Date: _____

Approved by: _____ Date: _____
Commanding Officer

If any of the answers to the questions below is "No," provide a detailed explanation of the deviation from the ESMP management prescription and describe actions taken to correct the situation.

| **FOREST MANAGEMENT (Section 5.1.1 of ESMP and environmental assessment [EA])** | | |
|---|---|---|
| 1 | Did IAAAP refrain from tree cutting activities during the Indiana bat and northern long-eared bat maternity roosting season (April 1 through September 30)? | ☐ Yes ☐ No |
| 2 | Did forest management at IAAAP support the following goals?<br>· An average of at least one live, potential maternity roost tree per 5 acres with a diameter at breast height (dbh) greater than 20 inches will be maintained in each stand.<br>· An average of at least six live, potential maternity roost trees per 5 acres with a dbh greater than 9 inches will be maintained in the stand.<br>· If the stand does not contain trees with a dbh greater than 20 inches, the two largest live, potential maternity roost trees per 5 acres with a dbh greater than 14 inches will be maintained in the stand. | ☐ Yes ☐ No<br>☐ Not Applicable<br>☐ Yes ☐ No<br>☐ Yes ☐ No<br>☐ Not Applicable |
| 3 | Did IAAAP leave shagbark hickory (*Carya ovata*) and shellbark hickory (*Carya laciniosa*) trees standing during forest management activities? | ☐ Yes ☐ No |
| 4 | Was 60 percent or more canopy cover maintained in each forest stand after forest management activities? | ☐ Yes ☐ No |
| 5 | Were snags left standing during forest management activities? | ☐ Yes ☐ No |
| 6 | If IAAAP engaged in tree cutting activities within 100 feet of a perennial stream or within 50 feet of an intermittent stream, did the activities maintain or improve the quality of the Indiana bat or northern long-eared bat habitat? (If so, explain below.) | ☐ Yes ☐ No<br>☐ Not Applicable |
| 7 | Were known maternity roost trees protected until they were no longer standing? | ☐ Yes ☐ No<br>☐ Not Applicable |
| 8 | Did IAAAP apply only those pesticides approved by the U.S. Environmental Protection Agency (EPA) and the IAAAP natural resources manager from April 1 through September 30? | ☐ Yes ☐ No |
| 9 | Did IAAAP refrain from prescribed burning of woodlands from April 1 through September 30? | ☐ Yes ☐ No |

**EXPLANATION/COMMENTS:**

_____

_____

_____

_____

**IOWA ARMY AMMUNITION PLANT (IAAAP)**
**ENDANGERED SPECIES MANAGEMENT PLAN (ESMP)**
**ANNUAL COMPLIANCE CHECKLIST**

| | | |
|---|---|---|
| **AGRICULTURAL MANAGEMENT (Section 5.1.2 of ESMP/EA)** | | |
| 10 | Were agricultural management prescriptions included in all lease agreements, tract management plans, and land use regulations? | ☐ Yes ☐ No |
| 11 | Did lessees comply with lease agreements and associated management prescriptions? | ☐ Yes ☐ No |
| 12 | Were only EPA- and IAAAP-approved pesticides used? | ☐ Yes ☐ No |
| 13 | Were pesticides applied only after use of other integrated pest management techniques was considered and only when the potential for economic loss from crop damage was evident? | ☐ Yes ☐ No |
| 14 | Was consideration given to rotation of pesticide classes from application to application in order to reduce pest resistance? | ☐ Yes ☐ No |
| 15 | Was precision farming using variable-rate technology employed whenever possible to adjust the percentage of active pesticide ingredients used based on the soil type or the location of pests in a field? | ☐ Yes ☐ No |
| 16 | Were pesticides used in accordance with container label provisions? | ☐ Yes ☐ No |
| 17 | Were pesticides applied only during the period between 30 minutes after sunrise and 30 minutes before sunset? | ☐ Yes ☐ No |
| 18 | Did agricultural lessees refrain from applying pesticides in gusty winds or when the wind speed exceeded 10 miles per hour? | ☐ Yes ☐ No |
| 19 | Did agricultural lessees refrain from aerial application of pesticides? | ☐ Yes ☐ No |
| **CONSTRUCTION, DEMOLITION, AND ENVIRONMENTAL REMEDIATION (Section 5.1.3 of ESMP/ EA)** | | |
| 20 | Did IAAAP perform appropriate Endangered Species Act (ESA) Section 7 consultation before initiating construction, demolition, or environmental remediation activities that might adversely impact the Indiana bat or northern long-eared bat habitat? (If so, explain below.) | ☐ Yes ☐ No<br>☐ Not applicable |
| **TRAINING EXERCISES (Section 5.1.4 of ESMP/EA)** | | |
| 21 | Did IAAAP perform appropriate ESA Section 7 consultation before initiating intensive training exercises that might impact the Indiana bat or northern long-eared bat? | ☐ Yes ☐ No<br>☐ Not applicable |

