Standing Analysis and Implementation Plan – Department of Defense-War Determination Key for Indiana Bat, Northern Long-Eared Bat and Tricolored Bat

Version 1.0
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Northeast Region
U.S. Fish and Wildlife Service
Hadley, MA

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1 INTRODUCTION

1.1 PURPOSE OF ANALYSIS

This Standing Analysis (SA) provides the analytical basis for an optional, alternative consultation process for Department of Defense- Department of War (DODW) to address potential effects of future actions, pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA), to the following species: the federally listed endangered northern long-eared bat (*Myotis septentrionalis*; NLEB) and Indiana Bat (*Myotis sodalis*; IBAT) and IBAT critical habitat (CH), and the federally proposed endangered tricolored bat (*Perimyotis subflavus*; TCB). No CH has been designated for NLEB or TCB. The U.S. Fish and Wildlife Service (FWS) developed this SA to streamline the process of reviewing actions that would result in a "may affect, not likely to adversely affect" (NLAA) determination for the subject species and CH. This SA also provides proactive technical assistance to DODW in making a "no effect" (NE) determination. This SA provides an analytical basis for consultations that is available to DODW for actions that meet the criteria described below as delivered through a Determination Key (Dkey) in the FWS's Information for Planning and Consultation (IPaC) application. To obtain consultation documents, including technical assistance for NE and concurrence with NLAA determinations, DODW must use the associated Dkey in IPaC to answer questions about the proposed action. By screening the project through the Dkey, all or part of the SA is adopted by DODW and used to submit a concurrence request to support their NLAA determination. It also provides technical information to help DODW determine whether an action will have no effect on the species or CH. Formal consultation under ESA Section 7(a)(2) is required for actions that "may affect" a listed species or CH, unless the FWS concurs in writing that actions are NLAA listed species or CH. Actions which DODW determines will have no effect on species or CH do not require submittal to FWS.

Federal agencies must consult with U.S. Fish and Wildlife Service under section 7(a)(2) of the ESA when an action "may affect" a listed species. TCB is proposed for listing as endangered under the ESA but not yet listed. For actions that "may affect" a proposed species, agencies cannot consult, but they can *confer* under the authority of section 7(a)(4) of the ESA. Such conferences can follow the procedures for a consultation and be adopted as such if and when the proposed species is listed. Should the TCB be listed, agencies must review projects that are not yet complete, or projects with ongoing effects within the TCB range that previously received a NE or NLAA determination from the Dkey to confirm that the determination is still accurate. The consultation determinations reached would be applicable to the TCB if the final listing determination is to list the species under the ESA.

With the IPaC Dkey established for this SA, DODW may receive a letter of concurrence for eligible projects by providing specific information requested by the Dkey. This analysis is based on the best available scientific information and will be updated if new information becomes available that may impact outcomes in the Dkey. The SA also explains the basis for actions that do not warrant predetermined outcomes via the DKey and that should undergo additional review or consultation.

Throughout the remainder of this document, statements regarding this SA refer to both the SA and the associated Dkey. DODW is not required to consult using this SA or follow all the built-in conservation measures. DODW can develop programmatic or individual project consultations as desired. In addition, if the action agency's proposed action is inconsistent with the SA or does not include the required conservation measures, it does not mean the project is automatically "likely to adversely affect" (LAA) for one or more of the bat species. It only means a FWS biologist needs to review the project, and the Service may still be able to concur with NLAA determinations outside of the Dkey.

1.2 Benefits and Justification for Determination Key

For those federal actions that FWS has accumulated significant knowledge in analyzing previously, FWS is able to develop an SA to streamline the consultation process for eligible federal actions. The streamlined process facilitated by this SA will reduce the amount of FWS and action agency staff time necessary to develop consultation documents and review actions requesting consultation and provide Federal agencies, consultants, and other project proponents a predictable, consistent, and timely response for qualified actions. The Dkey provides a concurrence letter upfront for NLAA determinations that are submitted by an employee of the federal action agency or the designated non-federal representative. Concurrence letters are subjected to a 15-day waiting period (versus the 60-day time period for traditional consultation), to allow the local Ecological Services Field Office (ESFO) biologists to audit Dkey submissions and contact the project proponent if errors are found.

1.3 Eligibility for Predetermined Consultation Outcomes via the Determination Key

A SA does not convey concurrence for NLAA determinations for individual projects. Rather, it serves as a streamlining tool. Action agencies may use it to develop their request for concurrence from the FWS. By serving as the analytical template to request concurrence, the SA also allows the FWS to quickly evaluate an action agency's request for concurrence with its finding that its action is NLAA relevant to listed species or designated CH. If the action agency's proposed action is consistent with the SA and includes any required conservation measures, the FWS will concur that the action will have insignificant, discountable, or wholly beneficial effects on the relevant listed species or CH.

The SA may also provide technical information to help agencies identify actions that will have no effects to the listed species or CH. For projects that do not qualify to use the SA, action agencies/project proponents should coordinate directly with the ESFO and address any consultation requirements, as appropriate.

1.4 Ensuring Accurate Determinations

As is true in all consultation procedures, the FWS relies on complete and accurate information provided by Federal action agencies during consultation. To apply this SA to a project, it is the responsibility of the action agency/project proponent to provide information that is truthful and accurate and that fully represents the entire scope of the project in order to comply with the ESA. In the letters delivered to project proponents, FWS states that "All information submitted by the Project proponent into IPaC must accurately represent the full scope and details of the Project. Failure to accurately represent or implement the Project as detailed in IPaC or the DODW Dkey for IBAT, NLEB and TCB, invalidates this letter."

Where appropriate in our analysis, we make note of which activities are expected to have no effects[1] on a species or CH. This information is provided as technical assistance to assist action agencies making no effect/may affect determinations.

1.5 Determination Key Applicability and Outcomes

The Dkey is intended to be used for section 7 consultation for DODW actions that may impact the IBAT, NLEB, and/or TCB.

1.5.1 Federal Agency Actions

Federal agencies must consult with FWS under section 7(a)(2) of the ESA on any action that may affect an endangered or threatened species or CH. This requirement applies to actions that a federal agency funds, authorizes, or carries out, in whole or in part.

For some actions, federal agencies will be able to complete ESA section 7 consultation for the IBAT, NLEB and/or TCB via the Dkey in IPaC. After completing the Dkey, agencies have met their consultation requirement for IBAT, NLEB and/or TCB when they receive a letter that verifies a determination of NLAA for these species. Because TCB is a proposed species, and consultation is not required for proposed species, the letter type delivered is based on the determinations for IBAT and NLEB only. The determination for TCB is provided for informational purposes while TCB is a proposed species. Should TCB be listed, the letter type will be determined by all three species (IBAT, NLEB and TCB). If TCB is the only species present (e.g., IBAT and NLEB are not present on the official species list) the letter type will be based on the determination for TCB.

Three types of letters are possible. 1) If both IBAT and NLEB are in the consultation range for the project, the NLAA verification letter will be delivered if both IBAT and NLEB reach the NLAA outcome, or if one species reaches the NLAA and the other species reaches a NE determination (Table 1). 2) If the project is consistent with a finding that the action will have no effect on IBAT and NLEB, the Dkey will produce a "no effect technical assistance letter." The NE technical assistance letter will only be delivered if both IBAT and NLEB reach the NE determination. 3) If the action "may affect" either the IBAT or NLEB but does not qualify for any of the pre-determined outcomes outlined in the Dkey, the agency would receive a "may affect technical assistance letter" which requires direct coordination with the ESFO to complete consultation. A "may affect technical assistance letter" will be delivered if IBAT or NLEB reaches a "may affect" determination in the Dkey. A "may affect" determination in this key indicates that the project, as entered, is not consistent with the questions in the key. Not all projects that reach a "may affect" determination are anticipated to result in adverse impacts to listed species. These projects may result in a NE, NLAA, or LAA determination after consultation with an ESFO depending on the details of the project. The "may affect technical assistance letter" will provide further instructions for completing consultation.

[1] A "no effect" determination is appropriate when either the species is not present in the action area or if present, is not exposed to any possible stressors or impacts (beneficial or negative) from the proposed action, or the proposed action would not result in any physical, chemical, biotic changes to the environment that are reasonably certain to occur and would not occur but for the action (i.e., no action area can be defined).

Table 1. Determination combinations and letter types produced for IBAT and NLEB in the DODW Dkey (NE = no effect; NLAA = not likely to adversely affect; MA = may affect).

IBAT Determination	NLEB Determination	Letter Type
NE	NE	NE Technical Assistance
NE	NLAA	NLAA Concurrence
NLAA	NE	NLAA Concurrence
NLAA	NLAA	NLAA Concurrence
NE	MA	MA Technical Assistance
NLAA	MA	MA Technical Assistance
MA	NLAA	MA Technical Assistance
MA	MA	MA Technical Assistance

1.5.2 Use of Dkey by Non-Federal Representatives of Federal Agencies

Another entity may conduct informal consultation if the federal agency has designated them in writing to FWS as their non-federal representatives (see 50 CFR § 402.08). These designated non-federal representatives may also conclude consultation for federal actions that "may affect" the IBAT and/or NLEB if they receive a verification letter for a finding of NLAA for all species via the Dkey.

1.6 Updating the Standing Analysis

The FWS Dkey sponsor (Northeast Region IPaC Coordinator) will ensure that this analysis is updated whenever changes to the Dkey are proposed and whenever new information warrants updates. Public access to the most recent version of the standing analysis will be available in IPaC on the description page for the Dkey.

2 Covered Area

This SA applies within the area described below, unless otherwise excluded (see Section 3.1.2). In delineating the geographic scope of this SA (covered area), we determined the appropriate extent based on the species included and the activities covered herein. To qualify to use this SA, a project's action area must fall completely within the covered area. More information about how the consultation ranges for NLEB and TCB are defined can be found in the "Northern Long-eared Bat and Tricolored Bat Voluntary Environmental Review Process for Development Projects" (Consultation Guidance).

The covered area is the consultation range for the IBAT (Fig. 1), NLEB (Fig. 2), and TCB (Fig. 3) in the United States. Action areas for individual projects considered under this SA are expected to be within DODW-controlled and DODW-owned sites within the reach and authority of the FWS and the ESA, as well as any area where activities take place that are authorized, funded or carried out by the DODW. Projects that are authorized, funded or carried out by the U.S. Army Corps of Engineers should continue to utilize the NLEB and TCB Rangewide Dkey.

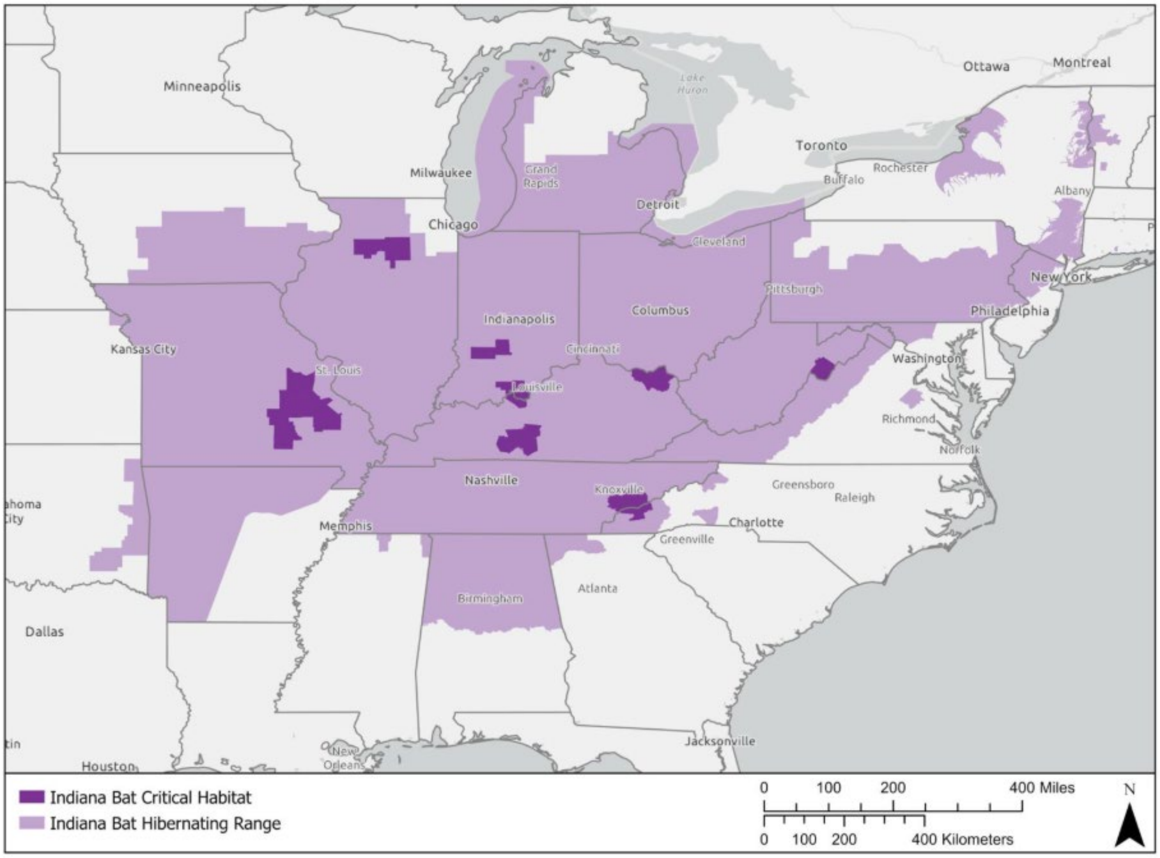

Figure 1. The consultation range of the IBAT, which is the area where IBATs may be present.

For IBAT, the covered area includes one zone: the hibernating range. For NLEB and TCB, the covered area includes three zones where behavioral differences influence impacts to bats: the hibernating range, Zone 1 year-round active range, and Zone 2 year-round active range (Figure 4). In the hibernating range, IBATs, NLEBs and TCBs roost in trees during the summer occupancy period and hibernate in caves and exhibit swarming and staging behavior in proximity to caves in the fall and spring, respectively. In the southern portion of the range, NLEBs and TCBs exhibit year-round activity. During winter, they continue to roost in trees, as well as road-associated culverts and bridges.

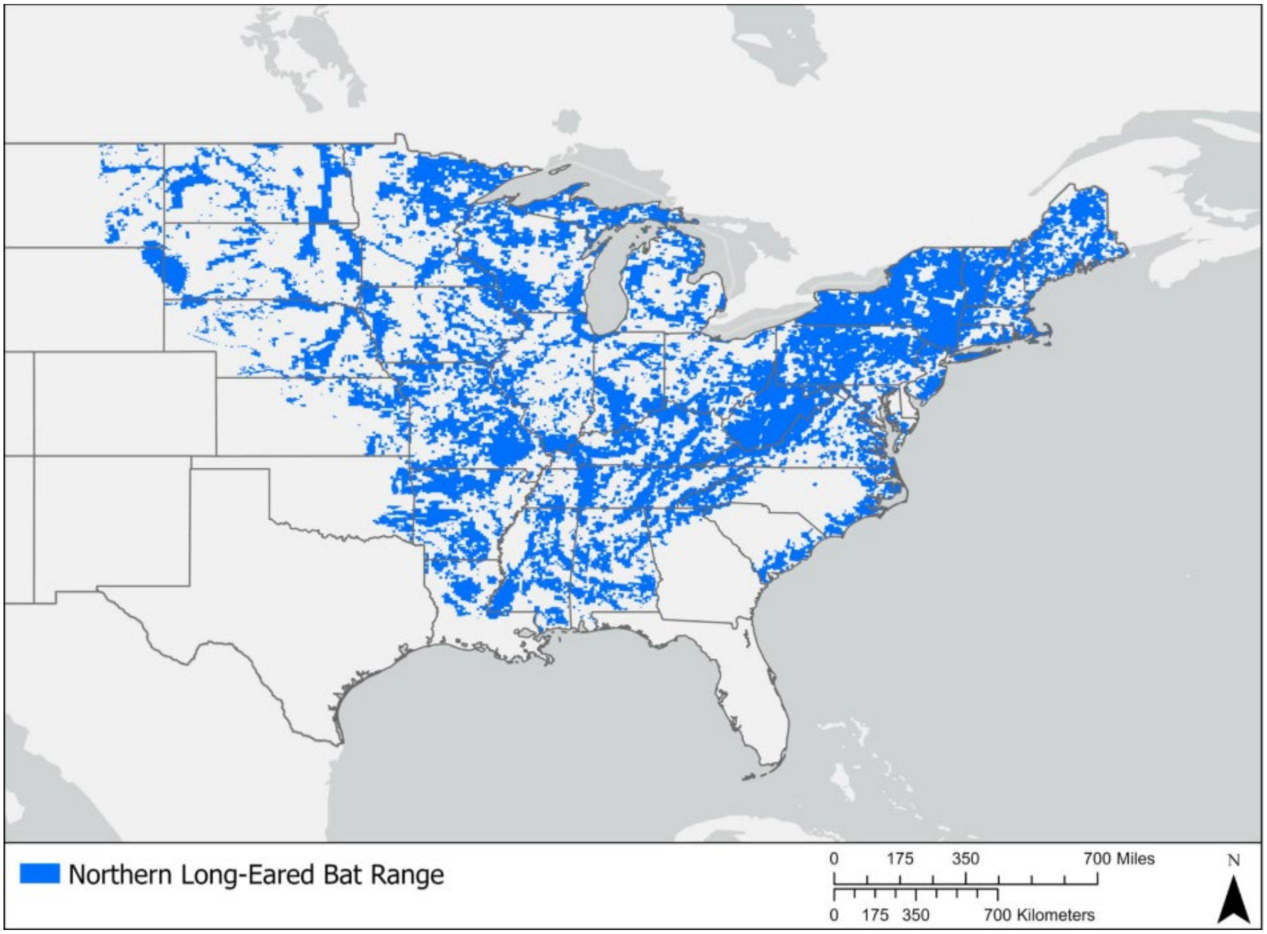

Figure 2. The consultation range of the NLEB, which is the area where NLEBs may be present.

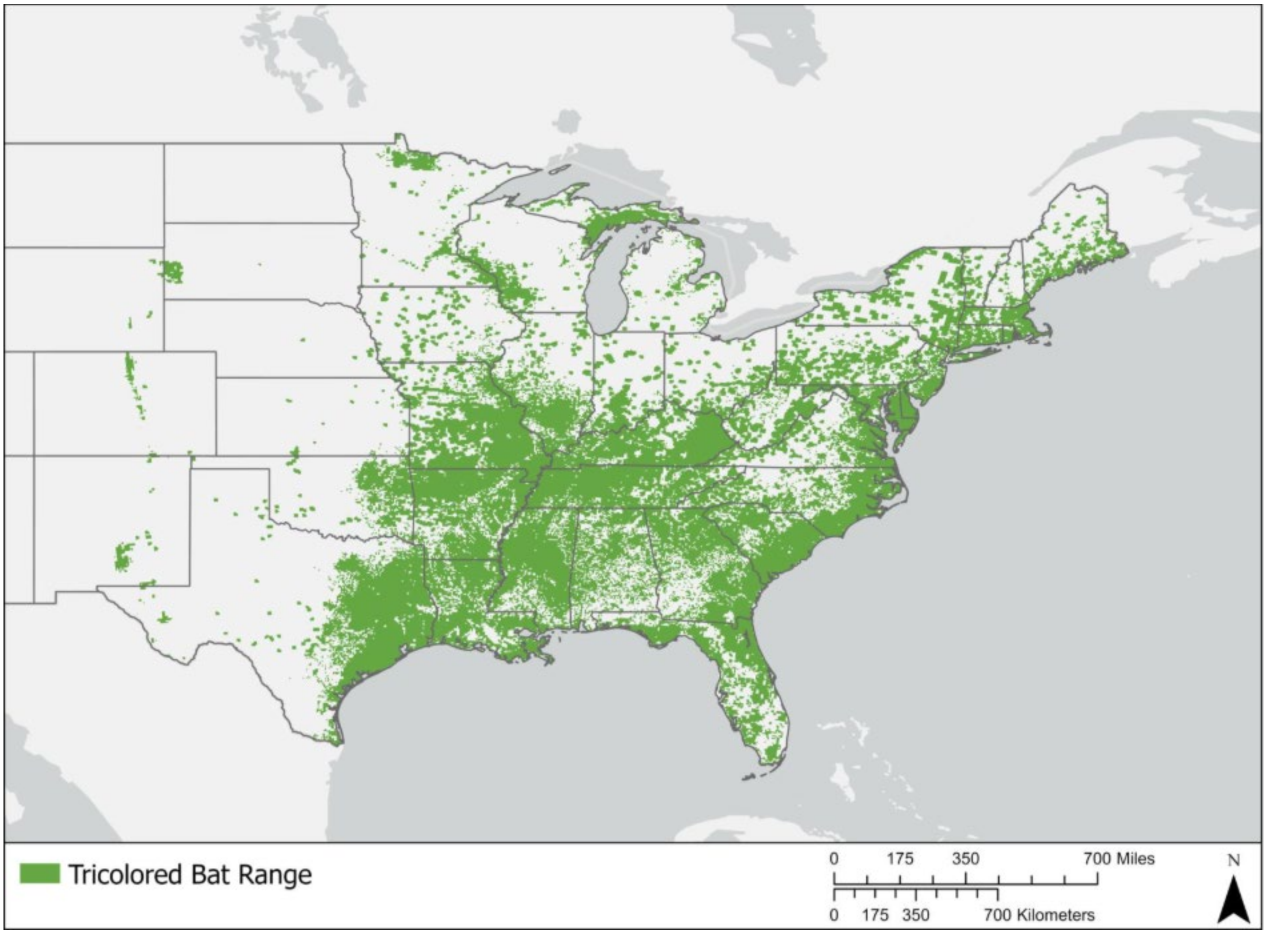

Figure 3. The consultation range of the TCB, which is the area where TCBs may be present.

To delineate the year-round active portion of the TCB and NLEB ranges, we compared winter bat activity data (e.g., captures, acoustics, and culvert use) and the number of frost-free days and determined that TCBs and NLEBs are active year-round in areas where the number of frost-free days is ≥ 200 days. Consequently, we determined that TCBs and NLEBs[2] are active year-round in all or portions of Alabama, Florida, Georgia, Louisiana, Mississippi, New Mexico, North Carolina, South Carolina, Texas, and Virginia (Figure 4). Furthermore, based on a review of winter bat activity data, when temperatures fell below 40 degrees Fahrenheit (F; [4.4 degrees Celsius (C)]), TCB are less likely to be detected in mist-net and acoustic surveys. We assume during these colder periods TCBs and NLEBs are likely entering a state of prolonged torpor (i.e., a state of lowered body temperature and metabolic activity) and consequently, TCBs and NLEBs roosting in trees may not arouse in sufficient time to flush from tree roosts during tree cutting activities. Based on a review of climate data from the last 30 years from the National Oceanic and Atmospheric Administration U.S. Climate Normals, mean temperatures fell below 40 degrees F (4.4 degrees C) between December 15 and February 15 within the area depicted in Zone 1 within the year-round active portion of the range (Figure 3). In Zone 2 of the year-round active range, temperatures only rarely fall below 40 degrees F (4.4 degrees C) and bats in trees are unlikely to exhibit deep torpor due to temperature. Although we recognize winter temperatures can occasionally drop below 40 degrees F (4.4

[2] The NLEB's range does not extend into Florida, New Mexico, or Texas.

degrees C) in Year-Round Active Zone 2, we anticipate these periods would be much shorter in duration than in Zone 1.

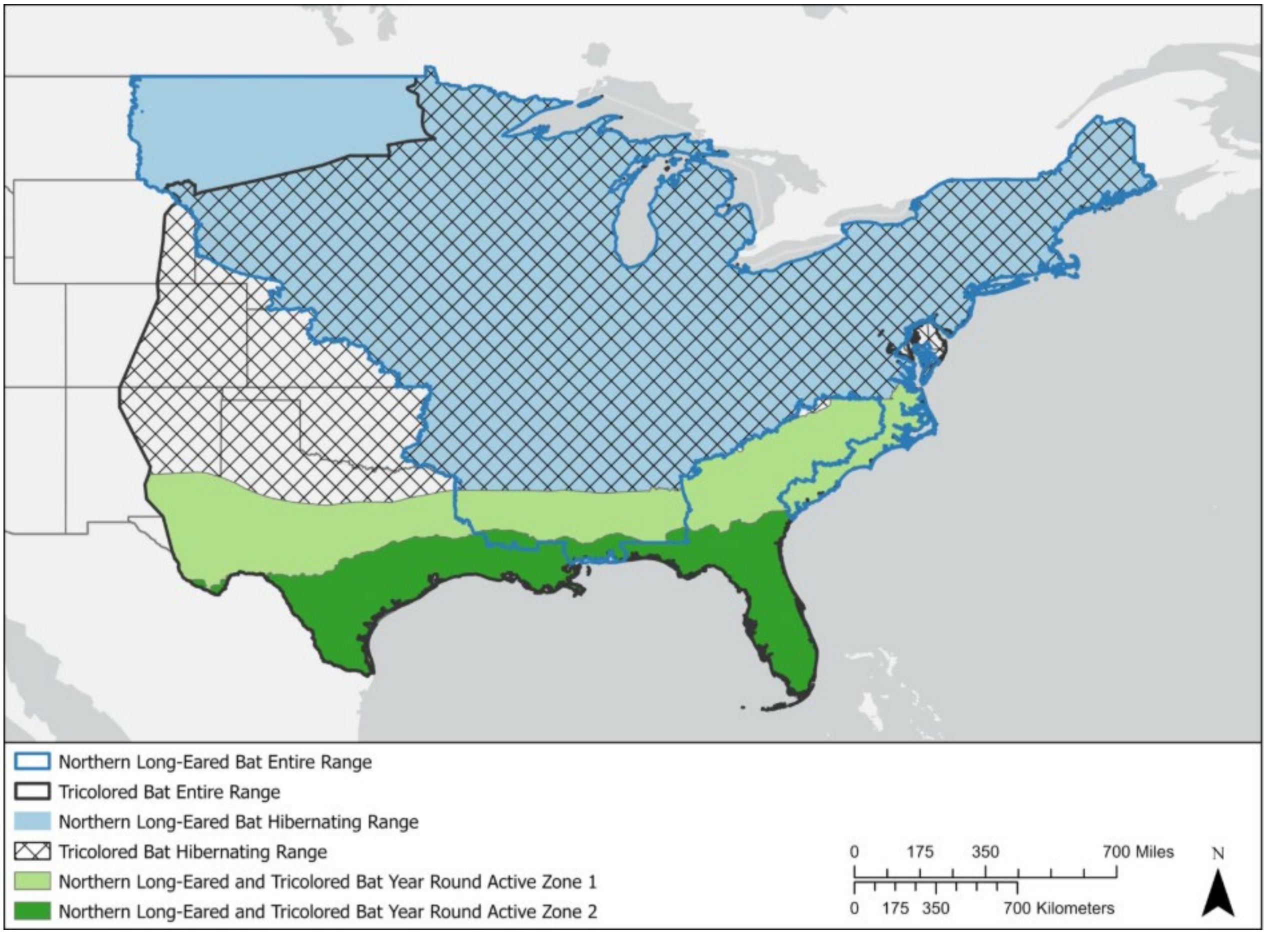

Figure 4. The NLEB and TCB hibernating and year-round active ranges.

3 COVERED ACTIVITY DESCRIPTION

The activities described herein include all activities addressed in this SA. The activity description, conservation measures, and covered area inform the SA and describe which specific activities are appropriate for NE or NLAA outcomes under this analysis. The description of activities and their inclusion in the SA should not be construed to indicate that these activities will always result in effects to the species, nor is it meant to cover activities that fall outside of the analysis described below. Action agencies are not required to use this SA; they continue to have the option to request individual consultation on a project; however, in most cases, we anticipate use of the SA will substantially decrease consultation time frames. The SA includes a wide variety of different activities that could cause effects to the IBAT, NLEB and/or TCB and to which agencies and others may apply the Dkey. The structure of the Dkey, including conservation measures (see below), will determine which specific actions in these broad groupings will be eligible for predetermined NE or NLAA outcomes. Listing of activities here does not imply that they will always result in effects to the IBAT, NLEB and/or TCB.

3.1 Covered Activities

The DODW Dkey includes a mixture of activity-specific questions and impact-specific questions. If an activity is not explicitly mentioned in the key, but the user receives a predetermined NE or NLAA outcome, they should consider that activity covered by the key. The Dkey is set up to include activity-specific conservation measures where available to avoid impacts to bats. The Dkey also includes impact questions that address stressor that are known to have adverse impacts on bats. If a user is unable to meet the activity-specific conservation measures or avoid stressors that may have adverse impacts on bats, they will not be eligible for a predetermined outcome of NE or NLAA through the Dkey. If the action does not include the activities named within the Dkey and will not result in any of the stressors that are known to have adverse impacts on bats, the action will be eligible for a predetermined outcome of NE or NLAA through the Dkey. As a result, activities that are not explicitly named in the Dkey, but otherwise meet the criteria used to determine whether an activity will avoid adverse impacts on bats will be eligible to use the Dkey.

Broad activity categories that are covered include:

- Military Training
    - Existing firing ranges, maneuver areas, field training and bivouac
    - Explosive ordnance
    - Smoke and obscurants
    - Air operations
    - Cave and subterranean training
- Installation Operations and Construction
    - New construction and previous footprint
    - Facilities, facility maintenance and structure demolition
    - Bridge maintenance
    - Culvert, conduit, and drainage ditch maintenance
    - Artificial lighting
- Landscape Maintenance and Outdoor Recreation
- Forest Management
- Invasive Species and Pest Control
    - Herbicide and pesticide aerial delivery
    - Facilities pest control
- Fire Management
    - Fire suppression and firebreak maintenance
    - Prescribed burns

3.1.1 Military Training

Military operations encompass a wide range of organized, coordinated activities carried out by a state or non-state actor to achieve specific objectives. These operations can range from large-scale combat to humanitarian assistance and disaster relief and can involve various branches of the military. Military operations may include the movement of people or equipment, use of incendiary devices, use of projectiles or firing ranges, use of explosives, use of smoke or obscurants, use of aircraft, use of vehicles in road or off-road environments, maneuver, bivouac and field training exercises, climbing or survival exercises and/or subterranean training.

3.1.1.1 Existing Firing Ranges, Maneuver Areas, Field Training and Bivouac

Military training areas can include maneuver areas, ranges, obstacle courses, simulated urban environments, and open grounds for military exercise. Maneuver areas and ranges provide training and testing locations for small arms, ground-to-air and air-to-ground weapons, tracked and wheeled vehicles, ships and aircraft, live explosives, demolitions, personnel actions, and other military operations. Field activities include war gaming, simulated firing, ground movements, and lightly fortifying emplacements. Military personnel may conduct field operations training on a routine basis. Training may consist of bivouac including erecting temporary shelters (tents), staging equipment and vehicles, safety and operational lighting, and use of generators and heaters near the temporary training sites. Bivouac and unit actions are likely to take place with cover in the tree lines. Military support units will train individually or collectively with other units providing services such as transportation of personnel and equipment, food service, refueling, water supply, heavy equipment and minor construction. Field deployment of refueling, food service, and similar support functions will typically be at larger bivouac and open field sites. Secondary equipment and personnel will typically be staged at the woodland edge. Field deployments may include training attack scenarios where a deployment area is “attacked” by an opposing force training unit. Such training events will include the use of blank small arms (e.g., rifle) ammunition, practice grenades, and artillery simulators. These events are short duration and infrequent. On most installations, these activities take place in roughly the same locations annually.

3.1.1.2 Explosive Ordnance

Explosive ordnance involves the deliberate detonation of materials that contain explosives or fused charges, including bombs, missiles, artillery rounds, rockets, and/or mines. Explosive demolitions are set charges used to destroy structures, facilities, or materials to accomplish a military objective, and are typically performed during daylight. Installations may have an Open Burn Open Disposal (OBOD) area, demolition (demo) pit, or similar areas used to dispose of excess explosives. These areas are cleared, and vegetation is maintained per explosive operation and fire danger requirements. In many locations there are seldom-used defensive shelters that may be at least partially buried to protect onsite personnel. Unexploded ordnance (UXO) can occur anywhere and is blown in place when extraction poses danger to humans including the UXO removal team. UXO is removed when possible and taken to a demolitions pit.

3.1.1.3 Smoke and Obscurants

Smoke and obscurants are used to conceal military movements and help protect troops and equipment in combat conditions. They can be used to mark and visualize targets, points of reference, and landing or drop zones for military operations. Smoke and obscurants are also used to simulate battlefield conditions and the results of simulated live fire. They can be used throughout the training, as part of a larger military operation or localized as part of an independent training scenario. Although they would be primarily used during the day, smoke and obscurants may be deployed at night. Training operations may include but are not limited to fog oil, colored smoke grenades, graphite smoke, and “other” smoke/obscurants (e.g., smokey Sams, artillery simulators).

Fog oil smoke is an obscurant smoke generated by injecting mineral oil into a heated manifold. The oil vapor produced condenses when exposed to the atmosphere, producing small aerosolized droplets which interact with ecological elements through respiration, ingestion, deposition, or other processes (e.g. adsorption through aquatic media). The military specification for fog oil specifies that the oil shall not demonstrate any toxic or potentially carcinogenic effect. As such, the currently used formulations are presumably less toxic and ecologically problematic than those produced prior to 1986 (von Stackleberg et al. 2004). Graphite flakes or powder are used for enemy electromagnetic tracking and targeting systems. Graphite is a form of carbon (C) that is chemical inert and exists naturally, as a result graphite exposure would only occur through inhalation. Graphite flakes are small and aerodynamic. As a result, dispersal is dependent on weather conditions (von Stackleberg et al. 2004). Colored smokes are composed of a pyrotechnic mixture of fuel and dye and used primarily for local signaling purposes. Typical use consists of small hand-held “grenades” which are released to mark specific sites. Colored smoke grenades use is relatively limited in extent and amount and smoke disperses rapidly (von Stackleberg et al. 2004).

3.1.1.4 Air Operations

Flight training operations include unmanned aerial vehicles (UAV), rotary-winged, vertical take-off and landing (VTOL), and fixed-winged aircraft. Aircraft are used for attack and transport training. Attack aircraft may carry almost any type of weapon from practice munitions to high explosive bombs, while transport aircraft carry personnel and/or equipment and may occasionally be used in training missions. Aircraft are operational year-round, both day and night. Unmanned aerial vehicles (UAV) are remotely piloted or self-piloted aircraft that can carry cameras, sensors, communications equipment or other payloads. UAVs range in size from hand-held model airplane to a Cessna airplane. UAVs are primarily used for reconnaissance and occasionally to deliver munitions into the ranges or into the Main Impact Area. VTOLs include traditional fixed-wing aircraft that can rotate their engines on the vertical axis to produce lift as well as fifth-generation jets that have auxiliary engines for vertical or abbreviated takeoff and landing. They include both transport and attack aircraft models. Some helicopter and VTOL training and operations on DODW sites follow fixed patterns and stay above 500 feet (ft; [52 meters (m)]) above ground level. However, maneuvering and hovering regularly occur below this level and at near ground levels.

Rotary-winged aircraft (helicopters) are used for a variety of functions from cargo and personnel movements to reconnaissance to air assault (insertion of combat forces from low hover or temporary landing) and attack. Rotary-wings often fly lower and hover more frequently than VTOL or other fixed-wing aircraft. Hover may take place for reconnaissance, ambush, loading or staging, and may be stationary or performed in small circles.

Fire operations using rotary-winged aircraft typically include the use of bambi buckets for training and actual fire events. This involves the helicopter lowering a suspended container into a large water source such as a pond, lake, or potentially even a swimming pool, until it fills. The pilot then raises the aircraft and transports the water to active fire or fire-retardant opportunities. Between 72-2,600 gallons of water may be dropped from heights as high as 23-115 ft (7- 35 m). The operation also involves extended hovering and rotor wash on lakeside tree lines and structures, often very low to the water surface (longer cables result in more pendulum action in flight). These operations typically occur in daylight for training missions but may occur at night for fire suppression. Due to the danger and weight of the payload, aircraft typically move slower than normal in these conditions, and flight distances are minimized as much as possible. Larger aircraft and water payloads are not typically flown by Defense agencies but could be used to assist in wildland fire operations or fire training on Defense lands.

3.1.1.5 Cave and Subterranean Training

Cave and subterranean training may include the use of caves and mines, shallow tunnel systems, bunkers, underground structures, and artificial training environments that support battlefield operations used for concealment and movement of personnel, storage and transport, command and control, and medical care.

3.1.2 Installation Operations and Construction

3.1.2.1 Construction, Maintenance or Operation

Construction, maintenance, operation and/or removal of objects, systems or organizations includes the use of equipment, tools or hands to build, create, attach or remove elements, materials, structures or pieces of equipment. Installation operations and construction include general construction and maintenance activities as well as military construction activities.

3.1.2.2 New Construction and Previous Footprint

Construction projects can include new buildings, building additions, new or upgraded utilities as well as activities such as tree removal, site preparation, fill, and wetland mitigation. Construction activities such as site grading, road construction, vertical and horizontal building, and other related activities are likely to occur during the bat active season during daylight hours but may occur at night with artificial lighting.

All construction projects over an acre will prepare a sediment and erosion control plan or a storm water pollution prevention plan, which details all erosion and sediment control practices and, when necessary, post-construction storm water management practices. Erosion and sediment controls vary, depending on individual impacts from each project. Some temporary examples of erosion and sediment controls include silt fences, check dams, and sediment traps. Permanent controls may include retention ponds, detention ponds, and grass lined swales.

3.1.2.3 Facilities, Facility Maintenance and Structural Demolition

Facility maintenance is generally located in developed areas of each installation and may include maintenance and upgrades to existing facilities, munitions storage structures, parking lots, storage sheds, concrete pads for utility boxes, sidewalks, and communications structures. Each project could have a ground disturbance footprint of up to 1 acre (0.40 hectare). Maintenance activities may involve the use of heavy equipment such as excavators, bulldozers, dump trucks, pavers, and scrapers. Facility maintenance may also include rehabilitation of older buildings or upgrading fittings.

Demolition of degraded, unsafe, or unnecessary facilities may occur to minimize safety concerns, reduce maintenance costs, or provide land for new construction. Demolition activities would mostly occur in developed areas, may involve ground disturbance down to 3 ft (0.9 m), and could include removal of existing facility structures, associated equipment and utilities, facility parking lots, and fencing. Demolition activities may require use of heavy equipment such as excavators, bulldozers, and dump trucks. Buildings to be demolished may be in disrepair or may be open and vulnerable to roosting bats prior to or during the demolition. Older military buildings often require decontamination prior to deconstruction, including removing lead, asbestos, and other materials.

3.1.2.4 Bridge Maintenance

New bridges may be constructed throughout all installations as needed. Materials such as rock, concrete, and sand are used to upgrade the physical structure. Bridge construction may also include removal and/or excavation of sediments and bottom material. Tree clearing or removal may be needed for construction of new bridges and maintenance of existing bridges. Bridge construction typically involves the use of heavy equipment such as excavators, scrapers, loaders, dozers, backhoe, cranes, and dump trucks. Construction zones, including staging areas, egress, and ingress routes, are designated on a project basis. Routine repair activities include the repair of footings to prevent future erosion, the installation of railings and support beams for structural support, the sealing of cracks, and the filling of potholes in roadways. Secondary activities include temporary dams and stream diversion, sediment and pollutant filtration, and potential disturbance of banks above and below the bridge site.

3.1.2.5 Culvert, Conduit and Drainage Ditch Maintenance

All installation infrastructure includes miles of underground storm drain lines and concrete and asphalt curbs and gutters. This system directs the flow of rainfall into hundreds of drainage structures, such as catch basins and culverts. Common problems in the storm drainage system include culvert backups, erosion, and minor flooding. Routine maintenance of blocked culverts and drainage ditches are best performed in the dry season, but also often occurs after major storm events. Maintenance activities include visual inspections of culverts and drainage ditches and the removal of debris and vegetation. Tree clearing or removal may be needed for construction of new or maintenance of existing culverts, conduits, and drainage ditches.

Blocked culverts sometimes require more intensive maintenance such as mechanical clearing of vegetation, excavation to clear debris and sediment build-up, and use of a high-pressure water distributor or sewer jet. The work area for culvert and drainage ditch maintenance is generally restricted to the immediate area; however, the work footprint is dependent upon the location of the culvert. Culverts, storm sewers, and gutters are all potential roosts for bats. Routine maintenance of the structural components at culverts and structures with no known bat occupation can take place outside of the maternity season. Unblocking and other actions that do not disturb structural integrity or block entrances and exits may occur at any time of the year.

3.1.2.6 Artificial Lighting

DODW uses artificial light for both safety and security reasons. Artificial light is used to illuminate training ranges, parking lots, and for general security issues. Artificial light may be permanent such as around buildings or sites that require increased security or may be temporarily deployed as part of construction or training (illuminating training areas for nighttime training or at bivouac sites).

DODW has specific unified facilities criteria (UFCs) that prescribe artificial lighting conditions. Military training areas are to receive no ambient lighting (Lighting Zone 0). Temporary lighting for bivouac and lighting surrounding nighttime range and personnel facilities may illuminate areas to the low ambient lighting condition (Lighting Zone 1). The highest illumination occurs at certain wharf and pier areas, aircraft hangers, air operations and headquarters, line shacks, terminal facilities, airfield utility service areas, and entry and access control facilities and points as a moderately high ambient lighting (Lighting Zone 3). All other urbanized portions of the installations fall under a moderate ambient lighting zone (Lighting Zone 2) or lower. Within Lighting Zone 2 as elsewhere on the installation, measures are generally taken to minimize light pollution and reflectance due to dark sky training needs, operational security, and energy cost reductions (DoD 2023a p.100). Additionally, light emissions must be limited where they interfere with pilot vision in runway clear zones per UFC 3-260-01. Luminaries are to be rated U0 in this zone and not exceed a glare rating of G2 (DoD 2023a p.105, 2023b, 2026).

3.1.3 Landscape Maintenance and Outdoor Recreation

Landscape maintenance activities include planting, trimming, and mowing, and the installation or removal of turf, shrubs, and flowerbeds. Landscaped areas occur predominantly in the main cantonment and housing areas, at high visibility facilities, and in the vicinity of the airfields. During the construction of new facilities, removal of existing vegetation and landscaping may occur in areas not previously landscaped. Maintenance also includes high brush removal and tree clearing in overgrown mission areas. Chemical methods of vegetation management are discussed as part of Invasive Species and Pest Control (section 3.1.5).

3.1.3.1 Vegetation Management - Mowing and Tree Removal

Vegetation management is the practice of controlling and managing plant growth through methods other than chemical use. Chemical methods of vegetation management are discussed as part of Invasive Species and Pest Control (Section 3.1.5). Vegetation management can include the use of equipment, tools or hands to remove or modify vegetation through cutting, pulling, grinding, burning or other methods.

Mowing may occur as often as weekly in developed areas and around flight line areas. In undeveloped areas, mowing occurs irregularly, depending on use and vegetative cover. Mowing can include lawn and airfield mowing, mowing to support bivouac and other mission needs, right of way and transportation infrastructure vegetation maintenance, and annual or semi-annual habitat maintenance in unimproved open areas.

Tree trimming and removal activities occur for security, safety, fire prevention, utility, road maintenance and inspection, access to facilities, and new construction. Tree and brush removal and mowing also may occur for invasive species removal programs and ecosystem restoration. Tree topping, tree and shrub trimming and/or removal may require the use of heavy equipment along an existing access and/or work corridor. Removal of single, multiple, or clusters of trees that are ≥3 inches diameter at breast height (DBH) may be necessary to support maneuver areas, construction sites, line of sight (firing lines, airfields), remove wildlife hazards and conflict (e.g., animal strike hazards from woody roosts or cover at airfields), for ecological reasons (such as endangered species habitat management), or because they may pose a risk to property or human life.

Installations use a variety of methods to remove single trees and small woodlots. Methods include hand felling with chainsaw and wedges, mechanical cutting with larger forestry tools, and mulching in place with large grinding equipment like drum mowers and mulching heads. With few exceptions, DODW is required to revegetate with native species.

3.1.3.2 ***Security, Erosion and Wildlife Fencing***

To enhance security and protect assets and resources, fences are erected throughout installations, around buildings, facilities, erosion sources, and areas containing natural and cultural resources. Total fence length varies by installation, and the type (e.g., chain link, barbed wire, snow fencing, electric, exclusion, fabric) and height varies based on the fence's purpose. Fence installation, maintenance, and replacement involve clearing brush, tree removal, digging holes and/or trenching mechanically or by hand, and installing new posts and fencing. Maintenance schedules are highly variable and depend on the condition of the fence and the asset it is protecting. Fences exposed to harsh coastal weather deteriorate rapidly and require more intensive, continuous maintenance.

3.1.3.3 Outdoor Recreation
Outdoor recreation areas may include parks, swimming pools, golf courses, and similar facilities. These are generally located adjacent to housing and the dormitories in the urbanized portion of the installation. Dispersed, undeveloped recreational areas are primarily utilized for hunting, hiking, mountain biking, camping, horseback riding, wildlife watching, and other consumptive and non-consumptive activities. These activities, whether dispersed or concentrated, are low impact activities that minimally alter the landscape or generate a disturbance.

Outdoor recreation programs may also include firewood permits. Firewood permits are generally granted for removal of dead and downed material, not standing dead trees useful for bat roosts (although occasionally this is permitted).

3.1.4 Forest Management
Forest management includes both even-aged (e.g., clearcutting or shelterwood) and uneven-aged (single tree or group selection) harvest methods to manage forests to support military training, timber production and health, and wildlife habitat creation/enhancement. Environmental conditions (e.g., wet or rocky soils), training requirements, and stand characteristics dictate harvest methods. These methods include hand felling with chainsaw and wedges, mechanical cutting with larger forestry tools, and mulching in place with large grinding equipment like drum mowers and mulching heads. Installations conducting forest management should have an Integrated Natural Resources Management Plan. Forest management and tree cutting are only covered in the Dkey for NLEB and TCB. IBAT will be addressed in future updates to the Dkey.

3.1.5 Invasive Species and Pest Control
Control of invasive plant species and the protection of native habitats and sensitive species are major issues of management concern on every installation. Methods used for the control and eradication of invasive species may include physical (manual, mechanical, and prescribed burning), chemical, and biological control. Removal of invasive plants will be based upon site-specific conditions and may include a combination of these methods. All herbicides and pesticides used are in accordance with the label directives, applicable laws, and regulations. Installations conducting invasive species management and pest control should have an Integrated Natural Resources Management Plan.

3.1.5.1 Targeted Application of Herbicides or Pesticides
Targeted application of herbicides or pesticides is conducted in accordance with the label directives, applicable laws, and regulations. All herbicides and pesticides used on installations are non-toxic or of low-toxicity to mammals. Use of herbicide within forested areas will be targeted, plant-specific applications.

Targeted application methods may include hack-and-squirt, basal bark, injections, cut-stump or spot-spraying. Stem injections and soil suppositories are preferred methods of delivery for forest and tree treatments against invasive diseases and insect infestations so long as the pesticides used are non-toxic or low-toxicity to mammals but some broadcast spraying is done on DODW lands.

3.1.5.2 Aerial Delivery of Herbicides or Pesticides
Aerial application of pesticide involves broadcast treatments of typically foliar, but sometimes also soil active herbicides. Additional invertebrate pests, such as spongy moth (*Lymantria dispar*), may also be

controlled through broadcast application to forest cover of active treatment agents including micro biotic controls (e.g., Bt for spongy moth and black fly [*Simuliidae* spp.] control) or chemical pesticides (e.g., mosquito control). Aerial delivery of herbicides is most often used for impact areas and UXO-contaminated sites where foot and vehicle delivery is deemed too dangerous, but may also be used where a large area is under treatment or in areas with no roadside access. Insecticides and biological controls are typically broadcast as cost-efficient controls on target quarantine pests or human disease vectors. Aerial applications are typically made by fixed wing, rotary wing, or drone aircraft. Objectives include invasive species control, health and safety, reduction of wildland fire risk, and habitat management.

3.1.5.3 Facilities Pest Control

Facilities pests are removed on an as-needed basis. Each issue is handled on a case-by-case basis depending on the pest species and the situation. When possible, wildlife will be deterred from areas by removing features that are attractive to the animals (e.g., eliminating potential food/nesting sources, plugging openings into buildings, etc.). Physical removal and relocation of these animals are generally performed with or without euthanasia. Rats (*Rattus* spp.) and mice (*Mus* sp.) infest installation buildings and housing areas and are controlled by sanitation controls, snap traps, glue boards, and rodenticides. Food handling establishments and commissary warehouses are primary areas where pest control occurs.

All pest control efforts are performed in accordance with the most current Animal Welfare guidelines. Lethal traps are primarily used for rodents and moles. Adhesive traps are allowable for rodent and insect control in buildings; however, they may inadvertently capture bats if placed incorrectly.

3.1.6 Fire Management

3.1.6.1 Fire Suppression and Firebreak Maintenance

Emergency wildland fire actions are conducted installation-wide and allow personnel to respond to emergency fires without delay, allowing quick containment of any unexpected threat to human health, safety or the environment. Installations conducting fire management should have a Wildland Fire Management Plan. Wildland fire actions may require the use of excavators, bulldozers, dump trucks, and fire trucks (aerial suppression is discussed in Section 3.1.1.4). Construction zones including staging areas, egress and ingress routes will be designated on a project basis. Fuels management is a major influence on fire behavior because it modifies the size, arrangement, and kind of vegetative fuels. This modification reduces the ignition potential, flame length, and rate of spread of a fire. It also may be useful in the control of specific invasive species within federally listed species habitat. A system of strategic roads and fire and fuel breaks are located throughout each installation for fire control and management.

Firebreaks are used to prevent or hinder the spread of fire and are usually blocks or linear strips of land managed to maintain very low or no fuel loading. Firebreaks can be disked or mowed and maintained between 20 and 100 ft (6 and 30 m) in width. The width of a firebreak is site-specific and dependent on the fuel type, asset being protected, and risk of potential wildfire. In addition, and as part of wildfire suppression and fuels management activities, the DODW uses access roads that can include single-lane secondary dirt roads (10 to 15 ft [3 to 4.5 m] wide) to access remote portions of the installations. These roads are used to break up contiguous fuel loads and provide a line of defense to execute fire-fighting actions.

In addition to firebreaks, ignition lines may use brush cutting and snag clearing to form a safe path to allow igniters access further into the fuel sources. These paths are typically narrow enough for single firefighters to walk carrying a drip torch (5 to 20 ft [1.5 to 6 m] wide).

3.1.6.2 Prescribed Burns

Prescribed burns include the planned, controlled application of fire to vegetation to achieve a specific natural resource management objective. Prescribed fires are ignited by qualified personnel in accordance with each approved site-specific burn plan. Prescribed burning operations utilize existing manmade and natural fuel breaks as much as possible. Additional fuel breaks are either mowed to reduce fuel loading or black lined as part of the firing operation. Prescribed fire is conducted within the limits and protocol of an Integrated Wildland Fire Management Plan or Burn Plan(s) to closely control where, when, and how fires are set. This may entail burn restrictions or specified ignition patterns and weather conditions (i.e., wind direction, peak minimum humidity, or other smoke and intensity).