**EXPLANATION/COMMENTS:**

**IOWA ARMY AMMUNITION PLANT (IAAAP)**
**ENDANGERED SPECIES MANAGEMENT PLAN (ESMP)**
**ANNUAL COMPLIANCE CHECKLIST**

| | | |
|---|---|---|
| **HUNTING AND OTHER OUTDOOR RECREATION (Section 5.1.5 of ESMP/EA)** | | |
| 22 | Were hunting activities at the installation conducted in accordance with state law? | ☐ Yes ☐ No |
| 23 | Were hunters advised not to shoot at turkeys that are in trees? | ☐ Yes ☐ No |
| 24 | Did IAAAP advise hunters and outdoor recreationalists to minimize disturbances to the Indiana bat or northern long-eared bat foraging and summer roosting habitat at the installation as part of the awareness program? | ☐ Yes ☐ No |
| **OPERATING CONTRACTOR ACTIVITIES (Section 5.1.6 of ESMP/EA)** | | |
| 25 | Did the operating contractor engage in necessary ESA Section 7 consultation for activities that might impact the Indiana bat or northern long-eared bat?<br>If so, were all consultation activities documented and coordinated with the IAAAP natural resources manager? | ☐ Yes ☐ No<br>☐ Yes ☐ No<br>☐ Not applicable |
| **TEST FIRING (Section 5.1.7 of ESMP/EA)** | | |
| 26 | Did IAAAP perform appropriate ESA Section 7 consultation before initiating more intensive test firing activities that might impact the Indiana bat or northern long-eared bat? | ☐ Yes ☐ No<br>☐ Not Applicable |
| **MONITORING OF INDIANA BAT AND NORTHERN LONG-EARED BAT AND HABITAT (Section 5.2.1 of ESMP/EA)** | | |
| 27 | Did IAAAP conduct a biological survey for the Indiana bat and northern long-eared bat? If so, summarize the results below.<br>Date of last survey: | ☐ Yes ☐ No<br>☐ Not Applicable |
| 28 | Did IAAAP conduct a forest resource inventory to monitor the stock of suitable potential maternity roost trees and snag density (if 10 years has passed since the last inventory)? If so, summarize the results below.<br>Date of last inventory: | ☐ Yes ☐ No<br>☐ Not Applicable |

**EXPLANATION/COMMENTS:**

**IOWA ARMY AMMUNITION PLANT (IAAAP)**
**ENDANGERED SPECIES MANAGEMENT PLAN (ESMP)**
**ANNUAL COMPLIANCE CHECKLIST**

| | | |
|---|---|---|
| **IMPLEMENTATION OF AWARENESS PROGRAM (Section 5.2.2 of ESMP/EA)** | | |
| 29 | Were the Indiana bat and northern long-eared bat fact sheets distributed to appropriate IAAAP employees, agricultural lessees, hunters, and other individuals whose activities might impact the Indiana bat or northern long-eared bat? | ☐ Yes ☐ No |
| 30 | Did IAAAP's natural resources manager meet with installation supervisors and plant managers to discuss the fact sheets and to request that they disseminate information on the Indiana bat and northern long-eared bat to their staff as appropriate? | ☐ Yes ☐ No<br>☐ Not applicable |
| 31 | Did IAAAP's natural resources manager disseminate information on the Indiana bat and northern long-eared bat through mandatory safety briefings and showing of the hunter safety video? | ☐ Yes ☐ No |
| **COMMUNICATION WITH U.S. FISH AND WILDLIFE SERVICE (USFWS) (Section 5.2.3 of ESMP/EA)** | | |
| 32 | Did IAAAP report findings of species and habitat monitoring activities to the USFWS Region 3 Rock Island Field Office? | ☐ Yes ☐ No<br>☐ Not applicable |
| 33 | Did IAAAP engage in ESA Section 7 consultation with the USFWS Region 3 Rock Island Field Office? (If so, explain below.) | ☐ Yes ☐ No<br>☐ Not applicable |
| **ESMP COMPLIANCE AND ESMP/EA REVIEW (Section 6.0 of ESMP/EA)** | | |
| 34 | Did the IAAAP natural resources manager make minor[a] or major[b] revisions to the ESMP/EA? (If so, explain below.) | ☐ Yes ☐ No |
| 35 | Have ESA violations been documented this year? (If so, explain below.) | ☐ Yes ☐ No<br>☐ Not applicable |