Prescribed fire may be used to control non-native vegetation species, discourage shrub encroachment, clear out understory or mid-story vegetation, and recycle nutrients back into the soil. In addition, prescribed fire increases safety and can reduce the risk or intensity of wildfires. Installations may use prescribed fire to regenerate oak and pine ecosystems, which may occur during the growing season and bat active period. Prescribed burns on DODW property may also occur in grassland and shrubland areas. Such burns will occur during the growing and dormant seasons and incorporate the use of firebreaks and activity buffers when burns take place in areas between grassland and/or open shrublands with forests.

3.2 Limits/Sideboards

The FWS will provide a series of questions through IPaC to assess whether the project meets the requirements of this SA. Projects that meet the requirements of the SA will result in a determination of NE or NLAA for the IBAT, NLEB and/or TCB based on the impacts associated with the project or through the implementation of conservation measures to avoid impacts to these species. Any actions that are LAA for the IBAT, NLEB and/or TCB are not part of the scope of analysis for this Dkey and do not qualify under this SA. Any project that may result in take of the IBAT, NLEB and/or TCB will require separate individual project review and consultation by the local ESFO.

Additional actions that may otherwise reach a NLAA determination will not be addressed in this SA. These actions may include certain activities, occur in certain geographic areas, or meet one or more context-dependent conditions, and as a result, will not be eligible for pre-determined NE or NLAA consultation outcomes. Instead, the Dkey will request that proponents of these actions contact the appropriate ESFO directly.

3.2.1 Activity Based Limits/Sideboards

To receive the FWS's technical assistance acknowledgement of an action agency's NE determination or the FWS's concurrence for a NLAA determination, based on this SA, actions and activities may NOT include the following:

1. Purposeful take of an IBAT, NLEB or TCB (e.g., capture and handling for surveys or research).
2. Actions that may include leasing, construction or operation of wind turbines.
3. Use of white phosphorus.

3.2.2 Location Based Limits/Sideboards

As outlined in the Covered Area Section (2.0) this SA will apply broadly where the IBAT, NLEB and/or TCB may be present in areas where activities are authorized, permitted, licensed, funded or being carried out by the DODW.

Actions will also be excluded when they affect areas near known maternity colonies or documented hibernacula. Buffer sizes vary depending on the activity in question. These and other conditional exclusions are addressed below under Conservation Measures.

3.3 IPAC AND INDIVIDUAL ACTION AREAS

The Dkey is made available to agencies and the public via IPaC. The Dkey uses GIS data to answer some key questions and to implement certain conservation measures, as described in the next section. To ensure that these geographically sensitive conservation measures are applied correctly, Dkey users will have to accurately enter their "project location" in IPaC.

IPaC users enter project locations by uploading GIS data or by using the built-in drawing tools. When in the program, the instructions for the user are to "draw the area where activities will occur." For projects with significant effects to areas outside of where project activities will occur, it is possible that some users will not fully define the action area. This is addressed by an answer to the 'frequently asked questions' in IPaC:

- "What should be considered when defining a project location?

  When designating your project location in IPaC, the FWS recommends that you consider not only the physical location of project activities, but also any surrounding area on the landscape where potential effects to species may occur (e.g., delineate all areas that could possibly be affected, including nearby areas that may be affected by runoff, noise, etc.). For projects with a Federal nexus that are required to consult with USFWS under section 7 of the Endangered Species Act, we recommend defining the project location for IPaC as your Action Area; definitions of Action and Action Area can be found at 50 CFR 402.02."

Projects that do not include the full extent of action area may receive an incorrect determination in the Dkey. Use of these instructions allows users to avoid and minimize the likelihood of failure to include the full extent of the action area.

3.4 CONSERVATION MEASURES

This SA applies conservation measures as design features to avoid adverse effects on an individual, population, or species. The FWS has previously found that incorporation of certain conservation measures, while voluntarily adopted by action agencies, has reduced effects to the extent that the actions are NLAA to listed species and/or CH, and therefore, do not require formal consultation with the FWS. We have built these conservation measures into questions in the Dkey such that any action that gets a NLAA verification letter or NE technical assistance letter is not expected to adversely affect the species. Therefore, answers to certain questions in the Dkey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid. The inability to voluntarily adopt certain conservation measures may result in a project not being eligible for a predetermined outcome of NE or NLAA determination which will result in a project not qualifying to use this SA.

3.4.1 Protection of Known and Potential Hibernacula and Hibernating Bats

3.4.1.1 Known and Potential Hibernacula

Actions are not eligible for a predetermined outcome of NE or NLAA if they include activities within 0.25 miles (mi; [400 m]) of known or potentially suitable hibernacula if those activities would impact the suitability of the hibernacula for use by bats (e.g., drilling, blasting, extensive ground disturbance, change in hydrology, change in air flow, or change in forest cover around potential entrances to hibernacula). The buffer size is determined by the distance that underground features of caves or hibernacula located on military installations extend. It is intended to be protective of these underground features and ensure that actions do not result in changes to hibernacula that would make it unsuitable for hibernation. This buffer size is determined based on bat data collected by military installations and specific to use on military installations and may not be appropriate for use related to hibernacula outside military installations.

Note that vegetation removal is permissible in areas around hibernacula entrances to avoid restricting bat access to the site, and/or avoid reducing airflow to the hibernacula. Vegetation can obscure entrances leading to declining hibernacula use. Vines and shrubs can also pose threats through thorns and other impalements (Jacomassa et al. 2017, Norquay et al. 2010, Sparks and Choate 2000), and predator concealment (Sparks et al. 2000). Actions are not eligible for a predetermined outcome of NE or NLAA if they include cave and subterranean training that will be conducted in hibernacula or enclosed environments known to be used by bats or hibernacula that provide suitable conditions for hibernation. Projects that include activities within hibernacula or enclosed environments are not eligible for a predetermined outcome of NE or NLAA if surveys or inspections for roosting bats have not been conducted within 5 nights of the scheduled start of training activities, or if roosting bats are discovered in a training structure. In addition, projects are not eligible for a predetermined outcome of NE or NLAA if the project would affect any hibernacula within an activity-specific buffer distance of 110 yards (yds; [100 m]) for explosive ordnance activities, portable generator use, or other major noise sources, and/or an activity-specific buffer of 273 yds (250 m) for smoke and obscurants use, new construction or facility maintenance. Buffers to protect known and potential hibernacula are applied along with additional activity specific conservation measures discussed in greater detail in following sections. Activity specific buffers will prevent disturbance of hibernating bats, as well as protecting swarming and staging areas in proximity to hibernacula.

3.4.1.2 Culverts or Bridges

The IBAT, NLEB and TCB have been documented using culverts and/or bridges as roosts during both summer and winter depending on the geographic area. In northern portions of the range where culverts and bridges reach freezing temperatures in winter, IBATs, NLEBs and TCBs are most likely to be found roosting in culverts or bridges during the summer season but have been occasionally found during spring and fall migration periods. In southern portions of their range, NLEBs and TCBs are present on the landscape and considered active year-round, and do not use traditional hibernacula that bats are found using in the northern/hibernating range. These bats found in the southern part of their range may go into short bouts of torpor while roosting and can be found using trees or structures for roosting locations during the winter. The suitability of bridges or culverts for roosting bats may be impacted by changes to the surrounding environment. As a result, actions are not eligible for a predetermined outcome of NE or NLAA if the project would affect a bridge or culvert without a survey to indicate whether the bridge or culvert may be occupied by NLEBs or TCBs at any time of year, or occupied by IBATs outside of winter hibernation.

3.4.1.3 "Atypical" Hibernacula

To ensure that certain natural atypical hibernacula are considered, we include a question in the key for certain states to ensure that action agencies coordinate with the FWS on actions that affect areas that contain talus, rock shelters, or rock crevices (within cliff or rock faces). NLEB and TCB hibernation in talus slopes has been documented in Maine (W. Mahaney, FWS, pers. comm. August 18, 2022). NLEB and TCB hibernation in crevices in cliffs, rock faces, or shallow rock shelters in cliffs has been documented in Maine (W. Mahaney, FWS, pers. comm, 2023), Nebraska (Lemen et al. 2016, entire; White et al. 2020, entire), Ohio (Johnson 2021, p. 51; 2024, pp. 6- 11), Pennsylvania (Johnson et al. 2024, p. 6; Aaron Semasko, pers comm, 2023) and Kentucky (Lacki and Hutchinson 1999, p. 11). Although documented thus far only in those states, FWS biologists also suspect use of talus or rock crevices in Alabama, Arkansas, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, western North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Vermont, and Wyoming. Therefore, the Dkey will direct users to ESFOs for individual coordination when actions may impact these 'atypical' potential hibernacula in those states.

3.4.2 Blasting

The Dkey includes a series of questions to ensure that blasting is not carried out where it could damage hibernacula, harm hibernating bats, or harm roosting bats, in suitable roosting habitat due to noise or vibration. Dkey users may only proceed with the key if the action will not include blasting or other activities that could affect known or potentially suitable hibernacula at any time of year, or if the action could affect suitable roosting habitat when bats are present (suitable summer habitat in the hibernating range, or suitable habitat within the active year-round portion of the range). Dkey questions that are protective of known or suitable hibernacula (section 3.4.1.1) will ensure that blasting or drilling activities will not impact hibernacula structures or harm hibernating IBATs, NLEBs and/or TCBs. Impacts could also include changes to hydrology or air flow that may impact the suitability of hibernacula. In suitable roosting habitat, impacts could include disturbance of roosting bats from noise or vibrations, time-of-year restrictions (TOYR) are applied to avoid these impacts.

There are two general types of blasting: production and controlled. Production blasting uses widely spaced, large explosive charges that are designed to fragment a large amount of burden (the rock that lies between the existing slope face and blasthole). Controlled blasting uses more tightly spaced and smaller explosive charges to remove smaller amounts of burden. This technique can remove material along the final slope face, or it can be used prior to production blasting to create an artificial fracture along the final cut slope.

3.4.3 Drilling

Drilling is a cutting process where a drill bit is spun to cut a hole of circular cross-section in solid materials. Projects that include drilling that will result in noise or vibrations above the baseline conditions at the site are not eligible for a predetermined outcome of NE or NLAA. Additionally, projects that include the use of bentonite or chemicals that could result in contamination of water sources are not eligible for a predetermined outcome of NE or NLAA. Dkey users may only proceed with the key if the action will not include drilling in or through bedrock surfaces during the summer occupancy season for bats. Drilling in or through bedrock surfaces could produce noise or vibration that could impact suitable roosting habitat when bats are present (suitable summer habitat in the hibernating range, or suitable habitat within the active year-round portion of the range). Dkey questions that are protective of known or suitable hibernacula (section 3.4.1.1) will ensure that blasting or drilling activities will not impact hibernacula structures or harm hibernating IBATs, NLEBs and/or TCBs. Impacts could also include changes to hydrology or air flow that may impact the suitability of hibernacula. In suitable roosting habitat, impacts could include disturbance of roosting bats from noise or vibrations. To avoid these impacts, users are asked whether drilling will occur in suitable habitat when bats may be present (summer habitat in hibernating range, or suitable habitat within the active year-round portion of the range).

3.4.4 Tree Cutting

Actions that include tree cutting during times of year when bats may be roosting in trees may be eligible for a pre-determined consultation outcome of NLAA if there is sufficient information supporting probable absence of IBATs, NLEBs and/or TCBs, based on a presence/probable absence summer bat survey that targeted IBATs, NLEBs and/or TCBs in the action area. The survey must have followed the most recent version of the FWS's Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (currently USFWS 2026) and must have been conducted within the last five years.

3.4.4.1 General Tree Cutting

Projects that have not conducted a presence/probable absence summer bat survey for IBAT, will not be eligible for a predetermined NLAA determination for IBAT if activities will cut trees that are suitable for IBAT roosting. Trees that are considered unsuitable for IBAT roosting can be cut or mulched without impacts to IBAT. Suitable IBAT roost trees are live trees and snags ≥ 5 inches DBH (12.7 cm) that have exfoliating bark, cracks, crevices, and/or hollows (see Section 5.4.1 for additional information). As a result, activities that include only tree cutting or mulching of trees that are unsuitable for IBAT roosting are eligible for a predetermined outcome of NE or NLAA. Depending on the location, projects are eligible for a predetermined NLAA determination for the NLEB and/or TCB if they comply with both the appropriate TOYR (Table 2) and acreage limits on general tree cutting activities (Table 3). The TOYR applied varies by species and location as follows:

1. Summer Occupancy Only – areas more than 5.0 mi (8.0 km) from any hibernacula for NLEB within the hibernating range, and year-round active Zone 2 for NLEB .
2. Summer Occupancy plus Fall Swarming and Spring Staging – areas within 5.0 mi (8.0 km) within any hibernacula for NLEB.
3. Summer Occupancy plus Winter Torpor – Year-round active range Zone 1 for NLEB.
4. Pup Season Only – areas more than 3.0 mi (4.8 km) from hibernacula for TCB in the hibernating range and year-round active Zone 2 for TCB.
5. Pup Season plus Fall Swarming and Spring Staging - within 3.0 mi (4.8 km) of a hibernacula for TCB.
6. Pup season plus Winter Torpor- year-round active range Zone 1 for TCB.

Winter tree cutting may result in indirect impacts to bats from increased energy expenditure, which may result in reduced fitness (see Section 5.4.3). To minimize the likelihood that tree removal during the hibernation period will adversely affect the species indirectly, actions will not be eligible for a predetermined outcome of NE or NLAA if the action includes tree cutting above the acreage specified for the action area depending on the size of the installation, forest density category of the 5x5 km grid that the action area is located within, the canopy cover of the forest, and the purpose of the tree cutting (e.g., forest management that results in less than 40 percent reduction in canopy cover spread throughout the forest stand that is undergoing thinning, or habitat conversion as a result of clear-cutting or large group election cuts).

The forest density for each 5x5 km grid was measured as the average forest cover within each 5x5 km grid cell based on the National Land Cover Database dataset from 2019 (National Land Cover Database, Dewitz 2019). The forest density category for the action area is determined based on the intersection of the action area with a set of maps that include all areas that fall within a layer for 0-30% forest density or 30-100% forest density.

The acreage limit for general tree cutting for the DODW Dkey is consistent with the acreages used for the NLEB and TCB Rangewide Dkey. For the Rangewide Dkey, experts were asked what percentage of forest in a NLEB or TCB homer range that can be removed without negative impacts occurring to an individual bat when assuming a landscape and home range with varying amounts of forest cover (see Section 5.4.3 for additional information). These acreages assume a worst-case scenario of removal of all trees within the specified acreage. In addition, projects using the Rangewide Dkey are individual projects that may be implemented by different project proponents, so larger habitat context is not always available.

For the DODW Dkey, we implemented additional parameters to assess the context of the forest habitat proposed to be removed, including the overall size of the installation, forest density category of the area to be cut, and percent canopy cover of the area to be cut. DODW implements forest management on installations to support military training, timber production and health, and wildlife habitat creation or enhancement. As part of forest management that retains at least 60% of the canopy cover throughout the forest stand, projects can remove trees within a project footprint that is twice the size of the project footprint allowed for non-timber management projects. If a non-timber management project is allowed to remove 100 percent of the canopy cover within a 100-acre parcel, then removal of less than 40 percent of the canopy cover in an area twice the acreage is expected to remove an equivalent amount or less of the forest than is allowable for general tree cutting.

Table 2. TOYR for tree cutting by species and geographic location.

Species	Geographic Location	TOYR
NLEB	Within 5 miles of all Hibernacula	Summer Occupancy Fall Swarming Spring Staging
NLEB	All other areas in Year-Round Active Zone 1	Summer Occupancy Winter Torpor
NLEB	All other areas in Year-Round Active Zone 2	Summer Occupancy
NLEB	All other areas within Hibernating Range	Summer Occupancy
TCB	Within 3 miles of all Hibernacula	Pup Season Fall Swarming Spring Staging
TCB	All other areas in Year-Round Active Zone 1	Pup Season Winter Torpor
TCB	All other areas in Year-Round Active Zone 2	Pup Season
TCB	All other areas in Hibernating Range	Pup Season

Table 3. Acreage limits during tree cutting activities for the NLEB and TCB.

Installation Size (acres)	Forest Density (%)	Canopy Cover (%)	Thinning or Small-group Selection Cut	Cutting Limit (Acres)
Over 10,000	30 – 100	30 – 100	Yes	200
Over 10,000	30 – 100	30 – 100	No	100
Over 10,000	30 – 100	0 – 30	Yes	50
Over 10,000	30 – 100	0 – 30	No	25
Over 10,000	0 – 30	30 – 100	Yes	80
Over 10,000	0 – 30	30 – 100	No	40
Over 10,000	0 – 30	0 – 30	Yes	20
Over 10,000	0 – 30	0 – 30	No	10
Under 10,000	30 – 100	30 – 100	Yes	80
Under 10,000	30 – 100	30 – 100	No	40
Under 10,000	30 – 100	0 – 30	Yes	20
Under 10,000	30 – 100	0 – 30	No	10
Under 10,000	0 – 30	30 – 100	Yes	80
Under 10,000	0 – 30	30 – 100	No	40
Under 10,000	0 – 30	0 – 30	Yes	20
Under 10,000	0 – 30	0 – 30	No	10

Protection of Bats During Summer Occupancy

NLEB

To ensure that tree cutting does not affect NLEBs directly (crushing, injury), actions will not be eligible for a predetermined outcome of NE or NLAA if the action includes tree cutting in suitable summer habitat during the summer occupancy season unless there is sufficient evidence of the species' absence. NLEBs could be harmed by tree cutting during the summer occupancy season (see Section 5.4.2). The timing of the summer occupancy season – when bats are present on their summer home range and/or roosting in colonies – varies depending on geographic location. To ensure that project proponents appropriately consider the timing of any tree cutting relative to the potential presence of the NLEBs in the affected area, the Dkey directs users to Bat Activity Periods for each state in Appendix A of the FWS's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines (USFWS 2026).

<u>TCB</u>

To ensure that tree removal does not affect TCBs directly (crushing, injury), actions will not be eligible for a predetermined outcome of NE or NLAA if the action includes tree removal in suitable summer habitat during the pup season unless there is sufficient evidence of the species' absence. TCBs are not likely to be harmed by tree cutting during the rest of the summer occupancy season because we expect TCBs capable of flight to flush from roosts when physically disturbed (see Section 5.4.2). While adult TCBs are capable of flushing during tree cutting, removal of occupied roosts when flightless young are present (i.e., pup season) may result in direct injury or mortality. Flightless young are not capable of flight and cannot independently flush from a falling tree. The timing of the pup season – when TCB pups may be present but unable to fly– varies depending on geographic location. To ensure that project proponents appropriately consider the timing of any tree removal relative to the potential presence of the non-volant TCB pups in the affected area, the Dkey directs users to Bat Activity Periods for each state in Appendix A of the FWS's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines (USFWS 2026).

<u>Protection of Bats during spring staging/fall swarming</u>

Geographic data is also used in the Dkey as embedded GIS data to notify users when their actions fall within spring staging or fall swarming habitat, which is defined as a buffer around hibernacula openings of 5.0 mi (8.0 km) around hibernacula entrances for the NLEB, or 3.0mi (4.8 km) around hibernacula entrances for the TCB. If the project falls within a hibernacula buffer, the user will be prompted with the TOYR which includes spring staging and fall swarming activity periods.

Tree removal that occurs within 0.25 mi (400 m) of a hibernaculum would not be eligible for a pre-determined NLAA outcome in the Dkey regardless of the timing or extent of the tree removal. For tree cutting within staging/swarming buffers, Dkey users could get an NLAA determination if the tree cutting is not carried out during summer occupancy plus fall swarming and spring staging for the NLEB within the hibernating range, and/or pup season plus fall swarming and spring staging for TCB within the hibernating range. Fall swarming and spring staging TOYR are not applied within areas in proximity to hibernacula within Zone 1 (Figure 4) of the year-round active area for tree cutting because bats in the year-round active zone are not hibernating and we have no information to suggest that bats are swarming or staging around caves. In Zone 1 of the year-round active area, tree cutting should not be conducted during winter torpor, when bats may be roosting in trees and temperatures may be less than 40 degrees F (4.4 degrees C).

In addition to the time of year restrictions described above, tree cutting in fall swarming/spring staging habitat should not exceed the appropriate acreage as determined for the forest density category identified for the project location (see section 5.4.3).

<u>Protection of Tree-roosting NLEB and TCB in Zone 1 of the Year-round Active Zone</u>

In Zone 1 of the year-round active areas, where NLEBs and/or TCBs may be present and roosting in trees year-round, time of year restrictions on tree cutting also include the time when bats may be in winter torpor and unable to rouse quickly to exit tree roosts. These dates have been calculated to include the timeframe when mean winter temperatures fall below 40 degrees F (4.4 degrees C) and bats roosting in trees are in torpor. Torpor is a state of lowered body temperature and metabolic activity that reduces a bats ability to respond to environmental cues like noise or vibration.

Date-based time of year restrictions are used for tree cutting in the Dkey, rather than a temperature-based time-of-year restriction, because tree cutting actions are more difficult to stop and start based on changing site conditions. A temperature based TOYR requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented in tree cutting activities.

Year-round active zone protections do not apply to IBAT because there are currently no observations of IBAT roosting in trees year-round.

<u>*Protection of Known Roosts*</u>

Actions will not be eligible for a predetermined outcome of NE or NLAA if the project would affect any area within 150 ft (46 m) of a known NLEB or TCB roost tree. For NLEB and TCB, the Dkey will use embedded GIS data to identify actions that fall within 150 ft (46 m) of a known roost tree. Bat location data in the Dkey is hidden to protect sensitive species locations.

3.4.4.2 *Tree Limbing*

Actions will not be eligible for a predetermined outcome of NE or NLAA if the project would include tree limbing during the pup season for NLEB, or TCB. NLEBs are unlikely to be present roosting under the bark of small tree limbs with smooth bark, or tree limbs that do not have loose or rough bark, cracks, crevices, or bark separating from the tree after the tree dies, senesces, or is injured. TCB may be roosting in leaf clusters, but we expect TCBs capable of flight to flush from leaf clusters when physically disturbed (see Section 5.4.2). While adult TCBs are capable of flushing during tree limbing, removal of occupied leaf clusters when flightless young are present (i.e., pup season) may result in direct injury or mortality. Flightless young are not capable of flight and cannot independently flush from a cut limb.

3.4.4.3 Tree Mulching

Actions will not be eligible for a predetermined outcome of NE or NLAA if the project would include whole tree mulching during the pup season for IBAT, NLEB, or TCB. Actions are not eligible for a predetermined outcome of NE or NLAA if they include mulching of whole trees when temperatures are less than 40 degrees F (4.4 degrees C) during the seasons when bats may be present (summer occupancy in the hibernating range or year-round active Zone 2, or winter torpor and summer occupancy in year-round active Zone 1). Generally whole tree mulching is conducted on trees less than 3 inches DBH, which would not be suitable roosts for IBATs or NLEBs. These trees may be suitable roosts for TCBs, but we expect TCBs capable of flight to flush from leaf clusters when physically disturbed (see Section 5.4.2). While adult TCBs are capable of flushing during tree limbing, removal of occupied leaf clusters when flightless young are present (i.e., pup season) may result in direct injury or mortality. Flightless young cannot independently flush from a cut limb. Tree mulching cannot be conducted when temperatures are less than 40 degrees F (4.4 degrees C) during the season when bats may be present to ensure that bats will be capable of rousing quickly and exiting the tree if needed.

3.4.4.4 Tree Cutting in Utility or Road Rights-of-Way

To avoid direct impacts to NLEBs and TCBs from tree cutting, limbing and trimming in already established and currently maintained utility and road rights-of-way (ROWs), actions are not eligible for a predetermined outcome of NE or NLAA if the action would occur during the TOYR provided for this activity:

1. Pup Season – hibernating range in areas more than 5.0 mi (8.0 km) away from hibernacula for NLEB and areas more than 3.0 mi (4.8 km) away from hibernacula for TCB; and year-round active Zone 2 for NLEB and TCB
2. Pup Season plus Fall-Swarming and Spring-Staging - within 5.0 mi (8.0 km) of a hibernacula for NLEB, and within 3.0 mi (4.8 km) of a hibernacula for TCB.
3. Pup season plus Winter Torpor- year-round active range Zone 1, for NLEB and TCB.

TCBs may be found roosting in trees within or directly adjacent to the edges of a previously cleared and established utility or road ROW. For these areas, we have applied the general tree cutting TOYR of summer occupancy season plus fall-swarming and spring-staging within 5.0 mi (8.0 km) of a hibernacula for the NLEB, and pup season for the TCB in the hibernating range, pup season plus fall-swarming and spring-staging within 3.0 mi (4.8 km) of a hibernacula for TCB, as well as pup season plus winter torpor in the year-round active range Zone 1 for TCB.

The NLEB is a forest-interior species that is not expected to be found roosting in trees within or directly adjacent to the edges of a previously cleared and established utility or road ROW. In order to qualify for these conservation measures, the utility or road ROW must include a field or forested edge with a canopy gap overhead of less than 33 ft (10 m) between tree canopies. This is included to ensure that forest roads with overhead canopies that mimic a more forest-interior habitat, which may serve as suitable roosting habitat for the NLEB, will not be eligible for a predetermined outcome of NLAA.

If NLEBs are occasionally roosting in trees along the edges of currently maintained utility or road ROWs, the TOYR described above further reduce the likelihood of effects to NLEBs because they should be able to rouse and flush from the trees before direct impacts occur. The TOYR applied to currently maintained utility and road ROWs will ensure that non-volant pups and bats in torpor are not harmed as a result of tree cutting.