**EXPLANATION/COMMENTS:**

Notes:

[a] Minor revisions are changes that will have no effect (considered together with all previous minor changes to the current ESMP/EA), beneficial or adverse, on the Indiana bat and its habitat or the northern long-eared bat and its habitat.

[b] Major revisions are changes that will impact the Indiana bat and its habitat or the northern long-eared bat and its habitat.

**APPENDIX D**

**FACT SHEETS ON THE INDIANA BAT AND NORTHERN LONG-EARED BAT**

(Four Pages)

# Indiana Bat
# *(Myotis sodalis)*

The Indiana bat is an endangered species. Endangered species are animals and plants that are in danger of becoming extinct. Threatened species are those that are likely to become endangered in the foreseeable future. Identifying, protecting, and restoring endangered and threatened species are primary objectives of the U.S. Fish and Wildlife Service's endangered species program.


Photo by Rich Fields

*Indiana bats eat up to half their body weight in insects each night.*

## What is the Indiana Bat?

### *Description*

The scientific name of the Indiana bat is *Myotis sodalis* and it is an accurate description of the species. Myotis means "mouse ear" and refers to the relatively small, mouse-like ears of the bats in this group. Sodalis is the Latin word for "companion." The Indiana bat is a very social species; large numbers cluster together during hibernation. The species is called the Indiana bat because the first specimen described to science in 1928 was based on a specimen found in southern Indiana's Wyandotte Cave in 1904.

The Indiana bat is quite small, weighing only one-quarter of an ounce (about the weight of three pennies). In flight, it has a wingspan of 9 to 11 inches. The fur is dark-brown to black. The Indiana bat is similar in appearance to many other related species. Biologists can distinguish it from similar species by comparing characteristics such as the structure of the foot and color variations in the fur.

### *Habitat*

Indiana bats hibernate during winter in caves or, occasionally, in abandoned mines. For hibernation, they require cool, humid caves with stable temperatures, under 50° F but above freezing. Very few caves within the range of the species have these conditions.

Hibernation is an adaptation for survival during the cold winter months when no insects are available for bats to eat. Bats must store energy in the form of fat before hibernating. During the six months of hibernation the stored fat is their only source of energy. If bats are disturbed or cave temperatures increase, more energy is needed and hibernating bats may starve.

After hibernation, Indiana bats migrate to their summer habitat in wooded areas where they usually roost under loose tree bark on dead or dying trees. During summer, males roost alone or in small groups, while females roost in larger groups of up to 100 bats or more. Indiana bats also forage in or along the edges of forested areas.

### *Reproduction*

Indiana bats mate during fall before they enter caves to hibernate. Females store the sperm through winter and become pregnant in spring soon after they emerge from the caves.

After migrating to their summer areas, females roost under the peeling bark of dead and dying trees in groups of up to 100 or more. Such groups are called maternity colonies. Each female in the colony gives birth to only one pup per year. Young bats are nursed by the mother, who leaves the roost tree only to forage for food. The young stay with the maternity colony throughout their first summer.

### *Feeding Habits*

Indiana bats eat a variety of flying insects found along rivers or lakes and in uplands. Like all insect-eating bats, they benefit people by consuming insects that are considered pests or otherwise harmful to humans. Their role in insect control is not insignificant – Indiana bats eat up to half their body weight in insects each night.

### *Range*

Indiana bats are found over most of the eastern half of the United States. Almost half of all Indiana bats (207,000

in 2005) hibernate in caves in southern Indiana. In 2005, other states which supported populations of over 40,000 included Missouri (65,000), Kentucky (62,000), Illinois (43,000) and New York (42,000). Other states within the current range of the Indiana bat include Alabama, Arkansas, Connecticut, Iowa, Maryland, Michigan, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia. The 2005 population estimate is about 457,000 Indiana bats, half as many as when the species was listed as endangered in 1967.