In addition to the TOYR, tree cutting, trimming and limbing will be limited to actions within already established and currently maintained utility and road corridors and actions that will not expand the footprint of the established ROW. This will ensure that trees within the forest interior will not be cut and most trees that are cut in established ROW are small, which further limits the potential effects. If these TOYR conditions are met, tree cutting, trimming and limbing will not be restricted to the acreage limits imposed on tree cutting outside currently maintained utility ROW. Tree cutting acreage limits are not imposed on this action because cutting will be conducted in a linear fashion within areas that have been previously fragmented. As a result, tree cutting, trimming or limbing is not expected to appreciably reduce the home range for the IBAT, NLEB or TCB, and direct impacts will be avoided by implementing TOYR.

3.4.5 Prescribed Fire

To avoid the likelihood that prescribed fire could adversely affect the IBAT, NLEB and TCB, actions will not be eligible for a predetermined outcome of NE or NLAA if the action includes prescribed fire that is conducted within suitable habitat for the IBAT, NLEB or TCB unless they include certain conservation measures. Actions that include prescribed fire within suitable forested habitat may be eligible for a NLAA determination when they include the following measures:

1. Prescribed fire plan includes average flame length of ≤ 6 ft (2 m) These flame lengths are anticipated to be equivalent to conducting prescribed fire at low to medium intensity on DODW installations.
2. Fire is only conducted when temperatures are ≥ 40 degrees F (4.4 degrees C) during times when bats may be present and roosting in trees (summer occupancy season in hibernating range and year-round active Zone 2, winter torpor and summer occupancy season in year-round active Zone 2).
3. Prescribed fire is not conducted within 0.25 mi (400 m) of an IBAT, NLEB or TCB hibernacula during the hibernation activity period.
4. Fire is conducted outside the pup season.

Unless surveys adequately demonstrate the probable absence of the IBAT, NLEB and/or TCB, prescribed fire that will affect suitable forested habitat for the IBAT, NLEB and/or TCB during the pup season will not be eligible for a NLAA outcome in the Dkey. This will minimize the likelihood that IBAT, NLEB and/or TCB pups will be exposed to harmful heat and flames or other indirect effects of fire during the period when they are unable to fly (non-volant). To ensure that project proponents appropriately consider the timing of any prescribed fire relative to the potential presence of non-volant pups in the affected area, the Dkey directs user to Bat Activity Periods for each state in Appendix A of the FWS's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines (USFWS 2026).

Prescribed fire of high intensity will not be eligible for a NLAA outcome in the Dkey at any time of year. Fire intensity is defined by the average flame length. Fires with average flame length ≤ 6 ft (2m) will result in a fire of low to moderate intensity for military installations. The average flame length used to represent a fire of low to moderate intensity in the DODW Dkey is specific to conditions on military installations, which routinely manage fuels with prescribed burning to ensure that other activities that include incendiary materials do not spark wildfires. The NLEB and TCB Rangewide Dkey uses a flame length ≤ 8 ft (2.4 m) in the eastern states and a flame length ≤ 4 ft (1.2 m) in the western states. A flame length of ≤ 6 ft (2m) is determined appropriate for military installations due to the combination of fuel reduction, vegetation management and fire suppression that are required to implement military activities that may result in increased wildfire risk. This average flame length may not be appropriate if applied to other activities or locations.

Prescribed fire will not be eligible for a NLAA outcome in the Dkey if it will be conducted when temperatures are lower than 40 degrees F (4.4 degrees C) during seasons when bats are expected to be present on the landscape (suitable summer habitat in the hibernating range, or suitable habitat within the active year-round portion of the range) because bats may be in deep torpor at these temperatures. The TOYR includes fall swarming and spring staging activity periods in the hibernating range, and winter torpor in the year-round active range. For prescribed fire, we can use temperature as a surrogate for the additional TOYR time frames applied to other activities because prescribed fire plans routinely include environmental conditions that must be met before the action can proceed. This practice provides the appropriate level of oversight needed to successfully meet the required conditions to avoid take. Other activities that may have less direct oversight of on-the-ground activities will use a date-based TOYR rather than a temperature-based TOYR.

3.4.6 Landscape Plantings

Landscape plantings are defined as native or non-native trees or shrubs that are planted for decorative or security purposes and routinely maintained. Landscape plantings routinely include trees or shrubs planted in cantonment areas that are not part of a forest patch. These can include trees that are planted in a row along a pathway or road that provide landscape value, screening or security. Landscape plantings are unlikely to provide suitable roosting habitat for the IBAT, NLEB or TCB. As a result, projects are eligible for predetermined NLAA outcomes even if the project would result in cutting, trimming, limbing or removal of landscape plantings.

3.4.7 Protection of Bats in Bridges and Culverts

3.4.7.1 Types of Bridge Actions Likely to be Excluded/Covered Under the Dkey

The Dkey includes measures to ensure that it does not inappropriately provide NLAA determinations for actions that involve work on bridges or culverts.

3.4.7.2 Geographically Specific Measures and Transportation Structure Assessments

Proponents of bridge actions will be directed to carry out a site-specific bridge/structure assessment, coordinate directly with the ESFO, or both. For assessments of bridge and certain other transportation structures that the NLEB or TCB may inhabit (e.g., culverts), the Dkey directs users to the FWS's Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines (USFWS 2026).

There is no record of NLEBs using bridges for roosting in either New Hampshire or Vermont, except for covered bridges (S. Von Oettingen, FWS, pers. comm. 2022). In areas of New Hampshire and/or Vermont that include the IBAT or NLEB, the Dkey will present bridge questions for actions affecting covered bridges, but not if the actions affect other bridge types. TCBs have been observed roosting in bridges in VT (A. Bennett, Vermont Agency of Natural Resources, Department of Fish and Wildlife, Essex Junction, VT, pers. comm. 2024) and are generally more likely to be observed using bridges than NLEB. In NH and VT, the Dkey will present bridge questions for actions affecting bridges only where the TCB is present on the official species list. In other states, the Dkey will present bridge questions for all projects that include the NLEB and/or TCB.

If a culvert may be impacted by project activities, proponents of the action will be directed to conduct a structure assessment depending on the size of the culvert (see the FWS's Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines for more information). For TCB, a structure assessment should be conducted if the culvert is greater than 3 ft tall (0.9 m) and 23 ft (7.0 m) in length. For IBAT, a structure assessment should be conducted if the culvert is greater than 4 ft (1.2 m) tall and 23 ft (7.0 m) in length. For NLEB, a structure assessment should be conducted if the culvert is greater than 4.5 ft (1.3 m) tall and 23 ft (7.0 m) in length. Project proponents should conduct a structure assessment using the same guidance as discussed above for bridges or coordinate with the ESFO. The dimensions for each species are equivalent to or slightly smaller than the minimum dimensions of culverts in which IBATs, NLEBs or TCBs have been documented, based on a review of the available information for NLEB and TCB conducted in 2022 by the FWS Asheville, North Carolina ESFO and that are described below in section 5.6. The smallest-diameter and shortest culverts in which IBATs have been documented was in Georgia and were 4.0 ft (1.2 m) tall and 50 ft (15m) long (L. Pattavina and E. Ferrall, University of Georgia, pers. comm 2022). Culvert records are limited for the IBAT. The smallest-diameter and shortest culverts in which NLEB and TCB have been documented were in Louisiana. The smallest-diameter and shortest culverts in which NLEBs have been documented were 4.5 ft (1.3 m) tall and 131 ft (40 m) long (Nikki Anderson, unpublished data, March 23, 2022). The shortest culvert for TCB was 5.0 ft (1.5 m) tall and 23.3 ft (7.1 m) long. The smallest-diameter culvert was 2.5 ft (0.8 m) tall and 377 ft (115 m) long. The smallest culvert overall was 3 ft (0.9 m) tall and 49.2 ft (15 m) long and was used in the summer and winter (Nikki Anderson, unpublished data, March 23, 2022). Through the review of existing data, it was determined that culverts less than 23 ft (7.0 m) in length do not need to be surveyed for any of the three species. The length dimensions are based on the typical size of a two-lane road, and bats are unlikely to be present in shorter culverts. The height dimensions for the NLEB were based on the height of the shortest culvert where NLEBs were found. TCBs have been documented in culverts as small as 2.0 ft (0.61 m) in diameter (USFWS 2022), however, instances of TCBs in culverts this small are expected to be rare and present a potential safety concern for regular surveys. Therefore, we recommend that culverts 3.0 ft (0.9 m) or larger in diameter be considered for assessments for TCB.

3.4.8 Protection of Bats in Buildings

3.4.8.1 Intentional Exclusion of Bats from Buildings

Intentional exclusion of bats from buildings that results in take of bats would be considered purposeful take and cannot be covered under section 7 of the ESA. The Dkey cannot provide a predetermined outcome of NE or NLAA to any project that will result in intentional take of a listed species. To ensure that intentional exclusion of bats from a building or structure does not result in take for IBAT, NLEB or TCB, the Dkey will not provide a predetermined consultation outcome for any action that includes this activity if exclusion does not follow proper methods to ensure safe exclusion of bats, including recommendations in the "Guidelines for the Capture, Handling, and Care of Mammals as Approved by The American Society of Mammalogists" and the National Park Service's "Standard Operating Procedure for the Study of Bats in the Field." The Dkey will not provide a predetermined consultation outcome of NE of NLAA if exclusion is conducted during pup season when non-volant pups may be left behind by adults. The Dkey will not provide a predetermined outcome of NE or NLAA if exclusion occurs without ensuring that sufficient suitable habitat exists within 1.5 mi (2.4 km) of the occupied building or structure to provide roosting habitat for any bats that were excluded.

For projects that use safe techniques to exclude bats from buildings, the Dkey is not determining whether the activity that could result in intentional take is NE or NLAA, because section 7 does not cover intentional take. Rather, the Dkey is assessing whether the project will conduct an activity that is likely to result in intentional take and whether that activity should disqualify the remainder of the project from coverage under section 7 using the Dkey. Projects that may result in intentional take of listed bats will receive a NA outcome in the Dkey because intentional take is not covered by section 7 of the ESA.

DODW installations contain a wide variety of buildings, structures, and bridges, and bats are often found utilizing these human-made structures. Exclusions are used to both keep bats from utilizing structures as well as removing bats safely. When bats are found in a human structure, a biologist (or otherwise appropriately trained or permitted personnel) will watch the structure's entrances and exits, seal up the structure except one access point and install netting or other material during the day so that bats can exit but not re-enter the building. This will be conducted for 2-3 days of good weather, then all access points will be sealed to permanently exclude bats. Efforts to remove bat colonies shall be attempted prior to remediation actions and disturbance of the interior of uninhabited structures or inhabitable exterior portions of structures

3.4.8.2 Removal, Modification, or Maintenance of Buildings
To help ensure that removal, modification, or maintenance of human-made building-type structures (barns, houses, storage sheds, or other buildings) does not adversely affect NLEB or TCB, actions that include any of those activities will not be eligible for a predetermined NLAA outcome if the structures are known or suspected to contain roosting bats. The action will not be eligible for a predetermined outcome of NLAA or NE if exclusion occurs as part of the building removal without ensuring that bats have safely exited the structure, such that injury or take of bats during the exclusion is not avoided. In order to avoid injury or take of bats, the action will not be eligible for a predetermined outcome of NE or NLAA if exclusion occurs without ensuring that sufficient suitable habitat exists within 1.5 mi (2.4 km) of the occupied building or structure to provide roosting habitat for any bats that were excluded. The action will not be eligible for a predetermined outcome of NE or NLAA if exclusion is conducted during the pup season, when non-volant pups may be left behind by adults. The action will not be eligible for a predetermined outcome of NE or NLAA if the exclusion does not follow proper methods to ensure safe exclusion of bats, including recommendations in the "Guidelines for the Capture, Handling, and Care of Mammals as Approved by The American Society of Mammalogists" and the National Park Service's "Standard Operating Procedure for the Study of Bats in the Field."

For projects that use techniques to exclude bats from buildings, the Dkey is not determining whether the activity that could result in intentional take is NE or NLAA, because section 7 does not cover intentional take. Rather, the Dkey is assessing whether the project will conduct an activity that is likely to result in intentional take and whether that activity should disqualify the remainder of the project from coverage under Section 7 using the Dkey. Projects that may result in intentional take of listed bats will receive a NA outcome in the Dkey because intentional take is not covered by section 7 of the ESA.

Abandoned and seldom-used bunkers, simulated buildings, and large concrete structures may provide habitat for roosting, maternity colonies, and hibernation sites for bats. For demolitions, if bat surveys have been performed with positive findings, bat roosts or occupation is known at the project site within the range, physical evidence of bat occupation is found within a structure within the range, or no surveys have been performed prior to hibernation, emergence surveys and a structural survey will be performed by a qualified biologist in suitable conditions before demolition can be conducted.

3.4.8.3 New Construction
The action may be eligible for a predetermined outcome of NLAA if the construction of a new facility is more than 273 yds (250 m) away from known or assumed maternity colonies or hibernacula. In addition, new construction will implement appropriate sediment and erosion control measures. If tree cutting is required as part of construction, the project must follow recommendations included for tree cutting (Section 3.4.4) to receive a predetermined outcome of NLAA. Tree cutting is not permitted within 440 yds (402 m) of assumed maternity colonies or hibernacula for NLEB and TCB. In areas where IBAT may be present and have not been determined to be absent based on surveys, tree cutting is not permitted for IBAT as part of the key if the trees to be cut could potentially be suitable roost trees for IBAT.

3.4.9 Potential Impacts of Vehicle Traffic – Ensuring Adequate Review
Vehicle traffic may pose a risk to IBATs, NLEBs and TCBs due to effects of risk of collision and noise. Impacts associated with roads may be a result of construction of new roads open to the public, addition of travel lanes to existing roads, or increased traffic on existing roads. Military installations are not open to the general public. As a result, overall traffic on military installations is expected to be relatively

consistent from year-to-year and unlikely to change substantially in volume, noise, or proximity of existing roads to roosting sites, foraging sites, and/or vegetation height near roads. In addition, actions in the Dkey will only be eligible for a predetermined outcome of NE or NLAA if vehicles are driven at speeds ≤ 45 mph (72 km/h) during night conditions on roads other than highways. Lower road speeds will give both bats and drivers an opportunity to avoid collisions. Roads that are utilized at highway speeds typically tend to be less suitable habitat for bats. As a result, the likelihood of bat road and trail mortality occurring between dusk and dawn is discountable.

Actions may be eligible for a predetermined outcome of NLAA if the action causes the construction of one or more new roads that are open to the public if they meet one of the following criteria:

1. The action will not occur in an area with forest on both sides of the road
2. If there is forest on both sides, the new road will not go through any area of contiguous forest that is greater than or equal to 10 acres (ac [4 hectares(ha)]) in total extent or will not pass between two patches of contiguous forest that are each greater than or equal to 10 ac (4 ha) in extent but are separated by less than 1,000 ft (305 m).
3. If neither of the above criteria are met , the action is ineligible for the key and the action proponent will be directed to coordinate with the FWS ESFO unless the answer is "yes" to the following question – "For every 1,000 ft (305 m) of new road that crosses between contiguous forest patches, will there be at least one place where bats could cross the road corridor by flying less than 33 ft (10 m) between trees whose tops are at least 66 ft (20 m) higher than the road surface?"

The Dkey deals with other potential effects of transportation actions in other series of questions, including effects to habitat and effects of artificial lighting.

3.4.10 Addressing Exposure to Water-Borne Contaminants

IBATs, NLEBs and TCBs may be exposed to water-borne contaminants in drinking water and in aquatic invertebrate prey. Water for drinking is known to be important for other Myotid bats and it's presumed that IBATs, NLEBs and TCBs also drink routinely from surface water sources (Adams and Hayes 2008, p. 1115; Geluso et al. 2018, p. 288).

To minimize the likelihood that actions will raise a significant risk of exposure to water-borne contaminants, actions for which the answer is 'yes' to either of the following two questions will not be eligible for a predetermined outcome of NE or NLAA:

1. Will the proposed action involve the creation of a new water-borne contaminate source (e.g., leachate pond pits containing chemicals that are not NSF/ANSI 60 compliant)?
2. Will the proposed action involve the creation of a new point source discharge from a facility other than a water treatment plant or storm water system?

3.4.11 Lighting

DODW will evaluate the use of outdoor lighting and seek to minimize light pollution by reducing the number of new lights and limiting the amount of light that reaches suitable habitat. Limiting extra light in the environment will be done by angling lights downward, fully hooding or shielding outdoor lighting, and minimizing nuisance glare onto adjacent properties or streets. All direct illumination will be kept to areas within the boundary of the building's property. In addition, LED light fixtures will be utilized to the maximum extent practicable.

To avoid or minimize the likelihood that artificial lighting could adversely affect IBATs, NLEBs and TCBs, actions are not eligible for a predetermined outcome of NE or NLAA if they result in temporary or permanent lighting within 300 ft (91 m) of suitable IBAT, NLEB or TCB habitat (not including vehicle headlights) unless the actions include certain conservation measures. In other words, actions that include lighting may be eligible for a predetermined outcome of NLAA when they include the following measures:

1. The use of only artificial lighting that is hooded, fully shielded (i.e., full cutoff fixtures), and/or aimed downward, with the same intensity or less for replacement lighting.

Even when projects include the required characteristics above, they must also ensure that any temporary lighting is directed away from suitable habitat during the active season to be eligible for a predetermined outcome of NLAA via the key. Actions that include lighting may be eligible for a predetermined outcome of NLAA determination when they include the following measure:

1. The action will not cause an increase in the extent of suitable forested habitat exposed to artificial lighting.
2. Minimize nuisance glare onto adjacent properties or streets and keep all direct illumination within the boundaries of the building's property.

3.4.12 Existing Firing Ranges, Maneuver Areas, Field Training, and Bivouac

The primary environmental effects of ranges and training areas include loud noises associated with munitions, detonations, and training vehicles. Existing firing ranges, maneuver areas, field trainings and bivouac exercises have been incorporated into baseline conditions for presence of IBATs, NLEBs and TCBs associated with military training environments. It is likely that bats associated with these environments have been either habituated to the routine activities that take place in proximity to roosting or foraging areas, or over time with extended use of these areas, the surrounding habitat has become unsuitable for bats. As a result, activities that are consistent with existing activities routinely performed are unlikely to cause additional impacts to bats. If activities do not take place in existing facilities, or differ substantially in noise intensity, frequency or duration, impacts from noise cannot be considered part of the baseline conditions and will not be eligible for a predetermined outcome of NLAA. In addition, if new firing range activities substantially differ in range utilization, these activities should not be considered part of baseline conditions for noise and will not be eligible for a predetermined outcome of NLAA.

Primary impacts include noise of irregular frequency and source location, as well as ground vibration. Noise levels are expected to be similar to activities like pile driving, blasting, or vehicle traffic over bridges containing roosting bats. Pile driving at a bridge project in Sonoma County, CA, within 300 ft of an active maternity colony did not result in the departure of roosting Yuma myotis (*M. yumanensis*) and Mexican free-tailed bats (*Tadarida brasiliensis*; Johnston et al. 2019). Results into the investigation of the effects of sound at Fort Leonard Wood, Missouri also suggest that sound generated by training events (simulated artillery and small-arms fire) do not startle, frighten, or cause bats to flee the area (USFWS 2010). Radiotelemetric monitoring of IBATs near active night training ranges at Fort Leonard Wood indicated that bats did not avoid active ranges or alter foraging behavior during night-time maneuvers (3D/I 1996). Bats in areas that are repeatedly exposed to predictable, loud noise (e.g., the maternity colony at the Indianapolis Airport) are believed to habituate to noise over time (USFWS 2010).

Actions are not eligible for a predetermined NE or NLAA outcome if they include new activities in existing firing ranges, maneuver areas, field training and/or bivouac exercises that substantially differ in noise intensity, frequency, or duration or include new activities that substantially differ in range utilization. Actions are not eligible for a predetermined outcome of NE or NLAA if they include maneuver training, field training, or bivouac activities within 110 y (100 m) of known of assumed maternity colonies or hibernacula. In addition, actions are not eligible for a predetermined NE or NLAA outcome if they include the use of portable generators, heaters, and other major noise sources within 110 yds (100 m) of known or assumed maternity colonies or hibernacula.

Live-fire training has the potential to cause direct impacts to bats and loss or damage to their roost trees, if conducted in proximity to suitable habitat for bats. Actions are not eligible for a predetermined outcome of NE or NLAA if they include firing range activities within 110 yds (100 m) of known or assumed maternity colonies or hibernacula. For direct fire training, trees more than 110 yds (100 m) away from targets may be only infrequently struck by ammunition fire. Occasional ammunition strikes will most likely cause minimal damage to trees (USFWS 2010). Significant damage could occur within 110 yds (100 m) of targets, but generally the land around firing points is cleared of trees. Risks to bats are also reduced because the same firing points are repeatedly used and actions that include new firing points would not be eligible for a predetermined outcome of NE or NLAA. Other impacts associated with firing ranges, maneuver areas, field training and bivouac include effects of artificial lighting and exposure to water-borne contaminants. These effects are addressed in the associated sections specific to those impacts.

3.4.13 Explosive Ordnance

The primary environmental effects of explosive ordnance include direct impacts to suitable habitat and loud noises and vibration associated with artillery, mortars, rockets, missiles, and maneuver live fire. Existing OBOD areas, demolition pits or areas used to dispose of excess explosives have been incorporated into baseline conditions for presence of IBATs, NLEBs and TCBs associated with military training environments. It is likely that bats associated with these environments have been either habituated to the routine activities that take place in proximity to roosting or foraging areas, or the surrounding habitat has become unsuitable for bats over time with extended use of these areas. As a result, activities that are consistent with existing activities routinely performed are unlikely to cause additional impacts to bats.

Primary impacts include noise of irregular frequency and source location, as well as ground vibration. Noise levels are expected to be similar to activities like pile driving, blasting, or vehicle traffic over bridges containing roosting bats. Pile driving at a bridge project in Sonoma County, CA, within 300 ft of an active maternity colony did not result in the departure of roosting Yuma myotis and Mexican free-tailed bats (*Tadarida brasiliensis*; Johnston et al. 2019). Results into the investigation of the effects of sound at Fort Leonard Wood, Missouri also suggest that sound generated by training events (simulated artillery and small-arms fire) do not startle, frighten, or cause bats to flee the area (USFWS 2010). Radiotelemetry monitoring of Indiana bats near active night training ranges at Fort Leonard Wood indicated that bats did not avoid active ranges or alter foraging behavior during night-time maneuvers (3D/I 1996). Bats in areas that are repeatedly exposed to predictable, loud noise (e.g., the maternity colony at the Indianapolis Airport) are believed to habituate to noise over time (USFWS 2010).

If activities do not take place in existing facilities, or differ substantially in noise intensity, frequency or duration, impacts from noise cannot be considered part of the baseline conditions and will not be eligible for a predetermined outcome of NLAA unless they include the following measures:

1. Activities are conducted more than 110 yds (100 m) from known or assumed maternity colonies or hibernacula.
2. Illumination artillery and mortar rounds will not be fired during the pup season and periods of high fire danger.
3. Nighttime demolition pit use will not occur during the summer occupancy season.
4. Nighttime use of OBOD areas will not occur when conditions may send smoke downwind into known or assumed maternity colonies or hibernacula.
5. Any structures used will be surveyed and inspected for bat use by a qualified biologist at least 5 nights before explosive ordnance activity occurs to ensure the absence of roosting bats.

Direct mortality may result from explosive ordnance activities conducted within suitable habitat for IBAT, NLEB and/or TCB, or as a result of fire associated with explosive ordnance activities. To avoid injury to personnel and wildlife, areas associated with explosive ordnances are cleared and vegetation is maintained per explosive operation and fire danger requirements. In addition, a 110 yds (100 m) activity buffer will be maintained around known or assumed maternity colonies or hibernacula. Nighttime use of demolition pits will also be avoided when bats may be foraging. These conservation measures ensure that direct mortality is not expected to occur as a result of explosive ordnance.

3.4.14 Smoke and Obscurants

Actions that include smoke and obscurants may be eligible for a predetermined outcome of NLAA when they include the following measures:

1. Military smoke grenades will not be used within 55 yds (50 m) of known or assumed maternity colonies.
2. Fog oil will not be released within 110 yds (100 m) of known or assumed maternity colonies.
3. Other smoke or obscurants will not be used within 55 yds (50 m) of known or assumed maternity colonies.
4. Smoke and obscurants will not be used within 273 yds (250 m) of known or assumed hibernacula.

3.4.15 Air Operations

Actions that include air operations (helicopter, fixed-wing aircraft, or UAV use) may be eligible for a predetermined outcome of NLAA when they include the following measures:

1. Air operations will not be conducted at night.
2. Air operations will not include hovering within 110 yds (100 m) horizontal distance of known or assumed maternity colonies.
3. Bambi buckets or similar aerial fire support training will not include pickup or drop off locations in forested areas or within 110 yds (100 m) of the tree line.
4. Air operations will not dump water from Bambi buckets in forested areas during the summer occupancy season.