## Why is the Indiana Bat Endangered?

### *Human Disturbance*

Indiana bats, because they hibernate in large numbers in only a few caves, are extremely vulnerable to disturbance. During hibernation, they cluster in groups of up to 500 per square foot. Since the largest hibernation caves support from 20,000 to 50,000 bats, it is easy to see how a large part of the total population can be affected by a single event. Episodes of large numbers of Indiana bat deaths have occurred due to human disturbance during hibernation.

### *Cave Commercialization and Improper Gating*

The commercialization of caves – allowing visitors to tour caves during hibernation – drives bats away. Changes in the structure of caves, such as blocking an entrance, can change the temperature in a cave. A change of even a few degrees can make a cave unsuitable for hibernating bats. Some caves are fitted with gates to keep people out, but improper gating that prevents access by bats or alters air flow, temperature, or humidity can also be harmful. Properly constructed gates are beneficial because they keep people from disturbing hibernating bats while maintaining temperature and other requirements and allowing access for bats.

### *Summer Habitat Loss or Degradation*

Indiana bats use trees as roosting and foraging sites during summer months. Loss and fragmentation of forested habitats can affect bat populations.

### *Pesticides and Environmental Contaminants*

Insect-eating bats may seem to have an unlimited food supply, but in local areas, insects may not be plentiful because of pesticide use. This can also affect the quality of the bats' food supply. Many scientists believe that population declines occurring today might be due, in part, to pesticides and environmental contaminants. Bats may be affected by eating contaminated insects, drinking contaminated water, or absorbing the chemicals while feeding in areas that have been recently treated.

## What is Being Done to Prevent Extinction of the Indiana Bat?

### *Listing*

Prompted by declining populations caused by disturbance of bats during hibernation and modification of hibernacula, the Indiana bat was listed in 1967 as "in danger of extinction" under the Endangered Species Preservation Act of 1966. It is listed as "endangered" under the current Endangered Species Act of 1973. Listing under the Endangered Species Act protects the Indiana bat from take (harming, harassing, killing) and requires Federal agencies to work to conserve it.

### *Recovery Plan*

The Endangered Species Act requires that recovery plans be prepared for all listed species. The U.S. Fish and Wildlife Service developed a recovery plan for the Indiana bat in 1983 and is now revising that Plan. The recovery plan describes actions needed to help the bat recover.

### *Habitat Protection*

Public lands like National Wildlife Refuges, military areas, and U.S. Forest Service lands are managed for Indiana bats by protecting forests. This means ensuring that there are the size and species of trees needed by Indiana bats for roosting; and providing a supply of dead and dying trees that can be used as roost sites. In addition, caves used for hibernation are managed to maintain suitable conditions for hibernation and eliminate disturbance.

### *Education and Outreach*

Understanding the important role played by Indiana bats is a key to conserving the species. Helping people learn more about the Indiana bat and other endangered species can lead to more effective recovery efforts.

***U.S. Fish & Wildlife Service***
***1 Federal Drive***
***Fort Snelling, Minnesota 55111***
***612/713-5350***
***http://www.fws.gov/midwest/endangered***

***December 2006***

# Northern Long-Eared Bat

*Myotis septentrionalis*

The northern long-eared bat has been proposed to be federally listed as an endangered species under the Endangered Species Act. Endangered species are animals and plants that are in danger of becoming extinct. Identifying, protecting, and restoring endangered and threatened species are primary objectives of the U.S. Fish and Wildlife Service's endangered species program.

Photo by Steve Taylor; University of Illinois

*This northern long-eared bat, observed during an Illinois mine survey, shows visible symptoms of white-nose syndrome.*

## What is the northern long-eared bat?

***Appearance:*** The northern long-eared bat is a medium-sized bat about 3 to 3.7 inches but with a wingspan of 9 to 10 inches. Its fur color can be medium to dark brown on the back and tawny to pale-brown on the underside. As its name suggests, this bat is distinguished by its long ears, particularly as compared to other bats in its genus, *Myotis*, which are actually bats noted for their small ears (Myotis means mouse-eared).