3.4.16 Cave and Subterranean Training

Actions that include cave and subterranean training may be eligible for a predetermined outcome of NLAA when they include the following measures:

1. Activities will not take place in hibernacula known to be used by bats or hibernacula that provide suitable conditions for hibernation.
2. Activities will not take place if roosting bats are present in the training structure.
3. Activities will not take place if roosting bats are discovered in a training structure.
4. Activities will not take place if entrances to artificial training environments will be accessible to bats when not in use for training.
5. Surveys and/or inspections will be conducted to inspect for roosting bats within 5 nights of the start of any activities

3.4.17 Invasive Species and Pest Control

Use of herbicide within forested areas will be targeted plant-specific applications. Actions that include invasive species and pest control may be eligible for a predetermined outcome of NLAA when they include the following measures:

1. Activities will not include the use of foggers in or around buildings occupied by roosting bats. Herbicides and pesticides will be used sparingly in buildings occupied by roosting bats.
2. Activities will not include application of herbicides or pesticides where the label includes mammal toxicity.
3. Activities will not include targeted application of herbicide for trees ≥ 3 in DBH in areas of known or assumed maternity colonies.
4. Activities will not include application of pesticides or herbicides around areas of known or assumed NLEB roost sites in gusty winds, or when constant wind speeds exceed label prescriptions.
5. Activities will not include application of pesticides or herbicides that result in broad dispersal (e.g., tow behind power blowers) within 328 ft (100 m) of known or assumed maternity colonies and hibernacula.
6. Activities will not include application of pesticides or herbicides that is directed to a heigh above 3.3 ft (1 m) in areas that are within 328 ft (100 m) of known or assumed maternity colonies and hibernacula.
7. Activities will not include application of pesticides or herbicides outdoors when the wind speed exceeds 8 mi/hr (13 km/hr) for all applications except power mist blowers. Pesticides applied via power mist blower will only be applied with wind speeds <5 mi/hr (8 km/hr).
8. Activities will not include aerial applications of pesticides or herbicides using fixed or rotary-winged aircraft at night (between one hour before sunset and one hour after sunrise).
9. Activities will not include application of pesticides or herbicides from ground mounted vehicles at night (between one hour before sunset and one hour after sunrise).
10. Activities will not include application of pesticide or herbicide from ground mounted vehicles within 98 ft (30 m) of known or assumed maternity colonies and/or hibernacula.
11. Activities will not include the use of glue or snap traps in any crawl space or attic compartment within buildings.

12. Activities will not include the placement of glue or snap traps in areas where bats are known to occur.
13. Adhesive traps will not be attached to trees within forests or woodlots with known or assumed presence of listed bats.
14. Adhesive traps will not be employed within forests or woodlots without protective measures to deter bat entrapment.

3.4.18 Fire Management

Actions that include prescribed fire may be eligible for a predetermined outcome of NLAA when they include the following measures:

1. Prescribed fire will occur only in areas that do not include suitable habitat for IBAT, NLEB and/or TCB.
2. Prescribed fire will not be conducted within 0.25 mi (400 m) of known hibernacula during the hibernation season.
3. Prescribed fire will include average flame lengths of less than 6 ft (1.8 m).
4. Prescribed fire will not occur when temperatures are less than 40 degrees F (4.4 degrees C) during the times when bats may be present and roosting in trees (summer occupancy season in hibernating ranges and year-round active Zone 2, winter torpor and summer occupancy season in year-round active Zone 1, spring staging/fall swarming in proximity to known hibernacula).
5. Prescribed fire will not occur during the pup season.

4 COVERED SPECIES

The following section includes a summary of relevant background information on the species and CH(s) used to develop this SA. A complete description of the species can be found on ECOS (https://ecos.fws.gov). This overview is included to inform the reader of the species prior to the analysis of the effects of the action presented below. Species and CH within a project's action area that may be affected by the proposed action, but are not covered by this SA, will require individual consultation with the local ESFO.

The Dkey covers the endangered IBAT and NLEB and the proposed endangered TCB.

4.1 SPECIES HABITS AND HABITATS

4.1.1 IBAT and CH

The IBAT is a migratory species that hibernates colonially in caves and mines in the winter, then migrates to wooded areas (roost sites) in the spring to bear and raise its young over the summer. While specific dates may vary by latitude or elevation, hibernation is typically from October through March or April. For hibernation, they require cool, humid caves or mines with stable temperatures under 50 degrees F (10 degrees C) but above freezing (USFWS 2007). IBATs generally mate during fall before they enter caves to hibernate, but mating can also occur in winter. The non-hibernation season includes the rest of the year during which spring emergence, migration, maternity season (i.e., colony formation, pregnancy, pup-rearing), and fall swarming occur. In spring, reproductive females migrate and form maternity colonies in wooded areas where they bear and raise their young.

During summer, IBATs (males and females) use forested habitat for roosting, foraging, and commuting. IBATs are often associated with floodplain or riparian forests with large trees, scattered canopy gaps, and open understories (USFWS 2007). Research has shown adaptability in habitats used, including upland forests, forests altered by grazing, swine feedlots, row-crops, hay fields, residences, clear-cut harvests, and shelterwood cuts (Garner and Gardner 1992).

Suitability of a roost tree is determined by its condition (dead or alive), suitability of loose bark, solar exposure, spatial relationship to other trees, and its spatial relationship to water sources and foraging areas. Potentially suitable roost trees can be trees of any species with bark separating from the tree after the tree dies, senesces, or is injured. Live trees that exhibit peeling or shaggy bark, such as hickories (*Carya* spp.) and large white oaks (*Quercus alba*), may also be suitable roost trees. Many maternity colonies have been associated with oak-hickory and elm-ash-cottonwood forest types. Tree cavities, hollow portions of tree boles or limbs, and crevices and splits from broken tops occasionally have been used as roosts, usually by individual bats. Roost longevity is variable due to many factors, such as the rate at which bark sloughs off or the tree falls down. Some roosts may only be habitable for one to two years while species with good bark retention, such as slippery elm (*Ulmus rubra*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), and various oaks (*Quercus* spp.) and hickories (*Carya* spp.) may provide habitat for four to eight years.

Trees over 15.7 in (40 cm) DBH are optimal for maternity colonies, while trees in excess of 8.6 in (22 cm) DBH may serve as alternate roosts. Females have been documented using roost trees as small as 5.5 in (14 cm) DBH (Kurta et al. 2002). The average size of a male roost tree is typically smaller than that of female maternity colonies, with one male observed in a roost tree measuring only 2.5 in (6.4 cm) DBH (Gumbert et al. 2002).

Maternity colonies have been documented to use eight to 34 roost trees per season (Callahan et al. 1997, Kurta et al. 2002). The extent and configuration of the roosting area is probably determined by availability of suitable roost trees in a given area. Distances between roosts can be a few meters to a few kilometers (Kurta et al. 1996, 2002). Primary roosts are generally larger in diameter and located in openings or at the edge of forest stands, while alternate roosts can either be in openings or the interior of the forest stand. Maternity colony movements among multiple roosts seem to depend on micro-climate changes, particularly solar radiation (Humphrey et al. 1977). Cool temperatures can delay fetal development and growth of juveniles; therefore, selection of maternity roost sites may be critical to reproductive success. Kurta et al. (1993) suggest movement between roosts may be the way that bats deal with the ephemeral nature of roost trees. It is not known how many alternate roosts must be available to ensure retention of a colony within a particular area, but large, nearby forest tracts would improve the potential for an area to provide adequate roosting habitat (Callahan 1993, Callahan et al. 1997). IBATs appear to have a fission-fusion society as demonstrated by frequent roost changing (Kurta et al. 2002). Barclay and Kurta (2007) explain "that in this type of a society, members frequently coalesce to form a group (fusion), but composition of that group is in perpetual flux, with individuals frequently departing to be solitary or to form smaller groups (fission) for a variable time before returning to the main unit."

IBATs predominately forage, roost, and travel within wooded habitats or along their edges (Cope et al. 1974, Humphrey et al. 1977, LaVal et al. 1977, LaVal and LaVal 1980, Gardner et al. 1991a and 1991b, Hobson and Holland 1995, Kiser and Elliot 1996, Butchkowski and Hassigner 2002, Rommé et al. 2002, Murray and Kurta 2004, Menzel et al. 2005, Sparks et al., 2005). Use of other habitat types appears to be infrequent relative to availability (Garner and Gardner 1992, Menzel et al., 2005, Sparks et al. 2005). Indiana bats show a high degree of fidelity to roost trees, roosting areas, and foraging areas (Gardner et al. 1991b, Humphrey et al. 1977, Kurta et al. 1996, 2002, Gumbert et al. 2002). Bats using familiar foraging and roosting areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002).

Females typically give birth to one pup sometime around late May or early June, and juveniles are weaned when they are three to five weeks old. Young IBATs become volant from early July to the first few days of August (USFWS 2007). During the fall “swarming" period, IBATs occupy the forested habitat around hibernacula where they mate and acquire additional fat reserves prior to hibernation (Hall 1962, LaVal and LaVal 1980). During swarming, bats will fly in and out of cave entrances at night and roost in trees during the day (Cope and Humphrey 1977). Some male bats may begin to arrive at hibernacula as early as July, but females typically arrive later. By late September, many females have entered hibernation, but males may continue swarming well into October. Most IBATs tracked have stayed within 2.0 to 3.0 mi (3.2 – 4.8 km) of the hibernacula during fall swarming, but some have been found up to 4.2 mi away (Rommé et al. 2002). Studies suggest that the majority of foraging habitat in spring and autumn is within 2.0 mi (3.2 km) of the hibernacula but extends to 10.0 mi (16 km) or more. They also utilize this habitat briefly during spring emergence before migrating to their summering areas. The initiation of hibernation may vary by latitude and annual weather conditions; however, most bats are hibernating by the end of November (USFWS 2007). Hibernating IBATS cluster on cave ceilings in densities of approximately 300 – 484 bats/ft ^{2} from approximately October through April.

Spring emergence occurs when outside temperatures have increased, and insects are more abundant (Richter et al. 1993). Most IBATs emerge in late March or early April; however, the timing of annual emergence may vary across the range, depending on latitude and annual weather conditions. Females emerge before males. Shortly after emerging from hibernation, the females become pregnant via delayed fertilization from the sperm that has been stored in their reproductive tracts through the winter (USFWS 2007). During the “staging” period, the bats forage for a few days or weeks near their hibernacula before migrating to their traditional summer roosting areas. Some reproductive females have been documented to migrate up to 418 mi (673 km) to form maternity colonies (Butchkowski and Bearer 2016), while others form maternity colonies within only a few miles of their hibernacula. Males are commonly found roosting near the hibernacula but have also been documented to migrate long distances to their summer habitat (Kurta and Rice 2002). Migration is stressful, particularly in the spring when their fat reserves and food supplies are low. As a result, adult mortality may be the highest in late March and April. Male bats disperse throughout the range and roost individually or in small groups. In contrast, reproductive females form larger groups.

IBATs forage between dusk and dawn and feed exclusively on flying aquatic and terrestrial insects, primarily moths, beetles, and aquatic insects. IBATs forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands. Old fields and agricultural fields are also used (USFWS 2007, Sparks et al. 2005). IBATs frequently forage along riparian corridors and obtain water from streams, ponds, and water-filled road ruts in forest uplands. They typically forage in and around tree canopy (USFWS 2007). Optimum canopy closures are 50 – 70 percent with relatively open understory (USFWS 2007). Foraging also occurs over clearings with successional vegetation, along cropland borders, fencerows, and over farm ponds. Foraging bats usually fly between 6 – 100 ft (1.8 – 30 m) above ground level (USFWS 2007).

Diet varies seasonally and variations exist among different ages, sexes, and reproductive status (USFWS 2007). It is probable that IBATs use a combination of both selective and opportunistic feeding to their advantage (Brack and LaVal 1985). Lepidoptera (moths), Coleoptera (beetles), and Diptera (midges and flies) are the bulk of the diet (Brack and LaVal 1985). Moths (Lepidoptera) have been identified as major prey items that may be preferentially selected (Brack and LaVal 1985), but beetles (Coleoptera) and flies (Diptera) were also found significant (Brack and Tyrell 1990). Among Diptera taken are especially midges and other species that congregate over water but IBATs rarely eat mosquitoes. Other prey items include wasps and flying ants (Hymenoptera), caddisflies (Trichoptera), brown leafhoppers and treehoppers (Homoptera), stoneflies (Plecoptera), and lacewings (Neuroptera) (Brack and LaVal 1985, USFWS 2007). Male IBATs summering in or near a hibernation cave eat primarily moths and beetles but feed on other terrestrial insects in lower percentages (USFWS 2007). IBATs use small impoundments as well as permanent and intermittent streams for drinking water.

Critical Habitat

On September 24, 1976, the FWS designated CH for the IBAT (41 FR 41914). Eleven caves and two mines in six states were listed as CH. For additional information on IBAT CH, see the FWS species profile for the IBAT.

4.1.2 NLEB

Within the hibernating portion of the NLEB range, they spend winter hibernating in caves, mines, or similar structures, preferring areas with constant temperatures, high humidity, and no strong air currents. The "active season" includes the portion of the year that the species is not hibernating. In the southern portion of their range (i.e., year-round active range), NLEBs have been found to be present and active year-round. In some places, where there are no known non-cave-like hibernacula (Grider et al. 2016, p.11), NLEBs were observed to be active and roosting in trees the majority of the winter, and although torpor was observed, time spent in torpor was very short with the longest torpor bout (i.e., hibernation period) for each bat averaging 6.8 days (Jordan 2020, p. 672).

During summer, NLEBs typically roost underneath bark or in cavities, crevices, or hollows of both live trees and snags (standing dead trees) that are typically ≥3 inches diameter at DBH; however, maternity roost trees are typically larger (≥ 9 in DBH). NLEBs exhibit site fidelity and return to general areas, but they use many alternate roost trees and a wide variety of tree species. To a lesser extent, NLEBs may roost in manmade structures, such as barns and sheds.

During spring, summer, and fall, NLEBs are a forest-interior species and typically roost in mature forests (Caceres and Pybus 1997) with occasional foraging over forest clearings, water, and along roads (Van Zyll de Jong 1979). Roosting and foraging habitat are typically within closed, intact forest stands (Sasse and Pekins 1996; Foster and Kurta 1999; Lacki and Schwierjohann 2001; Owen et al 2002). When available, NLEBs will use narrow lines of trees to move between forest patches to avoid crossing open fields and may "rarely venture more than a few meters from forest" (White et al. 2017, p. 8). Fall swarming near hibernacula occurs between the summer and winter seasons in areas outside of the year-round active range. Swarming sites play an important role in maintaining genetic diversity because mating and copulation occurs during swarming and because they attract members of multiple summer colonies (Kurta et al. 1997, p. 479, Lowe 2012, p. 51; Randall and Broders 2014, p. 114).

Based on best available information from NLEB radio-tracking studies, the NLEB typically roosts, commutes, and forages within 1.5-mi of known roost trees (Timpone et al. 2010, p. 118; Swingen et al. 2018, pp. 26–27), and we refer to this area as the maternity colony home range (USFWS 2026). A 1.5-mi (2.4-km) buffer encompasses 4,524 ac (1,831 ha).

NLEBs are nocturnal foragers and use hawking (catching insects in flight) and gleaning (picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, p. 88; Ratcliffe and Dawson 2003, p. 851). NLEBs have a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Griffith and Gates 1985, p. 452; Nagorsen and Brigham 1993, p. 88; Brack and Whitaker 2001, p. 207), with diet composition differing geographically and seasonally (Brack and Whitaker 2001, p. 208). The most common insects found in the diets of NLEB are lepidopterans (moths) and coleopterans (beetles) (Brack and Whitaker 2001, p. 207; Lee and McCracken 2004, pp. 595–596; Feldhamer et al. 2009, p. 45; Dodd et al. 2012, p. 1122), with arachnids also being a common prey item (Feldhamer et al. 2009, p. 45).

NLEB maternity colonies, consisting of females and young, are generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3); however, larger colonies of up to 100 adult females have been observed (Whitaker and Mumford 2009, p. 212). The NLEB has experienced severe declines following the arrival of white-nose syndrome (WNS). WNS has caused estimated population declines of 97–100 percent across 79 percent of the NLEB's range (USFWS 2022, p. 35). NLEB populations where WNS is present are severely reduced, which is likely to extend to NLEB maternity colony size. Most studies have found that the number of individuals roosting together in a given roost typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, p. 667; Lacki and Schwierjohann 2001, p. 485; Garroway and Broders 2007, p. 962; Perry and Thill 2007a, p. 224; Johnson et al. 2012, p. 227). NLEBs exhibit fission-fusion behavior (Garroway and Broders 2007, p. 961), where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main spatially discrete unit or network (Barclay and Kurta 2007, p. 44). As part of this behavior, NLEBs switch tree roosts often (Sasse and Pekins 1996, p. 95), typically every 2 to 3 days (Foster and Kurta 1999, p. 665; Owen et al. 2002, p. 2; Carter and Feldhamer 2005, p. 261; Timpone et al. 2010, p. 119). Adult females give birth to a single pup (Barbour and Davis 1969, p. 104). Birthing within the colony tends to be synchronous, with the majority of births occurring around the same time (Krochmal and Sparks 2007, p. 654). Parturition (birth) may occur as early as late May or early June (Easterla 1968, p. 770; Caire et al. 1979, p. 406; Whitaker and Mumford 2009, p. 213) and may occur as late as mid-July (Whitaker and Mumford 2009, p. 213). Juveniles often fly by 21 days after birth (Kunz 1971, p. 480; Krochmal and Sparks 2007, p. 651) and juvenile flight has been documented as early as 18 days after birth (Krochmal and Sparks 2007, p. 651).

4.1.3 TCB

In the hibernating portion of their range, TCBs spend winters hibernating in caves, abandoned mines, or similar structures, preferring areas with constant temperatures, high humidity, and no strong air currents. TCBs have also been documented roosting in natural rock faces and outcrops (Lemen et al. 2016, p. 11; Johnson et al. 2024, p. 9). In the southern portion of their range (i.e., year-round active range), TCBs exhibit shorter torpor length compared to northern portions of the range and TCBs remain active and feed during the winter (Grider et al. 2016, pp. 8–9; Newman 2020, pp. 13–17; Stevens et al. 2020, p. 528; Shute et al. 2021a, p. 970). Within the year-round active range, caves are sparse and TCBs often roost in road-associated culverts (Sandel et al. 2001, entire; Katzenmeyer 2016, pp. 32–36; Limon et al. 2018, p. 218; Bernard et al. 2019, p. 3; Lutsch 2019, unpaginated; Meierhofer et al. 2019, p. 3) and sometimes bridges (Ferrara and Leberg 2005, p. 731; Newman et al. 2021, p. 1335). In addition, tree cavities, foliage, and Spanish moss (*Tillandsia usneoides*) serve as winter roosting habitat for TCBs in the southern portion of the range (Newman et al. 2021, p. 1335).

During spring, summer, and fall, TCBs typically roost in live and dead leaf clusters of live and recently dead deciduous hardwood trees (Veilleux et al. 2003, p. 1071; Perry and Thill 2007b, pp. 976-977; Thames 2020, p. 32). In the southern and northern (Canadian) portions of the range, TCB will also roost in Spanish moss and beard lichen (*Usnea trichodea*), respectively (Davis and Mumford 1962, p. 395; Poissant 2009, p. 36; Poissant et al. 2010, p. 374). TCBs rarely roost in buildings, and when they do, they are often in well-lit or full daylight areas (Barbour and Davis 1969, p. 116). TCBs will roost in a variety of tree species, especially oaks (*Quercus* spp.), and often select roosts in tall, larger diameter trees, but will roost in smaller diameter trees when potential roost substrate is present (e.g., 4 in [10 centimeters (cm)]; Leput 2004, p. 32). TCBs commonly roost in the mid to upper canopy of trees although males will occasionally roost in dead leaves at lower heights (e.g., < 16 ft [5 m]) from the ground, (Perry and Thill 2007a, p. 979) and females will occasionally roost in Spanish moss of understory trees (Menzel et al. 1999, p. 191). Occasional summer roosts also include clusters of dead pine needles of large living pines (*Pinus echinata*), live branches of Norway spruce (*Picea abies*), eastern red cedar (*Juniperus virginiana*), abandoned gray squirrel (*Sciurus carolinensis*) nests, and under exfoliating birch (*Betula spp.*) bark (Veilleux et al. 2003, p. 1071; Perry and Thill 2007b, p. 977; WDNR 2016, unpaginated; WDNR 2017a, p. 6; WDNR 2017b, unpaginated; WDNR 2018, p. 8; Thames 2020, p. 32; Hammesfahr et al. 2022, p. 161).

Although the species has been captured within a variety of forest types, studies on forest associations of this species are limited (Silvis et al. 2016, p. 32). TCBs roost almost exclusively in hardwood trees and often roost in forest stands that contained abundant deciduous hardwoods (Perry et al. 2007, p. 164).

TCBs are opportunistic feeders and consume small insects including caddisflies (Trichoptera), flying moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera) (Whitaker 1972, p.879; LaVal and LaVal 1980, p. 24; Griffith and Gates 1985, p. 453; Hanttula and Valdez 2021, p. 132). TCBs emerge early in the evening and forage at treetop level or above (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116) but may forage closer to the ground later in the evening (Mumford and Whitaker 1982, p. 170). TCBs exhibit slow, erratic, fluttery flight while foraging (Fujita and Kunz 1984, p. 4) and commonly forage with eastern red bats (*Lasiurus borealis*) and silver-haired bats (*Lasionycteris noctivagans*) (Davis and Mumford 1962, p. 397; Mumford and Whitaker 1982, p. 169).

TCBs forage most commonly over waterways and forest edges (Barbour and Davis 1969, p. 116; Mumford and Whitaker 1982, pp. 170-171; Hein et al. 2009, p. 1204). TCBs seem to prefer foraging along forested edges of larger forested openings, along edges of riparian areas, and over water. TCBs avoid foraging in dense, unbroken forests, and narrow road cuts through forests (Davis and Mumford 1962, p. 395; Kurta 1995, p. 87; Lacki and Hutchinson 1999, p. 11; Ford et al. 2005, p. 535; Thames 2020, p. 63). Reproductively active (i.e., pregnant and lactating) adult female TCBs typically forage within 2.4 km of roost trees (Veilleux et al. 2003, p. 1073; Leput 2004, p. 28; Helms 2010, p. 14; Wisconsin DNR 2017a, unpaginated; Wisconsin DNR 2018, p. 11). Maximal distance traveled from roost areas to foraging grounds was 9.1 km for a pregnant adult female in Tennessee (Cable and Willcox 2024, p. 6) and 24.4 km for a male TCB in Tennessee (Thames 2020, p. 61).

Based on best available information from TCB radio-tracking studies, the TCB typically roosts, commutes, and forages within 1.5-mi (2.4 km) of known roost trees (Veilleux et al. 2003, p. 1073; Leput 2004, p. 28; Helms 2010, p. 14; Wisconsin DNR 2017a, unpaginated; Wisconsin DNR 2018, pp. 8–11; Cable and Willcox 2024, p. 6), and we refer to this area as the colony home range (USFWS 2026). A 1.5-mi (2.4 km) buffer encompasses 4,524 ac (1,831 ha).

In the hibernating portion of their range, fall swarming near hibernacula occurs between the summer and winter seasons when male and female TCBs converge at cave and mine entrances. Swarming sites play an important role in maintaining genetic diversity because mating and copulation occur during swarming and because they attract members of multiple summer colonies. TCBs disperse from winter hibernacula to summer roosting habitat in the spring. Female TCBs exhibit high site fidelity, returning year after year to the same summer roosting area (Allen 1921, p. 54; Veilleux and Veilleux 2004a, pp. 197–198; Poissant 2009, p. 57; Whitaker et al. 2014, pp. 51–52).

TCB maternity colonies are generally small, with groupings sometimes consisting of only a single female and her two pups. In Indiana, maternity colonies averaged 4.4 ± 2.4 bats (range: 1–8) (Veilleux and Veilleux 2004b, p. 62). TCBs switch roost trees regularly. In Indiana, 18 pregnant or lactating female TCBs monitored for an average of 9.1 days (± 1.7) used an average of 2.8 (± 1.7) roost trees and remained at roosts for an average of 3.9 (± 2.5) days (Veilleux et al. 2003, p. 1072). Young start flying at three weeks of age and achieve adult-like flight at four weeks of age (Lane 1946, p. 59; Whitaker 1998, pp. 654–655). As the maternity season progresses, colony sizes begin to fluctuate, females begin to disband soon after young became volant, and post-lactating females roost singly for the remainder of the summer (Veilleux and Veilleux 2004b, pp. 62–63).

4.2 SPECIES STATUS IN THE ACTION AREA

4.2.1 IBAT

The IBAT is found in 27 states in the mid-west, south-east and northeastern United States. The IBAT was originally listed as in danger of extinction under the Endangered Species Preservation Act of 1966 and was listed as endangered under the ESA on February 24, 1967 (30 FR 4001). Initially, winter disturbance and habitat loss were the main causes of decline. Since the early 1980s, populations dropped sharply until a brief recovery from 2003 to 2007, largely due to conservation efforts at key hibernacula and summer habitats. However, since 2009, the spread of WNS—a fungal disease caused by *Pseudogymnoascus destructans*—has led to widespread mortality and a renewed population decline.

By 2017, nearly all known hibernacula were affected. Although the IBAT has shown more resilience than some related species, scientists remain concerned about their long-term survival.

For more information on the IBAT, visit the IBAT species profile page.

4.2.2 NLEB

The NLEB is found in 37 states in the eastern and north central United States, the District of Columbia, and eight Canadian provinces from the Atlantic Coast west to the southern Northwest Territories and eastern British Columbia. The NLEB is one of the species most impacted by WNS. Due to declines caused by WNS and continued spread of the disease, the NLEB was listed as threatened under the ESA on April 2, 2015 (80 FR 17974). In 2022, FWS completed a species status assessment (SSA) for the NLEB, which included a thorough review of the species' taxonomy, life history, and ecology (USFWS 2022, entire). The SSA informed the FWS's proposal to reclassify the NLEB as endangered (87 FR 16442), which published on November 30, 2022, effective March 31, 2023 (88 FR 4908).

Although relatively common and locally abundant before WNS, the NLEB is now of conservation concern across its distribution. Although there are countless stressors affecting NLEB, the primary factor influencing the viability of the NLEB is WNS. Other primary factors that influence NLEB's viability include wind energy mortality, effects from climate change, and habitat loss (USFWS 2022, p. iii). Habitat loss may include loss of suitable roosting or foraging habitat, resulting in longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality. Loss of or modification of winter roosts (i.e., making hibernaculum no longer suitable) can result in impacts to individuals or at the population level (USFWS 2022, p. iv).