***Winter Habitat:*** Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible.

***Summer Habitat:*** During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds.

***Reproduction:*** Breeding begins in late summer or early fall when males begin swarming near hibernacula. After copulation, females store sperm during hibernation until spring, when they emerge from their hibernacula, ovulate, and the stored sperm fertilizes an egg. This strategy is called delayed fertilization.

After fertilization, pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. Maternity colonies, with young, generally have 30 to 60 bats, although larger maternity colonies have been observed. Most females within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth. Adult northern long-eared bats can live up to 19 years.

***Feeding Habits:*** Northern long-eared bats emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces.

***Range:*** The range of the northern long-eared bat includes much of the eastern and north central United States, and all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and

eastern British Columbia. Within the United States, this area includes the following 39 States: Alabama, Arkansas, Connecticut, Delaware, the District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.

## Why is the northern long-eared bat in danger of extinction?

***White-nose Syndrome:*** No other threat is as severe and immediate as the disease, white-nose syndrome. If this disease had not emerged, it is unlikely the northern long-eared population would be declining so dramatically. Since symptoms were first observed in New York in 2006, white-nose syndrome has spread rapidly from the Northeast to the Midwest and Southeast; an area that includes the core of the northern long-eared bat's range where it was most common before this disease. Numbers have declined by 99 percent in the Northeast. Although there is uncertainty about the rate that white-nose syndrome will spread within the species' range, it is expected to spread throughout the United States.

***Other Sources of Mortality:*** Although significant population declines have not been observed due to the sources of mortality listed below, they may now be important factors affecting this bat's ability to persist while experiencing dramatic declines caused by white-nose syndrome.

***Impacts to Hibernacula:*** Gates or other structures to exclude people from caves and mines restrict bat flight and movement and change airflow and internal cave and mine microclimates. A few degrees change can make a cave unsuitable for hibernating bats. Also, cave-dwelling bats are vulnerable to human disturbance while hibernating. Bats use up their energy stores when aroused and may not survive the winter or females may not successfully give birth or rear young.

***Loss or Degradation of Summer Habitat:*** Highway and commercial development, surface mining, and wind facility construction permanently remove habitat and are prevalent in many areas of this bat's range. Timber harvest and forest management can remove or alter (improving or degrading) summer roosting and foraging habitat.

***Wind Farm Operation:*** Wind turbines kill bats, including northern long-eared bats, although only a small number have been documented to date. However, there are many wind projects within a large portion of the bat's range and many more are planned.

## What Is Being Done to Prevent Extinction of the Northern Long-Eared Bat?

***Disease Management:*** Actions have been taken to slow the spread of white-nose syndrome through human transmission of the fungus into caves (e.g. cave and mine closures and advisories; national decontamination protocols). A national plan was prepared by the Service and other state and federal agencies that details actions needed to investigate and manage white-nose syndrome. Many state and federal agencies, universities and non-governmental organizations are researching this disease to try to control its spread and address its affect.

***Addressing Wind Turbine Mortality:*** The Service and others are working to minimize bat mortality from wind turbines on several fronts. We fund and conduct research to determine why bats are susceptible to turbines, how to operate turbines to minimize mortality and where important bat migration routes are located. The Service, state natural resource agencies, and wind energy industry are developing a Midwest Wind Energy Multi-Species Habitat Conservation Plan that will provide wind farms a mechanism to continue operating legally while minimizing and mitigating listed bat mortality.

***Listing:*** We are proposing to list the northern long-eared bat as an endangered species under the federal Endangered Species Act. Listing affords a species the protections of the Act and increases the priority of the species for funds, grants, and recovery opportunities.

***Hibernacula Protection:*** Many agencies and organizations have protected caves and mines that are important hibernacula for cave-dwelling bats.

## What Can I Do?

***Do Not Disturb Hibernating Bats:*** Comply with all cave and mine closures, advisories, and regulations. In areas without a cave and mine closure policy, follow approved decontamination protocols (see whitenosesyndrome.org/topics/decontamination). Under no circumstances should clothing, footwear, or equipment that was used in a white-nose syndrome affected state or region be used in unaffected states or regions.

***Leave Dead and Dying Trees Standing:*** Where possible and not a safety hazard, leave dead or dying trees on your property. Northern long-eared bats and many other animals use these trees.

***Install a Bat Box:*** Dead and dying trees are usually not left standing, so trees suitable for roosting may be in short supply and bat boxes can provide additional roost sites.