For additional information on the NLEB, including the SSA, visit the NLEB species profile page.

4.2.3 TCB

The TCB range includes much of the United States east of the Rocky Mountains, southern portions of four Canadian provinces from the Atlantic Coast west to the Great Lakes, and portions of Mexico, Guatemala, Honduras, Belize, and Nicaragua near the Gulf of Mexico. The TCB is one of the species most impacted by WNS. Due to declines caused by WNS and continued spread of the disease, the FWS published a proposed rule to list the TCB as endangered (87 FR 56381) on September 14, 2022. In 2021, FWS completed a SSA for the TCB, which included a thorough review of the species' taxonomy, life history, and ecology (USFWS 2021, entire). The SSA was updated in 2024 (FWS 2024b, entire).

Although relatively common and locally abundant before WNS, the TCB is now of conservation concern across its distribution. The primary stressors influencing TCB include WNS, wind-related mortality, and habitat loss (USFWS 2021). Population declines of this species following WNS have been great, and risk of local extirpation has increased following introduction of the disease (Frick et al. 2015, p. 745). The greatest threat to this species is WNS. Wind-related mortality of TCBs is also proving to be a consequential stressor at local and regional levels. TCBs are killed at wind energy projects primarily through collisions with moving turbine blades (USFWS 2021, p. ii; Arnett et al. 2008, p. 64). Loss of roosting, foraging, and commuting habitat may lead to minor or significant impacts to the TCB depending on the timing, location, and extent of the removal. Loss or modification of winter habitats may also result in negative impacts to TCBs, especially given the species' high site fidelity and narrow microclimate requirements for hibernation. Disturbance during hibernation results in increased arousals in TCBs, which leads to increased energy expenditure at a time when food and water resources are scarce or unavailable.

For additional information on the TCB, including the SSA, visit the TCB species profile page.

5 Effects of Covered Activities

This section covers the effects of the anticipated activities covered in this SA to the covered species (above). Where appropriate in our analysis, we make note of which activities are expected to have no effect on a species or CH. This information is provided as helpful technical assistance to those agencies and project proponents who may be unfamiliar with the species and activities and can be incorporated by reference by action agencies when they make a NE determination.

The effects of the action are all consequences to listed species or CH that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

A project's action area must include all areas affected (i.e., modifications to land, air, or water) by the proposed action, and not merely the immediate area involved in the action. If the activities satisfy the two-part test for causation ("but for" and "reasonably certain to occur"), they should be considered as part of the action. To qualify for use of this SA, a project's action area must be wholly encompassed by the coverage area for this SA as described above and all activities within the proposed action must fit within the scope of the SA.

Qualifying actions typically involve one or more of the stressors addressed below. Effects of the action apply to IBAT, NLEB and TCB unless otherwise noted.

5.1 Effects of Noise

Noise and vibration may disrupt normal feeding, sheltering, and breeding activities of IBATs, NLEBs, and TCBs. Many activities that increase noise/vibration above existing background levels may affect the covered bats. Anthropogenic activities constitute a major source of ambient noise on the landscape. For bats that use echolocation to locate prey, the reception of relevant echoes could potentially be impaired by high levels of background noise (Schaub et al. 2008). However, evidence also suggests that bats adjust echolocation call structure to avoid acoustic interference from background noise in their local environment (Schaub et al. 2008, Amichai et al. 2015).

Sources of noise could include any activities that increase noise or vibration above existing background levels. Military training, including existing firing ranges, maneuver areas, field training and bivouac are likely to include periodic sources of noise from personnel actions, as well as routine equipment used to support personnel actions (e.g., generators, vehicles, aircraft) and other military operations. These actions may produce noise levels consistent with other normal human activities found to contribute to existing background levels.

The primary environmental effects of ranges and training areas include loud noises associated with munitions, detonations, training vehicles and UXO. In addition to vehicle traffic, sources of chronic or intense anthropogenic noise that have been found to cause adverse effects in wild terrestrial organisms include compressor stations (Kleist et al. 2018); large concentrations of humans (i.e., crowds; Duarte et al. 2011, p. 840); military training (vehicles, aircraft, and encampments, Gese et al. 1989, p. 338); and low-altitude jet aircraft (Maier et al. 1998, pp. 761-763). Other potential sources of adverse anthropogenic noise include oil and gas extraction, construction, and mining (Jerem and Mathews 2021, entire)**.**

Not all frequencies of sound travel comparable distances or affect bats equally. Ultrasound can interfere with echolocation and habitat use directly within the frequencies that bats can both detect and produce (Sedlock et al. 2021). However, ultrasound attenuates quickly as it moves out from the source. Human audible sound is lower in frequency than the three target species produce and actively use for echolocation and foraging. In studies of compressor stations, Myotids and other small bats did not differentiate between activity noise levels as Brazilian free-tailed bats (*Tadarida brasiliensis*) did (Bunkley et al. 2015). Differentiation between the effects of ultrasonic sound from the ground and surface vibrations of infrasound are considered in the following subsections.

When assessing impacts of noise on IBATs, NLEBs and TCBs as a result of military activities, it's important to consider that there is significant anecdotal data showing that bats are not negatively impacted by noise on military installations at the population level. Surveys conducted prior to the onset of WNS support a high occurrence and abundance of IBATs, NLEBs and TCBs on military installations that experience routine activities that produce noise and vibration. This suggests that individual bats may be exposed to noise and vibration as a result of military activities, but that impacts of noise and vibration as a result of routine activities are not likely to rise to the level of disturbance. The intermittent nature of the sound and the scale of the landscape of military installations results in a smaller potential impact area for bats, reducing the number of individuals that are exposed to activities that produce noise above background levels.

5.1.1 Effects of Noise on Foraging and Drinking Bats

Exposure to intense night-time noise could have adverse effects on bats' ability to use affected areas for foraging by impairing use of echolocation or causing bats to abandon noisy feeding patches. Luo et al. (2015) observed that bats reduced their foraging effort in conditions with traffic noise, even when traffic noise did not overlap with prey echoes. Bats abandoned feeding patches immediately after the start of noise playback, suggesting that they are avoiding the noise itself.

Ambient noise influences the availability and use of acoustic information in animals in many ways. Anthropogenic noise emissions, such as urban and traffic noise, constitute a major source of ambient noise. Noise can obscure relevant acoustic signals to bats (Schaub et al. 2008, p. 3174). For bats that use echolocation to detect prey, the ability to detect the return of echolocation calls could potentially be reduced by high levels of ambient noise (Schaub et al. 2008, P. 3174). Studies suggest that noise from turbulent water could interfere with echo-based prey detection in bats that forage close to water surfaces (Rydell et al. 1999, p. 252; Schaub et al. 2008, p. 3179). Evidence also suggests that bats adjust echolocation call structure to avoid acoustic interference from ambient noise in their local environment (Schaub et al. 2008). Bats can also adjust their frequency, duration, and other attributes of their calls to differentiate echolocation calls from the background noise when necessary (Amichai et al. 2015).

Other sources of night-time noise, like loud music, can have similar and distracting effects on foraging and drinking (Domer et al. 2021, pp. 499-500). Noise can distract bats and when attempting to forage in noisy areas they increase sonar pulses and are less successful in locating and capturing prey (Allen et al. 2021, pp. 4- 5). Noise effects on bat foraging and other behaviors will vary in relation to volume, proximity, and duration of noise. Effects from noise attenuates with distance; for example, two studies found no or insignificant effects of traffic noise to bats when bats were more than 55 - 165 yds (50- 150 m) from the noise source (Bonsen et al. 2015, p. 347, 355).

In an experiment that exposed free-living bats to recorded traffic noise in England, *Myotis* species substantially decreased their activity in experimental areas where they were exposed to the noise (Finch et al. 2020, p. 5). They found no evidence of habituation across the approximately 2 to 3-month duration of the two study periods in 2017 and 2018 (Finch et al. 2020, p. 5). The lesser response to ultrasound compared to noise in the sonic spectrum indicated that the noise acted "through general deterrence and avoidance" as opposed to interfering with echolocation (Finch et al. 2020, p. 5). In Germany, successful foraging bouts decreased "and search time drastically increased" for greater mouse-eared bats (*Myotis myotis*) when exposed to noise intended to simulate conditions 8 yds (7.3 m) from a road (Siemers and Schaub 2011, p. 1650). Like the findings of Finch et al. (2020, entire) for *Myotis* species, Luo et al. (2015, p 3285) found that noise acted as an aversive stimulus and did not mask prey echoes.

Some bats – for example, the piscivorous lesser bulldog bat (*Noctilio albiventris*) – are versatile in their use of different pulse types and apply that versatility when "faced with noisy conditions" (Yantén et al. 2022, p. 6). This species increased feeding in response to traffic noise, presumably due to challenges in detecting and locating prey "under noisy conditions" despite their ability to vary the duration of their echolocation pulses (Yantén et al. 2022, p. 4). Experimental studies done on the insectivorous pallid and greater mouse-eared bats indicate that search time increases, and capture success is reduced when they are exposed to noisy conditions (Siemers and Schaub 2011, p. 1650). Since foraging under noisy conditions may affect bat activity, there are potentially missed foraging opportunities when bats decide to abandon feeding patches due to frequent or chronic noise that interferes with the detection of signals or reduces the chance of detecting threats (Francis and Barber 2013, p 308).

Exposure to intense night-time noise could have adverse effects on NLEB's ability to use affected areas for foraging by impairing perception of sounds made by prey. Gleaning bats like the NLEB "rely on listening for prey rustling sounds to find food (i.e. `passive listening')" (Schaub et al. 2008, p. 3174). In a controlled study, greater mouse-eared bats – another gleaning species – were allowed to forage in silent chambers or those with three different noise treatments. The bats avoided areas exposed to sources of intense noise, including that resembling noise of vehicle traffic (Schaub et al. 2008, p. 3179). The bats also avoided noise whose structure resembled vegetation noise, but at an intensity that may only occur during storms (Schaub et al. 2008, p. 3174). The "click-like" noise used in their study to resemble the noise of rustling vegetation may have impaired the bats' "perception of prey-rustling clicks" (Schaub et al. 2008, p. 3179). NLEBs are "active gleaners" – they glean but use echolocation to detect their prey (Faure et al. 1993). The authors concluded that their results suggested that foraging areas within 55 yds (50 m) of highways and presumably also to other sources of intense broadband noise "are degraded in their suitability as foraging areas for the greater mouse-eared bat" and that the number of vehicles would affect the intensity of the degradation (Schaub et al. 2008, p. 3179).

5.1.2 Effects of Noise on Roosting Bats

Day-time noise produced during construction or implementation phases of actions and more permanently during operational phases could cause IBATs, NLEBs or TCBs to respond adversely. Adverse responses could include increased exposure to predators (Mikula et al. 2016), energy depletion, and physiological stress (Luo et al. 2014). An individual's response to this stressor is dependent on the magnitude of the noise, the proximity of the individual to the source, and an individual's level of habituation to the stressor.

If activities produce noise in very close proximity to a bat roost, day-time noise and vibration could cause bats to flush from tree roosts. Bennett and Braun (2004) found that noise associated with tree cutting, regardless of felling method can cause an IBAT to flush. Callahan (1993) also observed IBAT to abandon a roost tree in response to a bulldozer operating in proximity (Callahan 1993). Clutter-adapted gleaning species, like the NLEB may be more vulnerable to predators if disturbed during the day by noise and/or vibration due to their typically low and slow flight (Mariton et al. 2023, p. 7), though this is expected to be extremely rare.

Exposure to day-time noise while roosting can result in stress that leads to physiological and psychological changes that impact eating habits. Chronic noise, defined as noise over a timescale of multiple days, can impact how bats perceive the level of threat and lower the ability to communicate through acoustic signals. This may result in increased energy expenditures related to anti-predator behavior or vocalization (Song et al. 2020, p 1922). Song et al. (2020, p. 1915) exposed Asian particoloured bats (*Vespertillio sinensis*) to a recording made at a bridge and played back at an intensity intended to mimic exposure roosting in crevices of the bridge. The exposed bats fed and weighed more and had a higher concentration of thyroid hormones (Song et al. 2020, p. 1922). The authors concluded that increased feeding was probably a result of the stress response to the noise and noted that weight gain is an expected result of a physiological stress response.

Several bat species roost in places that are exposed to loud anthropogenic noise. Nearly all bats are most sensitive to frequencies greater than 10 kHz, which is much higher than the frequencies in anthropogenic sounds (Luo et al. 2014, p. 1072). There is experimental evidence that bats can habituate quickly to exposure to "repeated and prolonged noise" when in torpor, but that they become more sensitive to noise as torpor progresses towards night (Luo et al. 2014, p. 1074). The type of noise that they are exposed to can also impact the level of disturbance that bats experience. Luo et al. (2014, p. 1073) observed that traffic noise was less disturbing than colony or vegetation noise for torpid bats. Traffic noise has the most energy below 5 kHz, which falls outside the range where bats have the most hearing sensitivity. Sensitivity to noise frequency range may impact bats reactivity levels to different anthropogenic noises.

Some bat species, like the greater mouse-eared bats, may commonly roost where they are exposed to noise – e.g., in church towers near loud bells and in highway bridges (Schaub et al. 2008, p. 3178). These areas may remain useful for roosting, however, due to the short duration and low frequency of church bell use and by roosting in the structure of bridges where "high frequency components of traffic noise will be strongly attenuated" (Schaub et al. 2008, p. 3178).

5.2 Effects of Artificial Lighting

Artificial lighting at night varies by location, with light pollution tending to be highest in urban areas and lower in rural areas. Natural environments under a full moon have an illuminance of approximately 0.1 to 0.3 lux (Falchi et al. 2011, p. 2716). In contrast, artificial light from a typical shopping center can reach 20-30 lux - about 200 times brighter than a full moon (Falchi et al. 2011, p. 2716). Artificial lighting attracts and repels animals in taxon-specific ways and can alter physiological processes. As nocturnal species, bats are among the most affected.

DODW has specific UFCs that prescribe artificial lighting conditions. Military training areas are to receive no ambient lighting (Lighting Zone 0). Temporary lighting for bivouac and lighting surrounding nighttime range and personnel facilities may illuminate areas to the low ambient lighting condition (Lighting Zone 1). The highest illumination occurs at certain wharf and pier areas, aircraft hangers, air operations and headquarters, line shacks, terminal facilities, airfield utility service areas, and entry and access control facilities and points as a moderately high ambient lighting (Lighting Zone 3). All other urbanized portions of the installations fall under a moderate ambient lighting zone (Lighting Zone 2) or lower. Within Lighting Zone 2 as elsewhere on the installation, measures are generally taken to minimize light pollution and reflectance due to dark sky training needs, operational security, and energy cost reductions (DoD 2023a p.100). Additionally, light emissions must be limited where they interfere with pilot vision in runway clear zones per UFC 3-260-01. Luminaries are to be rated U0 in this zone and not exceed a glare rating of G2 (DoD 2023a p.105, 2023b, 2026).

Lighting can impose both costs and benefits to individual bats, making the net impact difficult to estimate. Avoidance of artificially lit areas may result in increased energy expenditure and reduced foraging opportunities (Stone et al. 2012, p.2464). Bats may react to changes in the amount of light due to predation risk, changes in spatial orientation abilities, or prey availability in the area (Polak et al. 2011, p. 25). Artificial lighting can disrupt established flight routes and delay commuting behavior (Stone et al. 2009, p. 1125). Open-air flying species have been observed to emerge and start to feed as insect abundance starts to decline, suggesting that factors other than insect abundance, such as prevailing light level, are impacting foraging behavior (Rydell et al. 1996, p. 249). Exposure to visual predators (e.g., owls) may be greater when light levels at night are higher (Rydell et al. 1996, p. 249). In response, bats may fly faster when light levels are higher to reduce risk of capture (Polak et al. 2011, p. 25).

Projects that incorporate certain conservation measures that will limit the ‘spill’ of light into habitat suitable for the IBAT, NLEB and TCB will qualify for predetermined NLAA determinations in the key. Studies have suggested that tree cover can mitigate the impacts of artificial light at night. In England, *Myotis* species remained active near lit areas as long as the experimental light treatments were blocked by a hedge, “indicating that good management of light spill, can mitigate disturbance to” these bats (Zeale et al. 2018, p. 5915). Straka et al. (2019, p. 8) observed that bat activity was higher in areas with tree cover when artificial light was present.

<u>IBAT and NLEB</u>

Bat species such as IBAT and NLEB that fly late at night, forage in narrow spaces, and that are adapted for “flight within cluttered vegetation” are consistently found to avoid or reduce activity in artificially lit areas (Threlfall et al. 2013; Pauwels et al. 2019, p. 1; Voigt et al. 2021). In Indiana, IBATs avoided foraging in urban areas and Sparks et al. (2005) suggested that it may have been in part due to high light levels. Using captive bats, Alsheimer (2011) also found that the IBAT conspecific little brown bat (*M. lucifugus*) was more active in the dark than light. Artificial light can delay onset of nightly activity in bat species that are active mostly during the darkest hours (Mariton et al. 2022; 2023).

Numerous studies involving bat species like the IBAT and NLEB suggest that artificial light could reduce the suitability of an area for foraging and cause them to avoid lit areas. Studies in Europe indicated that activity of Myotis species declined when artificial lighting was present (Kuijper et al. 2008, p. 37; Stone et al. 2012, p. 2458; Lacoeuilhe et al. 2014, p. 3; Azam et al. 2015, p. 4336-4337; Zeale et al. 2018, p. 5912; Russo et al. 2019, p. 1671). Some research suggests that IBAT and little brown bats avoid lit areas (Sparks et al., 2005, Alsheimer 2011). In North Carolina, NLEBs were never recorded at sites with bright artificial light at night (Li et al. 2024, p. 9). In Connecticut, lighting negatively affected little brown bat activity and decreased their use of a lit wetland for foraging. Azam et al. (2018, p. 130) actually detected streetlight avoidance at values below 1 lux by *Myotis* species and Serotine bat (*Eptesicus serotinus*) at 50 m from a streetlight (Azam et al. 2018, p. 123). They did not detect avoidance at 110 yds (100 m).

<u>TCB</u>

Streetlights can have a positive impact on the feeding abilities of some bat species by concentrating insects in a small space (Acharya and Fenton 1999, p. 32; Jones and Rydell 2003, p. 331). The responses of bats to lighting are species-specific and can be influenced by flight morphology and type of flight (Rydell 1992, p. 744; Rowse et al. 2016, p. 187). Fast-flying aerial hawking species, similar to TCB, have been observed feeding around streetlights suggesting light-tolerance. Bats have routinely been observed feeding near lights (Acharya and Fenton 1999, p. 1999; Rowse et al. 2016, p. 196). However, Li et al. (2024, p. 6) observed that TCB foraging activity was approximately four times higher at sites without artificial night lighting than at sites with artificial light at night, suggesting that TCBs show higher activity levels in dark areas.

TCBs emerge early in the evening and feed in relatively open habitats, foraging at treetop level or above (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116, Jones and Rydell 1994, p. 452), but may forage closer to ground later in the evening (Mumford and Whitaker 1982, p. 170). Artificial lighting may result in changes in the use of established flight routes and delaying commuting behavior (Stone et al. 2009, p. 1125). Although artificial lighting may provide an opportunity to forage in areas of concentrated insect activity, it may also delay the timing of emergence for open-air flying species like TCB. Studies suggest that open-air flying species do not time evening emergence with the peak of insect activity, instead they emerge later in the evening while insect abundance is declining, and light levels are lower (Rowse et al. 2016, p. 206). As a result, TCBs exposed to artificial light at night may not meet their energy requirements leading to a potential reduction in fitness (Rowse et al. 2016, p. 206). Foraging accounts for the largest proportion of energy use for pregnant and lactating bats and these energy requirements may account for the low proportion of energy spent on tissue production and milk production compared to small terrestrial mammals (Kurta et al. 1989, p. 816). As a result, if artificial lighting creates a mismatch between emergence and peak insect abundance, impacts may be highest to pregnant or lactating females who have increased energetic demands (Cravens and Boyles 2019, p. 70). For soprano pipistrelles, artificial lighting was found to delay roost emergence, but also to provide foraging locations (Hale et al. 2015, p. 2468).

5.3 Loss and Degradation of Aquatic Resources

IBATs, NLEBs and TCBs may be affected by a reduction in stream length over which they forage and by a reduction in habitat available for aquatic insects. Water quality degradation because of increased sedimentation could reduce the densities of aquatic insects that bats consume. As a result, bats may have to fly farther to access foraging resources. Actions that will directly impact streams likely require a permit or authorization from the U.S. Army Corps of Engineers conditioned with Best Management Practices (BMPs) to minimize sedimentation onsite and downstream. Projects on military lands that may cause erosion and sedimentation away from direct surface water inputs often still require Stormwater Pollution Prevention Plans (SWPPPs) developed specifically to the project. We expect the effects of sedimentation of aquatic resources to be minimized by BMP and SWPPP implementation.

Drinking water is known to be important for other *Myotis* bats and IBATs, NLEBs and TCBs likely drink routinely from surface water sources (Adams and Hayes 2008, Geluso et al. 2018). Although NLEBs may prey primarily on terrestrial insects, they do sometimes prey on aquatic insects (Broders et al. 2014). IBATs will roost in riparian, bottomland, or upland forest (USFWS 2007) and their diet consists of a variety of aquatic insects, making water quality important to food resources. TCBs forage most commonly over waterways and forest edges (Barbour and Davis 1969, p. 116) and consume aquatic insects including caddisflies (Trichoptera; Whitaker 1972, p. 879; LaVal and LaVal 1980, p. 24; Griffith and Gates 1985, p. 453; Hanttula and Valdez 2021, p. 132). Bats can become sick from drinking polluted waters and from bioaccumulation of contaminants in insect prey.

5.4 Effects of Tree Cutting, Loss of Roost Trees

For the purposes of this Dkey, tree removal is defined as tree cutting or other means of knocking down or bringing down trees, tree topping, tree limbing, pruning, or tree trimming, whether the purpose of the activity or incidental to the purpose of the activity. When discussing topping, limbing, trimming, or maintenance, these actions refer to tree disturbance leaving at least a major portion of the trunk and tree remaining. These actions often take place in an urbanized environment or along rights of way (trails, utilities, fence lines, and rarely line-of-sight).

5.4.1 Roost Tree Identification

IBAT

IBATs roost in live trees and snags ≥ 5 inches DBH (12.7 cm) that have exfoliating bark, cracks, crevices, and/or hollows. A typical IBAT primary roost is located under the exfoliating bark of a dead ash (*Fraxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), maple (*Acer* spp.), oak (*Quercus* spp.), or poplar (*Populus* spp.), although any tree that retains large, thick slabs of peeling bark is potentially suitable. Primary roosts are usually located in trees that are in early-to-mid stages of decay. While smaller trees (< 5 inches DBH) with exfoliating bark, cracks, crevices, and/or hollows may have some potential to be male IBAT summer roosting habitat, the FWS does not consider early successional, same-aged stands of trees < 5 inches DBH to be suitable roosting habitat. Suitable roosting habitat is defined as forest patches with trees of 5-inch DBH or larger interspersed with non-forested habitats (e.g., emergent wetlands and agricultural fields, old fields, pastures) and linear features such as hedgerows, riparian forests, and other wooded corridors, while early successional habitat with small diameter trees between 3-5 inches DBH may serve as foraging habitat. Individual trees may be considered suitable roosting habitat when they exhibit characteristics of suitable roost trees and are within 1,000 ft (305 m) of forest.

IBATs exhibit a degree of inter-annual fidelity to particular roost trees and/or maternity areas (Humphrey et al. 1977, Gardner et al. 1991a, Gardner et al. 1991b, Gardner et al. 1996, Callahan et al. 1997). Maternity colonies use a minimum of 8–25 roost trees per season, centered around one to three primary roosts (Callahan 1993, Callahan et al. 1997, Kurta et al. 2002). Use of alternate roosts may be a way of discovering new primary roosts since IBATs must maintain an awareness of suitable replacements of their ephemeral roosts (Kurta et al. 1996, Kurta et al. 2002). Colonies are larger earlier in the season and break up over time with smaller exit counts later in the summer (Barclay and Kurta 2007). Colony dynamics are complex, and the importance of alternate roost trees is not well understood (Silvis et al. 2014).

NLEB

NLEBs roost in live trees and snags ≥3 inches DBH that have exfoliating bark, cracks, crevices, and/or cavities; however, maternity roost trees are typically larger (≥ 9 in DBH). NLEBs roost singly or in maternity colonies underneath bark or more often in cavities or crevices of both live trees and snags (Sasse and Pekins 1996, p. 95; Foster and Kurta 1999, p. 662; Owen et al. 2002, p. 2; Carter and Feldhamer 2005, p. 262; Perry and Thill 2007b, p. 222; Timpone et al. 2010, p. 119; Silvis et al. 2015, p. 758). Roosting habitat is typically within the forest interior and at times near edge habitat. NLEBs select roosts to optimize thermal conditions and so preferences for tree species and roost characteristics (e.g., live versus dead; canopy position and solar exposure) vary with difference in ambient temperatures based on weather and climate (Patriquin et al. 2016, p. 53). Individual trees may be considered suitable roosting habitat when they exhibit characteristics of suitable roost trees and are within 1,000 ft (305 m) of forest.

NLEBs are flexible in tree species selection and while they may select for certain tree species regionally, likely are not dependent on certain species for roosts throughout their range; rather, many tree species that form suitable cavities or retain bark will be used by the bats opportunistically (Foster and Kurta 1999, p. 668; Silvis et al. 2016, p. 12; Hyzy 2020, p. 62). Carter and Feldhamer (2005, p. 265) hypothesized that structural complexity of habitat or available roosting resources are more important factors than the actual tree species. Further, Silvis et al. (2012, p. 7) found forest successional patterns, stand and tree structure to be more crucial than tree species in creating and maintaining suitable long-term roosting opportunities. While NLEBs use trees over multiple years, Silvis et al (2015) demonstrated that even with loss of roost trees during the winter season, the colony of NLEBs remained in the same roosting area as before. This provided strong evidence of the colonies' ability to adapt to roost tree removal.

TCB

TCBs predominantly roost in the foliage of deciduous hardwood trees. TCBs roost singly or in small groupings. Roosts are often in clusters of live and dead foliage of live and recently dead trees or broken branches that retain dead leaves. Single dead oak leaves may also serve as roosting sites for lone males (Perry and Thill 2007b, p. 977). Live-leaf roosts are typically dense in structure but occasionally exhibit only a few leaves serving as shelter (Veilleux et al. 2003, p. 1071). Other important roost substrates include Spanish moss (*Tillandsia usneoides*) and beard lichen (*Usnea trichodea*) (Jennings 1958, p. 23; Davis and Mumford 1962, p. 395; Menzel et al. 1999, p. 191; Shute et al. 2021b, p. 467; Poissant 2009, p. 36; Poissant et al. 2010, p. 374; Quinn and Broders 2007, p. 7). Occasional summer roosts include clusters of dead pine needles of large live pines (*Pinus echinata*), live branches of Norway spruce (*Picea abies*), abandoned gray squirrel (*Sciurus carolinensis*) nests, and under the pealing bark of live birch trees (*Betula* *spp.*) (Veilleux et al. 2003, p. 1071; Perry and Thill 2007b, p. 977; Wisconsin DNR 2016, p. unpaginated; Wisconsin DNR 2017a, p. 6; Wisconsin DNR 2017b, p. unpaginated; Wisconsin DNR 2018, p. 8).

TCBs roost in a variety of tree species, especially oaks (*Quercus* spp.), and often select roosts in tall, large diameter trees, but will roost in smaller diameter trees when foliage is present (e.g., 4-in [10-cm]; Leput 2004, p. 32). TCBs commonly roost in the mid to upper canopy of trees although males will occasionally roost in dead leaves at lower heights (e.g., < 5.4 yds (5 m) from the ground; Perry and Thill 2007b, p. 979) and females will occasionally roost in Spanish moss of understory trees (Menzel et al. 1999 p. 191). TCBs may roost and forage in forested areas near anthropogenic structures and buildings (e.g., suburban neighborhoods, parks, etc.) (Helms 2010, p. 11; Shute et al. 2021a, p. 973). Highly developed urbanized areas generally devoid of native vegetation (including isolated trees surrounded by expansive anthropogenic development), however, are considered unsuitable habitat (e.g., parking lots, industrial buildings, shopping centers).

TCBs exploit a diversity of forest types, and roost sites have been located in mixed pine-hardwood stands in southwestern Nova Scotia (Quinn and Broders 2007, pp. 19–24; Poissant et al. 2010, p. 374); upland hardwood, riparian hardwood, and bottomland hardwood forests in west-central Indiana (Veilleux et al. 2003, pp. 1071–1073); fragmented woodlots in central Indiana (Helms 2010, pp. 4–5); hardwood-dominated forests in Kentucky and Tennessee (Schaefer 2017, pp. 40–48; Thames 2020, pp. 32–34; Zirkle 2022, pp. 18–20); hardwood-dominated and mixed pine-hardwood forests in Arkansas (Perry and Thill 2007b, pp. 976–978); upland hardwood and cove hardwood forests in southwestern North Carolina (O'Keefe et al. 2009, pp. 1760–1761); upland cove hardwood, pine-hardwood, and pine-dominated forests in western South Carolina (Leput 2004, p. 28); bottomland hardwood in west-central South Carolina (Carter et al. 1999, p. 5); mixed oak-pine stands and oak stands along the Georgia coast (Menzel et al. 1999, pp. 187–192); and mixed pine–hardwood forests, maritime forest, and bottomland forest in the southern coastal plain of South Carolina (Shute et al. 2021b, pp. 467–470).

Female TCBs exhibit site fidelity to summer roosting areas, returning year after year to the same locations (Allen 1921, p. 54; Veilleux and Veilleux 2004a, pp. 197-198; Poissant 2009, p. 57; Whitaker et al. 2014, pp. 51-52). Given TCB primarily roost in leaves, TCB roosts are considered a common (non-limiting) resource in forested landscapes and highly ephemeral. Silvis et al. (2016, p. 38) stated, "virtually nothing is known about the effects of roost loss on TCBs," but concluded that effects of roost loss would "limited, given their preference for an abundant and highly ephemeral roosting resource (i.e., foliage that lasts for days to weeks rather than years)." TCBs switch roost trees regularly (Veilleux et al. 2003, pp. 10972-1073; O'Keefe et al. 2009, p. 1760; Poissant 2009, pp. 56-58) and are likely well-adapted to shifting roosts when their current roosts are no longer suitable (e.g., leaves fall off trees during wind/storm events). In forest-dominant landscapes, individuals will not have to expend a significant amount of energy to locate new roosts if their current roosts are lost. In areas where forest is more limited, however, we are less certain of potential effects to TCBs from the removal of suitable roost trees.

5.4.2 Avoiding Effects of Roost Removal in Occupied Habitat during the Active Season

5.4.2.1 Summer Season

NLEB

Because NLEBs typically roost in cavities, cracks, or under bark, removing an occupied roost tree may harm or kill adult and flightless young that may not be able to safely exit the roost. -Risk of injury or death from being crushed when a tree is felled is most likely to impact non-volant pups but may also impact adults if they are not able to flush from affected trees successfully. The risk is greater to adults during cooler weather when bats periodically enter torpor and may be unable to arouse quickly enough to respond. In addition, this may increase the risk of predation if bats are flushing from roosts during the day. Removal of occupied roosts when flightless young are present (i.e., pup season) may result in direct injury or mortality. Pups that are not capable of flight cannot independently flush from a falling tree.

In summer use areas, time of year restrictions are applied during the summer occupancy season to avoid direct effects to NLEBs. Suitable roost trees will not be cut during the summer use activity period when adult bats and/or flightless young are present unless site-specific information (e.g., survey) demonstrates probable absence from the Action Area. This period is longer than TCB restrictions, which are focused on the pup season, because NLEBs may take more time to exit tree roosts in response to stimuli given their roosting ecology (i.e., propensity to form larger colonies, remain in colonies longer, and roost in tree cracks/crevices). IBATs and NLEBs may also enter into short periods of torpor during the active season if temperatures are below 40 degrees F (4.4 degrees C), which can slow reaction times. Ultimately, the chance that NLEBs may be adversely affected by tree removal activities outside the summer occupancy activity period (or winter torpor in Zone 1) is discountable since individuals are more likely to roost singly or in smaller groups during this time, and the dispersed nature greatly reduces the risk. When NLEBs are roosting individually or in smaller groups, it is easier for bats to flush when disturbed. In addition, NLEBs have many roosts within proximity of each other that are used by their colony, increasing their ability to switch roosts when disturbed.

TCB

To avoid direct effects to TCBs from suitable roost tree cutting, suitable roost trees will not be cut during timeframes when flightless young are present (i.e., pup season), during spring staging and fall swarming near hibernacula, and when TCBs are in torpor when temperatures are below 40 degrees F (4.4 degrees C) in areas where TCBs do not hibernate. Within 3.0 mi (4.8 km) of known TCB hibernacula, TOYR when cutting will include the pup season, spring staging, and fall swarming. Spring staging and fall swarming are added to the time of year restrictions in these areas because bats are concentrated in the areas around known hibernacula and temperatures at these times of year are more likely to be below 40 degrees F (4.4 degrees C), where bats may go into torpor. If trees are cut when bats are in torpor, they are less likely to arouse in time to safely exit their roost location. In addition to avoiding direct effects to TCBs from suitable roost tree cutting, potential indirect effects will be avoided by limiting the amount of habitat removed.

We expect TCBs capable of flight to flush from roosts when physically disturbed. For example, while monitoring a maternity colony with a spotting scope, Veilleux (2022, pers. comm.) observed TCBs flush from their roost when disturbed by strong winds. Strong thunderstorms arrived in late afternoon (at least two hours prior to the time TCBs would typically be emerging for their nightly foraging). The wind "violently" shook the leaf cluster, with the leaf cluster "crashing" into neighboring branches and consequently, TCBs flushed from the roost. Arguably, the wind from the thunderstorm simulated what we might expect to happen when a tree is felled (e.g., shaking the leaf cluster) and in this case, the bats responded by flushing and presumably found alternative cover because they returned to the same leaf cluster the following day. Ultimately, the chance that TCBs may be adversely affected by tree removal activities outside the pup season activity period (or winter torpor in Zone 1) is discountable since TCB individuals that are capable of flight are expected to be able to flush when disturbed and switch roosts regularly.

While adult TCBs are capable of flushing during tree cutting, removal of occupied roosts when flightless young are present (i.e., pup season) may result in direct injury or mortality. Young that are not capable of flight cannot independently flush from a falling tree. Female TCBs typically have two pups and during the first few nights after birth females carry pups (Lane 1946, p. 60). When disturbed, adult females will “carry much larger young” (Lane 1946, p. 60). Although mothers can carry/move young, pups may ultimately become too heavy to move as they grow, especially in the haste of escaping a falling roost tree. To avoid direct effects to TCBs, suitable roost trees will not be cut when flightless young are present unless site-specific information (e.g., survey) demonstrates probable absence from the Action Area.

5.4.2.2 Spring Staging and Fall Swarming

The habitat surrounding hibernacula may be one of the most important habitats in the bat annual cycle. Within the hibernating portion of the range (Figure 4.), bats spend the winter season hibernating in caves, then emerge in the spring to migrate back to their summer roosts in trees. This habitat must support the foraging and roosting needs of large numbers of bats during the fall swarming period. At the time of emergence, bats will have their lowest fat reserves and will be concentrated in trees near hibernacula while they forage in preparation for spring migration (i.e., spring staging). In the fall, there is a period of increased activity (including mating) near hibernacula prior to hibernation, and like spring staging, NLEBs and TCBs will be concentrated in trees near hibernacula (i.e., fall swarming). After arriving at a given hibernaculum, many bats build up fat reserves (Hall 1962), making local foraging conditions a primary concern. Migratory bats may pass through areas surrounding hibernacula, apparently to facilitate breeding and other social functions (i.e., bats that utilize the area for swarming may not hibernate at the site) (Barbour and Davis 1969, Cope and Humphrey 1977). Juvenile bats should be newly volant at this time. However, novice bats and some adult individuals may not be capable of quickly abandoning the roost which could result in injury or death to individuals. More experienced fliers are better able to quickly abandon a roost, however, this forced abandonment means IBATs will need to immediately find alternate roosts.

Modifications of the surface habitat around the hibernacula can impact the integrity, and in turn the microclimate, of the hibernacula. Areas surrounding hibernacula also provide important summer habitat for male IBAT that do not migrate, which is thought to be a large proportion of the male population. Loss or degradation of habitat within this area has the potential to impact a large proportion of the bats using the hibernacula. This is particularly true for hibernacula supporting large numbers of bats, or areas that support multiple hibernacula that together support large numbers of bats. For example, four caves located in eastern Crawford County and western Harrison County in southern Indiana, within approximately 10 mi (16 km) of each other, harbored 128,000 IBATs during the 2005 hibernacula survey; this was 28 percent of the total range-wide population.” Also, in 2013, one site in north Missouri harbored 123,000 IBATs (this is 25 percent of the total range-wide population) (USFWS unpublished data). The area of bat use around this site likely extends beyond that of other hibernacula that house a few hundred or a thousand individuals.

To avoid direct effects to, NLEBs and TCBs, in addition to avoiding tree cutting during the summer occupancy season for NLEBs and pup season for TCBs, suitable roost trees will not be cut during spring staging and fall swarming within 5.0 mi (8 km) of hibernacula entrances for NLEBs and within 3.0 mi (4.8

km) of hibernacula entrances for TCB. Spring staging and fall swarming are added to the time of year restrictions in these areas because bats are concentrated in the areas around known hibernacula and temperatures at these times of year are more likely to be below 40 degrees F (4.4 degrees C), where bats may go into torpor. If trees are cut when bats are in torpor, they are less likely to arouse in time to safely exit their roost location.

5.4.2.3 Bats in Winter Torpor

NLEBs and TCBs in the southern portion of the range exhibit shorter torpor bouts and remain active and feed year-round. During the winter in the year-round active portion of the range, NLEBs and TCBs have been observed to be active and roosting in trees year-round. In addition to roosting in trees, NLEBs and TCBs have been observed roosting in culverts (most often) and bridges (less common). TCBs will also roost in cavities in live trees, live and dead leaf clusters, Spanish moss, and/or culverts (Sandel et al. 2001, pp. 174–176; Newman et al. 2021, pp. 1335–1336). IBATs have not been observed to be active and roosting in trees year-round in any portion of their range, therefore, IBAT is not discussed in this section.

To avoid effects to NLEBs and TCBs in torpor and roosting in trees during cold winter temperatures, in addition to avoiding tree cutting during the summer occupancy and pup season, respectively, suitable roost trees will not be cut during winter torpor (December 15 and February 15) within Zone 1 of the year-round active range. This additional TOYR does not apply in Zone 2 of the year-round active range because the time periods when winter temperatures drop below 40 degrees F (4.4 degrees C) are likely to be limited and brief. As a result, the tree cutting TOYR for Zone 2 are limited to the summer occupancy period for NLEBs and the pup season for TCBs, which are the most vulnerable timeframes. We recognize NLEBs and TCBs use torpor at other times of the year, especially during cooler spring and fall weather; consequently, protections are in place to avoid effects to TCBs during spring staging and fall swarming.

5.4.3 Avoiding Indirect Effects from Tree Cutting and Roost Removal

Bats will shift roosting and foraging areas over time in direct response to habitat loss (Whitaker et al. 2004, pp. 157–159). Effects of roost tree removal to NLEBs and TCBs will likely vary depending on the amount of removal and remaining alternative roosts for bats to shift. We must consider whether and to what degree the anticipated habitat alteration will alter the quantity and character of roosting habitat available to NLEBs and/or TCBs within their home range. If suitable roost trees become limiting after loss of roosting habitat, adverse fitness consequences are possible (e.g., increased energetic costs caused by longer flights between roosting and foraging areas). Consequently, potential impacts would likely be reduced if an adequate extent of suitable roost habitat is maintained within the traditional maternity colony's home range (i.e., roost trees used before the habitat loss occurs), particularly in forest-limited areas where there is less habitat for colonies to shift. Adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat (USFWS 2021, USFWS 2022).

Tree cutting in areas where IBAT may be present that includes suitable roost trees for IBAT is not currently covered by the Dkey. To determine whether forest loss within NLEB and TCB home range areas affect individual bat fitness, we elicited expert opinion from a multidisciplinary team of experts following widely accepted best practices in planning, preparing, eliciting, and synthesizing expert judgments (Szymanski and Gilbert 2023, entire). Expert input was elicited using facilitated discussion and asking experts to first provide their lowest and highest reasonable estimates for the variable in question, followed by their level of confidence that the true value of the variable falls within their stated range (lowest to highest values), and lastly, the most likely (best) estimate.

Specifically, experts were asked what percentage of forest in a NLEB or TCB colony home range area can be removed without negative impacts occurring to an individual bat when assuming a landscape and home range with varying amounts of forest cover (e.g., 5, 15, 25, 35, 50, and 75 percent forest cover). A negative impact was defined as impaired fitness of an individual NLEB or TCB (experts were told negative impacts do not need to rise to the level of direct mortality). Fitness impairments could include: 1) using roosts that do not provide thermal conditions conducive to energy conservation by adults or young affecting, for example, the ability of lactating females to maximize milk production; or 2) increasing energetic costs caused by longer flights between roosting and foraging areas due to fragmentation of remaining forest patches. Forest removal refers to cutting trees suitable for roosting followed by replacement with non-forest land cover types (experts were told to assume the forest removal was permanent). Finally, experts were told to assume direct impacts (e.g., injury or death) would be avoided by avoiding suitable roost tree removal during the summer occupancy season for NLEB and during the pup season for TCB. We assumed TCBs capable of flight will avoid direct impacts by flushing from trees before being killed or injured. Pups will not be capable of flight during the pup season. For both NLEBs and TCBs, tree removal should be avoided during spring staging/fall swarming periods near hibernacula, and when NLEBs or TCBs are exhibiting prolonged torpor due to cold temperatures in Zone 1 of the year-round active portion of the range.

As expected, there was a clear positive relationship between the amount of forest loss that can occur without fitness consequences and the amount of forest within a hypothetical NLEB or TCB home range (Figure 4).

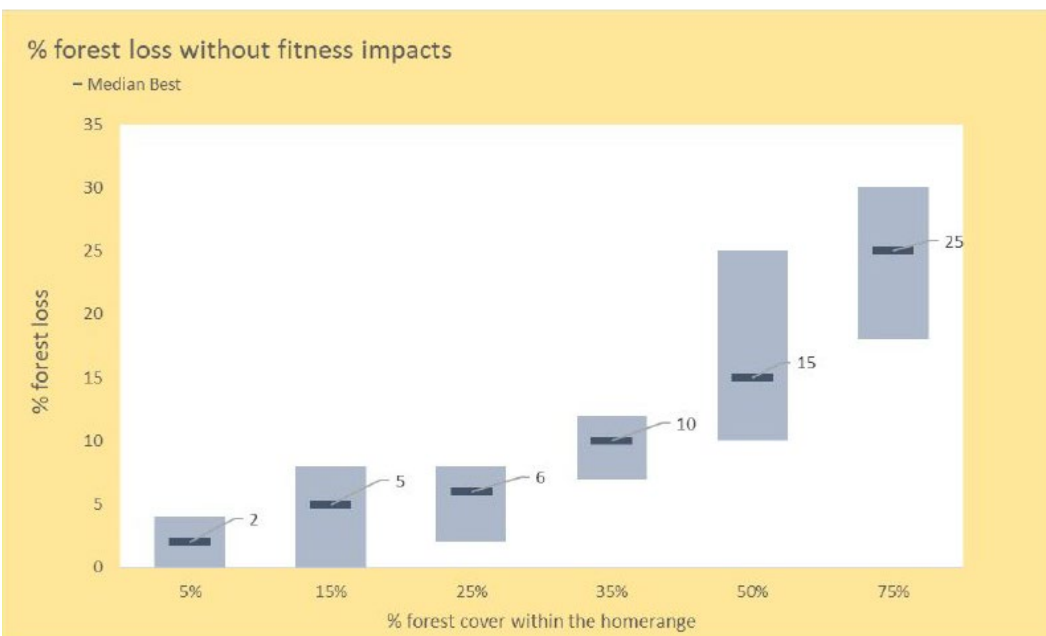

Figure 4. Median estimates of forest loss that can occur without negative impacts incurred. Box represents median lowest (bottom of box), median best (dash line), and median highest (top of box) estimates. X-axis represents the percent forest cover within the hypothetical TCB home range (source: Figure 2, Szymanski and Gilbert 2023).

Based on the expert's median best estimates of forest loss[3] and our knowledge of the home range size for NLEBs and TCBs, to avoid effects to INLEBs and/or TCBs, forest removal will not exceed the following number of acres in each of 2 forest density categories. As described above, we assumed a 4,524-ac (1,831 ha) home range for the, NLEB and TCB. Forest cover was measured as the average forest cover within 5x5 km grid cells (National Land Cover Database, Dewitz 2019, entire). Projects will be eligible for a predetermined consultation outcome of NLAA for NLEB or TCB if the tree cutting occurs outside the time of year restrictions and acreages are less than or equal to the maximum acreages for the parameters specified. For installations greater than 10,000 acres that fall within the 30-100 percent forest density areas, installations can work within a project footprint of 200 acres for timber management projects that occur in areas with greater than 30% forest canopy, and will preserve at least 60% of the canopy cover throughout the forest stand, or cut up to 100 acres for projects that do not meet the criteria for forest management.

For installations greater than 10,000 acres that also fall within the 30-100 percent forest density areas, in acres with greater than 30% canopy cover, installations can work within a project footprint of 200 acres for timber management projects that will preserve at least 60% of the canopy cover throughout the forest stand, or cut up to 100 acres for projects that do not meet the criteria for forest management.

For installations greater than 10,000 acres that also fall within the 30-100 percent forest density areas, in areas with less than 30% canopy cover, installations can work within a project footprint of 50 acres for timber management projects that will preserve at least 60% of the canopy cover throughout the forest stand, or cut up to 25 acres for projects that do not meet the criteria for forest management.

The next set of criteria apply to installations that are greater than 10,000 acres but fall within the 0-30 percent forest density category, or installations that are less than 10,000 acres in either forest density category. Installations in areas with greater than 30% canopy cover can work within a project footprint of 80 acres for timber management projects that will preserve at least 60% of the canopy cover throughout the forest stand or cut up to 40 acres for projects that do not meet the criteria for forest management. Installations in areas with less than 30% canopy cover can work within a project footprint of 20 acres for timber management projects that will preserve at least 60% of the canopy cover throughout the forest stand, or cut up to 10 acres for projects that do not meet the criteria for forest management.

The acreage limit for general tree cutting for the DODW Dkey is consistent with the acreages used for the NLEB and TCB Rangewide Dkey. These acreages assume a worst-case scenario of removal of all trees within the specified acreage. In addition, projects using the Rangewide Dkey are individual projects that may be implemented by different project proponents, so larger habitat context is not assessed within the Dkey.

For the DODW Dkey, we implemented additional parameters to assess the context of the forest habitat proposed to be removed, including the overall size of the installation, forest density category of the area to be cut, and percent canopy cover of the area to be cut. DODW implements forest management on installations to support military training, timber production and health, and wildlife habitat creation or

[3] Experts were asked the same forest loss question for NLEB; consequently, the expert's median best estimates were slightly lower for NLEB. For the combined NLEB/TCB Rangewide Dkey, we relied on the input for NLEB (i.e., the more conservative estimates) and applied the results for both NLEB and TCB tree removal thresholds. The DODW Dkey uses the same approach as the Rangewide Dkey for consistency.

enhancement. As part of forest management that retains at least 60% of the canopy cover throughout the forest stand, projects can remove trees within a project footprint that is twice the size of the project footprint allowed for non-timber management projects. If a non-timber management project is allowed to remove 100 percent of the canopy cover within a 100-acre parcel, then removal of less than 40 percent of the canopy cover in an area twice the acreage (200 acres) is expected to remove less of the forest than is allowable for general tree cutting. This logic is applied to all tree cutting acreages, with the acreage applied for each set of parameters determined based on a worst-case scenario of clear cutting all trees within the acreage footprint, then acreage is doubled under the assumption that timber management projects will retain at least 60% of the canopy cover throughout the forest stand. Projects that are required to retain at least 60% of the canopy cover throughout the forest stand will result in the removal of fewer board feet than will be removed during clear-cutting projects, despite the larger project footprint allowed as part of the DODW key.

These thresholds also apply within 5 mi (8 km) of known hibernacula in the hibernating range for NLEB and within 3 mi (4.8 km) of known TCB hibernacula during the active season. In addition, qualifying actions will not remove trees within 0.25-mi (400 m) of known NLEB or TCB hibernacula. Some trees used in the fall by swarming bats may be removed while they are unoccupied. The limited studies on roosting habitats of NLEBs in fall have shown that roost switching occurs every two to three days (Kiser and Elliot 1996; Gumbert et al. 2002). The conservation measures limit the number of potential roost trees that may be removed, making it unlikely that any action would remove a significant portion of trees used during fall swarming. In addition, NLEBs will also roost in the hibernacula during spring staging and fall swarming.

5.4.4 Avoiding Effects from Tree Trimming, Limbing and Cutting within a Currently Maintained Utility Corridor

Currently maintained utility or road ROW corridors are defined as a strip of land of varying widths that may contain any utility provider lines, systems, infrastructure or other facilities. Utility distribution structures could be composed of underground pipelines or utility lines, above-ground transmission towers and utility lines, or other structures associated with the distribution of utilities. Potentially unique to DODW, line of sight to targets also are considered ROW, and fence lines and boundary markings useful for both security (perimeter) and safety (range limits) are also maintained in this manner. The area within the utility ROW that we are considering for the purposes of this SA is the portion of the ROW that is routinely maintained, through mowing, herbicide, brush and shrub removal to be a relatively open area with low vegetation. Maintained utility ROW corridors generally have very little woody vegetation within the maintained corridor but may have an established edge where the open habitat transitions to trees.

In some cases, the legal ROW or easement extends into forested areas, but for the purposes of this SA, we are considering the maintained utility ROW to end at the forested edge. Maintained utility corridors can range from 50–200 ft (15-61 m) depending on the size of the pipeline, utility pole or tower infrastructure. Many rights-of-way contain more than one underground pipeline or utility and can be wider depending on the number of infrastructure assets located within the maintained corridor.

For NLEBs, the TOYR applied to tree cutting, trimming and limbing within a maintained utility ROW corridor allows additional cutting due to unique aspects of NLEB biology associated with the forest habitat located along established edges of maintained utility corridors. NLEB is a forest-interior species (Caceres and Pybus 1997). Roosting and foraging habitat are typically within closed intact forest stands

(Sasse and Pekins 1996; Foster and Kurta 1999; Lacki and Schwierjohann 2001; Owen et al. 2002). When available, NLEBs will use narrow lines of trees to move between forest patches to avoid crossing open fields and may "rarely venture more than a few meters from forest" (White et al. 2017, p. 8). Maintained utility ROWs often mimic open fields due to the removal of trees and shrubs and consistent maintenance performed to create an early successional habitat. As a result, NLEB individuals are unlikely to be found roosting within trees on the edges of routinely maintained utility ROW corridors as long as tree trimming, limbing or cutting is limited to trees within the established footprint of the ROW, with no tree cutting conducted to expand the established footprint. In the rare chance that a NLEB may be roosting in a tree along the edge of an established ROW, the implementation of a TOYR to avoid tree cutting, limbing or trimming during the pup season would provide an opportunity for volant NLEBs to rouse and flush from the tree before cutting.

For ROW corridors to be considered eligible for a predetermined outcome of NLAA in the Dkey, they must include a field or forested edge with a canopy gap overhead of greater than 30 ft (9 m) between tree canopies. Utility or road ROWs with a canopy gap of less than 30 ft exhibit conditions similar to forest-interior habitats where NLEBs may be present and roosting in the trees along the edge of the ROW. Utility or road ROWs with a canopy gap of greater than 30 ft will create more open conditions with light penetration at the forest edge. NLEBs are likely to avoid these conditions. As a result, NLEBs are not likely to be roosting in trees along the edge of a road ROW with a canopy gap of greater than 30 feet.

TCB may be more likely to be found roosting along established forest edges than NLEBs because they are not as closely tied to forest interior. However, we expect TCBs capable of flight to flush from roosts when physically disturbed (see Section 5.4.2). As a result, the TOYR applied to TCB for tree cutting in ROW (pup season plus winter torpor and swarming/staging in appropriate areas) is equivalent to the TOYR applied for all tree cutting, trimming or limbing activities.

For NLEB and TCB in summer use areas and year-round active Zone 2, a TOYR is applied to avoid direct effects during the pup season. For NLEB and TCB in year-round active Zone 1, the winter torpor activity period is added to the pup season TOYR. The spring staging and fall swarming activity period TOYR is implemented within 5.0 mi (8 km) of NLEB hibernacula and within 3.0 mi (4.8 km) of TCB hibernacula.

The tree cutting acreage thresholds described in Section 5.4.3 will not apply within an established and maintained utility ROW. Utility ROW corridors are linear in nature and to qualify for additional conservation measures under this activity, tree cutting, limbing or trimming must occur within the footprint of the established and maintained utility corridor within the ROW without expanding that footprint. Tree cutting, trimming, and/or limbing conducted within these linear corridors is less likely to intersect with an NLEB or TCB home range, and if it intersects, will impact a smaller portion of the home range. Impacts of limited tree limbing or trimming are unlikely to make entire trees unsuitable as roosts for NLEBs or TCBs. Tree cutting may result in the removal of a number of potentially suitable roost trees for TCBs, however, TCBs capable of flight are expected to be able to switch roosts without adverse fitness consequences. NLEBs are not expected to utilize trees along the established edge of a maintained utility ROW corridor as roost trees, therefore, they are unlikely to experience adverse fitness consequences as a result of tree removal in these locations.

5.5 EFFECTS TO BATS USING BRIDGES OR CULVERTS

The following is adapted from the FWS' *Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat* (USFWS 2024).

5.5.1 Occurrences of Bats in Transportation Structures

Bridges

Bats roosting in bridges during the day are often found in expansion joints and other crevices, in contrast, night bat roosts are often found in open areas between support beams that are protected from the wind (Keeley and Tuttle 1999). NLEBs and TCBs have been found using bridges, including the following types of bridges: parallel box beam, pre-stressed girder, cast-in-place, and I-beam.

IBAT

IBATs have been documented roosting under bridges in at least seven states: Indiana (Kiser et al. 2002, A. King, Service, pers. comm. 2010), Ohio (A. Boyer, Service, pers. comm. 2010), Kentucky (Roby et al. 2025), Iowa (Benedict and Howell 2008), Tennessee (D. Pelren, Service, pers. comm. 2014), West Virginia (B. Douglas, Service, pers. comm. 2010), and North Carolina (Lauren Wilson, Service, pers. comm. 2023).

Between October 2006 and April 2011, there were 878 observations of IBATs roosting in a bridge over the West Fork of the White River in Indiana. IBATs were documented during every month except January and February. This bridge is 15 mi (24.1 km) from one of the largest hibernacula in the state and is 25 mi (40.2 km) from 12 other hibernacula (Cervone et al. 2016). In 2017, a maternity colony was documented using a bridge in Tippecanoe County, Indiana. This is the first documented IBAT maternity colony found using a bridge. The bridge is a single-span concrete bridge with expansion joints that run parallel with the span. The underside of the bridge is approximately 8 ft (2.4 m) above the surface of the water. In 2021, IBAT maternity use was found at a bridge in southern Indiana. Monitoring in the summer of 2022 showed peaks of nearly 100 IBATs in July. Bats used areas of spalled concrete and vertical faces of support beams and corners where beams and diaphragms intersected (R. McWilliams, Service, pers. comm, 2023). In September 2014, 66 IBATs were documented in a metal culvert approximately 180 ft (54.9 m) long by 9 ft (2.7 m) high under multiple lanes of I-65 in Clark County, Indiana. The culvert was re-inspected in May 2016 and there was no documentation of bats; however, in mid-August 2016, approximately 12 to 15 bats were counted. The culvert was recently inspected in mid-August and early September 2023 (after the new structure was built and additional travel lanes added) and documented 60 and 107 IBATs, respectively. Biologists assume bats are using the culvert as a migration stopover rather than a summer roost (R. McWilliams, Service, pers. comm. 2023). The surrounding landscape is a mix of agriculture, rural neighborhoods, forest blocks, and riparian areas.

One IBAT was tracked from its hibernaculum to a bridge in west Tennessee in 2014. It apparently utilized the bridge as a temporary roosting site in transition to a likely maternity colony in Benton County, Tennessee. West Virginia has two documented locations of IBATs using bridges as a roost; one IBAT was documented using a smaller two-lane "older" style bridge near the Monongahela National Forest with minimal traffic (B. Douglas, Service, pers. comm. 2010), and a bachelor (male) colony has been established under a four-lane highway with concrete cells underneath. The bachelor colony is located under a span between a pier and abutment. The span is "cave-like," built into a hillside, and is enclosed on three sides. The four-lane highway bridge receives heavy traffic, including large trucks that create loud noise and strong vibrations. However, it spans a mid-sized stream and small country road with minimal noise or disturbance. Likely the key factor is the level of disturbance below the bridge/roost site. This bachelor colony has been documented from summer through December (B. Douglas, Service, pers. comm. 2013). In western North Carolina, many *Myotis* species of bats (IBAT, little brown bat, eastern smallfooted bat [*Myotis leibii*], gray bat [*Myotis grisescens*], and NLEB, as well as big brown bats, TCBs, and Mexican free-tailed bats (*Tadarida brasiliensis*) have been found roosting in bridges (Susan Cameron, Service, pers. comm. 2023).

Of the 37 bridges visited in Benedict and Howell's study in 2005 and 2006 in Iowa (Benedict and Howell 2008), 6 IBATs were documented. Five of the six IBATs were found under concrete bridges, the other IBAT was found using a steel bridge. Five of the six were males and the female was found under a concrete bridge. All the bridges passed over a creek or river with trees along the riparian edge.

<u>NLEB</u>

NLEBs have been documented using bridges in at least five states: Illinois (Feldhamer et al. 2003), Louisiana (Ferrara and Leberg 2005), Iowa (Benedict and Howell 2008), Tennessee (J. Griffith, FWS, pers. comm. 2014), and Mississippi (McCartney et al. 2024).

Feldhamer et al. (2003) surveyed 232 bridges in southern Illinois and found 4 species of bats using 15 bridges. NLEBs comprised 3 percent of the bats found. In Louisiana, Ferrara and Leberg (2005) documented 7 NLEBs during 902 bridge surveys, which were conducted from 2002 to 2003. NLEB represented 0.4 percent of total bats detected. The NLEBs observed were using the bridges as day roosts (Ferrara and Leberg 2005). However, Kiser et al. (2002) reported NLEBs using bridges as night roosts as well. Analysis of guano in 2023 at a bridge in northern Indiana found NLEB DNA (R. McWilliams, FWS, pers. comm. 2023).

Of the 37 bridges visited in Benedict and Howell's study in 2005 and 2006 in Iowa (Benedict and Howell 2008), 2 NLEBs were found under separate concrete bridges (1 lactating female; the sex of the other was not clear in the report). Also, a NLEB bachelor colony using a timber bridge was found in Iowa in 2013 (K. McPeek, FWS, pers. comm. 2014). At about the onset of WNS-associated declines in Minnesota, two bridges, including one being used as a maternity roost, were documented to have NLEBs in 2017 and 2018. NLEBs have not been verified using these two bridges since 2018 (Christopher E. Smith, MnDOT, pers. comm. 2023).

As part of the 2023 Mississippi Bats and Bridges Initiative, 33 bridges were surveyed in seven Mississippi counties from late August – October. Three bridges were occupied by NLEBs (representing a 9 percent occupancy rate) in six counties (McCartney et al. 2024).

<u>TCB</u>

TCBs have been documented using bridges in at least five states: Illinois (Feldhamer et al. 2003), Louisiana (Ferrara and Leberg 2005), North Carolina (Susan Cameron, FWS, pers. comm), South Carolina (Newman 2020) and Minnesota (Christopher E. Smith, MnDOT, pers. comm. 2023). TCBs utilize bridges in many parts of the range, and they have been detected at all times/seasons of the year. Bridges do not appear to be commonly used as hibernation sites throughout much of the range, although some states have detected TCBs in weepholes/plugged drains in the winter, on the edges of metal under decking, and occasionally in expansion joints. On cooler days, tree cavities are consistently colder than bridges due to poor insulation, and trees may pose a greater freezing risk than bridges to bats. TCBs that used tree roosts did so on warmer days but often switched to bridges on cooler days. The daily mean temperature of tree roosts when occupied was 51.8 +/- 8.2 degrees F (11 +/- 4.6 degrees C) in accessible tree cavities, with temperature fluctuations of 7.2 degrees F (4.0 degrees C; Newman et al. 2021, p. 1335). Bridges likely were warmer than cavities during cold periods as a result of solar radiation and concrete's high thermal mass. Therefore, bridges could provide predictable microclimates for TCBs to use during periods of increased freezing risk (Newman et al. 2021, p. 1337). A study in South Carolina also indicated that TCBs overwintering in bridges display skin temperatures similar to short-term torpor bouts rather than traditional hibernation.

Feldhamer et al. (2003) surveyed 232 bridges in southern Illinois and found 4 species of bats using 15 bridges. TCBs comprised 18.4 percent of the bats found. In Louisiana, Ferrara and Leberg (2005) documented 79 TCBs, during 902 bridge surveys, which were conducted from 2002 to 2003. TCBs represented 4 percent of total bats detected. The TCBs observed were using bridges as day roosts (Ferrara and Leberg 2005). Ferrara and Leberg (2005) studied bridge use by bats in north-central Louisiana and reported that TCBs were rarely observed during the summer but represented approximately 5 percent of the bats during winter (November to March).

Culverts

<u>IBAT</u>

In September 2014, 66 IBATs were documented in a metal culvert approximately 180 ft (55 m) long by 9 ft (2.7 m) high under the four lanes of I-65 in Clark County, Indiana (R. Mc Williams, USFWS, pers. comm.). Bats are likely to be using the culvert as a migration stop over rather than a summer roost (R. Mc Williams, USFWS, pers. comm.).

<u>NLEB</u>

NLEBs have been documented using culverts in at least five states: Indiana (R. McWilliams, FWS, pers. comm. 2023), Oklahoma (Martin, K. pers. comm. 2005), Mississippi (McCartney et al. 2024), Missouri (Droppelman 2014), and Tennessee (J. Griffith, FWS, pers. comm. 2014). As part of the 2023 Mississippi Bats and Bridges Initiative, 113 culverts were surveyed in 7 Mississippi counties from late August – October. Twenty-nine culverts were occupied by NLEBs (representing a 26 percent occupancy rate) in six counties (McCartney et al. 2024).

In Missouri, a bat survey conducted for a mine tailings impoundment associated with the Brushy Creek Mine in Reynolds County documented two NLEBs using a 250 ft (76.2 m) long corrugated metal culvert pipe for roosting. This pipe culvert carries Lick Creek under County Road 908 and is 9 ft (92.7 m) in diameter (Droppelman 2014). The survey results in Tennessee have indicated that NLEBs have showed no preference in roosting sites. In addition to bridges and culverts, the survey documented NLEBs in barns, porches, mobile homes, and telephone poles when potential roost trees were nearby and available (J. Griffith, FWS, pers. comm.). Data collected across the state of North Carolina show no evidence that NLEBs are using culverts in the state, though most surveys, until recently, were limited to culverts measuring 5 ft (1.5 m) tall by 200 ft (61 m) long.

TCB

TCBs have been documented using culverts in southeastern states along the Gulf and Atlantic coastlines. Katzenmeyer (2016) conducted a comprehensive assessment of transportation structures in Mississippi between November and March from 2010 to 2015. Although neither IBATs nor NLEBs were observed, the survey recorded five other bat species and their abundance in 16 caves and 214 culverts. Over the five-year period, 3,789 roosting bats were recorded in caves and 16,812 were detected in culverts, with TCBs most abundance in culverts. Southeastern myotis (*Myotis austroriparius*) was most abundant in caves, with TCB second most abundant.

The following species were documented using culverts as roosting sites in North Carolina: gray bat, southeastern bat, TCB, big brown bat, Mexican free-tailed bats, and Rafinesque's big-eared bat. Further, five survey efforts for NLEBs in bridges and culverts in eastern North Carolina have failed to detect the species roosting in these structures.

Visual diurnal and nocturnal surveys of selected culverts (>36-in (0.9 m) diameter) were conducted along Dry Creek/Daytown Road in Delaware County, Oklahoma, on September 16, 2005. A solitary male NLEB was noted in one culvert located in the northern portion of the project. No other bats were noted during the surveys (Martin, K. pers. comm. 2005). Additional assessments from 2010 through 2023 in 10 counties in Oklahoma have found NLEB, TCB, cave myotis, big brown bats, and gray bats roosting in culverts (P. Crawford, ODOT, pers. comm.)

TCBs utilize culverts in many parts of the range, and they have been detected at all times/seasons of the year. In the southern portion of the range where TCBs exhibit shorter torpor bouts and remain active and feed year-round, most states have reported that TCBs are more common in culverts than bridges overall, but especially in the winter. Several other states have reported TCBs hibernating in culverts extensively, with rare instances of culvert use in the summer. However, most surveys are biased to colder months.

TCBs usage of nontraditional roost sites such as culverts, bridges and cavities can vary with ambient temperatures and among roost structures (Newman et al. 2021). TCBs hibernating in Texas culverts are believed to select roosts based on microclimate (Meierhofer et al. 2021) and potentially proximity to other roosts and suitable summer habitat (Sandel et al. 2001). Meierhofer et al. (2021) suggested ambient weather conditions, including humidity, determine occupancy of culverts by TCBs. In culvert hibernacula in Texas, maximum and minimum temperatures ranged from 21.2 to 80 degrees F (-6 to 27 degrees C) for 1995–1996 and 30 to 84 degrees F (-1 to 29 degrees C) for 1996–1997 (Sandel et al. 2001, p. 175). TCBs were more likely to be present in culverts at lower elevations and lower temperatures (Meierhofer et al. 2019, p. 1276).

TCBs along the southeastern Gulf and Atlantic coastlines exhibit different strategies in the winter when compared to northerly parts of their range, often roosting in roadway culverts in the states of North Carolina (Katherine Etchison, FWS, pers. comm. 2023); South Carolina (J.B. Kindel, South Carolina Department of Natural Resources, pers. comm. 2023); Georgia (Ferrall 2022; Lutsch 2019); Alabama (Jessica Anderson, unpublished data 2022); Florida (Lisa Smith, unpublished data 2022); Mississippi (Cross, 2019; Katzenmeyer 2016); Louisiana (Nikki Anderson, Louisiana Department of Wildlife and Fisheries, pers. comm. 2023); and Texas (Meierhofer et al. 2019, 2021, Sandel et al. 2001).

Colony abundance in culverts can exceed 1,000 individuals, as observed in Mississippi and Texas, but other states report many, low abundance colonies at a high occupancy frequency, as observed by Ferrall (2022) in Georgia, with winter culvert occupancy rates of 32 percent (N=369) and as high as 52 percent in Mississippi (Katzenmeyer 2016). Considering the high exposure of culvert, tree, and bridge roosts during winter months, this behavior appears to be limited to areas with mild winters and few frost days. Generally, winter roosting in these exposed areas is contained within zones where mean minimum temperatures for December through February are generally warmer than 35 to 40 degrees F (1.7 to 4.4 degrees C) with some large culvert roosts located within 31-62 mi (50-100 km) north of this zone.

5.5.2 Bridge/Culvert Characteristics

Many studies have documented the characteristics of bridges and culverts being used as artificial roosts by bats, to determine roosting potential. Kiser et al. (2002) identified bridges built with concrete girders being used by IBATs and NLEBs to range from 45.9 to 223 ft (14 to 68 m) in length, and 26.2 to 39.3 ft (8 to 12 m) in width. All the bridges were over streams and all but one bridge was bordered by forested, riparian corridors connected to larger forested tracts. The riparian forest was within 9.4 to 16.4 ft (3 to 5 m) of the bridges. Traffic across the bridges ranged from less than 10 vehicles per day to almost 5,000 vehicles per day.

In Keeley and Tuttle's (1999) study, most bat species using artificial roosts chose concrete structures with crevices that were sealed at the top, at least 6-12 in (15- 61 cm) deep, 0.5 -1.25 in (1.3- 3.2 cm) wide, 10 ft (3m) or more above the ground, and typically not located over busy roadways. Feldhamer et al. (2003) reported an average height of 16.7 ft (5.1 m) above the ground for nine of the roosts. They did not note if any species showed a preference for a bridge type, or if any maternity or bachelor colonies were discovered.

Cleveland and Jackson (2013) reported bats (species not specified) roosting in 55 of 540 bridges examined in Georgia. Bats were found in 78 percent (43 of 55 roost bridges) of roost bridges with transverse crevices, but only 7.2 percent (4 of 55 roost bridges) were found in roost bridges with parallel crevices and 7.2 percent (4 of 55 roost bridges) of roost bridges with a combination of transverse and parallel crevices. All roost bridges either spanned water or were within 0.62 mi (1 km) of water. Roost bridges had open flyways with at least 6.56 ft (2 m) under their roost.

Ormsbee et al. (2007) noted that the largest numbers of night-roosting bats are often located in the warmest chambers of bridges, which tend to occur at either end and are located over land. Whereas central chambers located over water are less suitable (as a result of greater exposure to air currents and convective heat loss) for night-roosting. Adams and Hayes (2000) also reported higher occupancy in end chambers than center chambers. Feldhamer et al. (2003) reported that when occupied bridges in southern Illinois spanned flowing water, areas of the bridge that were occupied by bats were situated over land. However, the 2023 Mississippi Bats and Bridges Initiative survey documented three bridges occupied by the NLEB that were cement prestressed girder structures located over relatively wide rivers (> 100 ft [30.5 m]) that are tributaries to the Mississippi River, with two of the bridges located over the same river four miles apart.

An evaluation of 44 culverts in the Netherlands determined lowest height and cross-sectional area amenable to bats are 1.3 ft (0.4 m) and 3.9 ft^2 (1.2 m^2) respectively (Boonman 2011). Also, 15 box culverts along Interstate Highway 45 in southeast Texas documented southeastern bat, TCB, and big brown bat in culverts varying 3.9- 7.2 ft (1.2 – 2.2 m) height, 3.9-5.9 ft (1.2-1.8 m) width, and 197-394 ft (60-120 m) length, commonly with standing water and entranceway vegetation (Smith and Stevenson 2015). In New Mexico, 2016 unpublished data from Smith and Stevenson documented minimum culvert heights of 2 ft (0.6 m) and 3 ft (0.93 m) for *Myotis* spp. and *Corynorhinus townsendii*, respectively.

The Katzenmeyer (2016) study of 214 culverts in Mississippi documented 111 of the culverts (smallest size being 30 ft [9.14 m] long and 2 ft [0.61 m] tall) being used for winter roosting by five different bat species: Rafinesque's big-eared bat, southeastern myotis, big brown bat, TCB, and Brazilian free-tail bat. All five species were detected in culverts as short as 109 ft (33.4 m) long, but only TCBs were found in smaller culverts (smallest being 30 ft [9.14 m] long and 2 ft [0.61 m] tall). The culverts occupied by NLEBs in the 2023 Mississippi Bats and Bridges Initiative survey were all cement box culverts ranging in length from 40 – 400 ft (12 – 122 m) long and 2 – 12 ft (0.61 – 3.66 m) high and wide.

In September 2014, 66 IBATs were documented in a metal culvert measuring approximately 184 ft (54.86 m) long by 9 ft (2.74 m) tall in Clark County, Indiana. Georgia has documented the species in only one culvert state-wide. The Georgia Department of Natural Resources reports that IBAT were found winter roosting with TCB in a concrete pipe culvert that perpendicularly intersects a triple box culvert. The pipe culvert measured 4 ft (1.22 m) tall and 50 ft (15.24 m) long; however, all bats enter the box culvert first, which measured 8 ft (2.44 m) tall and runs 504 ft (153.62 m) long (L. Pattavina & E. Ferrall, University of Georgia, pers. comm. 2022). Culvert records are limited for IBAT.

A July 2014 survey in Missouri found two NLEBs in a culvert with an entrance measuring approximately 9 ft (2.7 m) in diameter and a Google Earth length estimate of 250 ft (76.2 m) (Droppelman, 2014; L. Droppelman, Eco Tech, pers. comm. 2022). Winter 2014 surveys in Louisiana by Richard Steven documented NLEB in seven concrete tube and box culverts ranging in size from 4.5 ft to 10.5 ft (1.36 m to 3.2 m) tall and 131 ft to 476 ft (40 m to 145 m) long. NLEB co-occurred in these culverts with southeastern myotis, TCB, Rafinesque's big-eared bat, and big brown bats (Nikki Anderson, unpublished data, March 23, 2022). The Louisiana Department of Wildlife and Fisheries has surveyed more than 1,000 culverts over three winters and found TCBs in 21 percent of them. Summer surveys of a much smaller number of culverts found the species in about 4 percent of surveyed culverts. The shortest length culvert occupied by TCB was 23.3 ft (7.1 m) long and 5 ft (1.52 m) tall (Nikki Anderson, unpublished data, March 24, 2022).

In 2020, the U.S. DOT Volpe National Transportation Systems Center (Volpe Center), on behalf of the Federal Highway Administration, in collaboration with the FWS, conducted an analysis of bridge/culvert and structure bat assessment forms that had been uploaded through IPaC system between 2016-2019. Data were also provided by the Georgia Department of Natural Resources from assessment forms across the state. The information from both sources was combined to create a "bats in structures assessment form database" that contains a total of 2,378 assessments. Evidence of bats (all species) was observed at 260 (11 percent) of these structures (see Table 4). Where evidence of bats was observed, 184 structures (71 percent) included information on the species present (Table 5). While IBATs and NLEBs have been observed using bridges and culverts, none were reported in this analysis[4]. However, TCBs were found using both bridges and culverts.

[4] Not all Transportation Agencies identify the bat species when bat occupancy or signs of bat use are observed.

Table 4. Evidence of Bats in Bridges and Culverts (2015-2019)

Structure Type	Total Bat Evidence Entries	% of Total Bat Evidence Entries	% of Structure Type with Bat Evidence	Total No Bat Evidence Entries	% of Total No Bat Evidence Entries
Bridge (total=1,148)	84	32%	7.3%	1,064	50%
Culvert (total=689)	140	54%	20.3%	549	26%
Unknown (n=541)	36	14%	6.7%	505	24%
Total:	*260*	*100%*		*2,118*	*100%*

Table 5. Bat Species Identified from Volpe's Bats in Structures Assessment Form Database

Bat Species Name	Bat Species Acronym	# of Database Entries Identifying the Species
tricolored bat (*Perimyotis subflavus*)	PESU	101
southeastern myotis (*Myotis austroriparius*)	MYAU	64
big brown bat (*Eptesicus fuscus*)	EPFU	45
Mexican or Brazilian free-tailed bat (*Tadarida brasiliensis*)	TABR	11
Rafinesque's big-eared bats (*Corynorhinus rafinesquii*)	CORA	7
gray bat (*Myotis grisescens*)	MYGR	5
eastern red bat (*Lasiurus borealis*)	LABO	2
little brown bat (*Myotis lucifugus*)	MYLU	1
evening bat (*Nycticeius humeralis*)	NYHU	1
	Total:	*237*

An additional analysis was conducted using the bats in structures assessment form database to assess how culvert size might influence the presence of bats. Of the 689 culverts assessed, 154 (23 percent) were associated with culvert size data, and—of those—53 indicated presence of bats (see Table 6 for more detail). Where evidence of bats was observed in culverts with a reported height, 100 percent also reported species information; as noted above, none of the species identified included IBAT or NLEB. TCBs were documented at 25 of the 53 culverts with presence of bats. Of the 53 culverts with bat use, the minimum culvert height was 2 ft (0.60 m) (1 culvert), and the maximum was 9 ft (2.74 m). TCBs were found in the minimum and maximum culvert heights. Only 3 culverts of the 53 with evidence of bats were $\leq$3 ft (0.91 m) in height (southeastern myotis and TCB); three culverts were less than 4 ft (1.22 m) in height (southeastern myotis and TCB); the remaining 47 culverts with documented use of bats were $\geq$ 4 ft (1.22 m) in height (southeastern myotis, TCB, Rafinesque's big-eared bat, and gray bat).

Table 6. Culvert assessments with size data.

Culvert Assessment	Size Information Included?	Number of Culverts	Percent of Total
No Evidence of Bats	No	448	65%
No Evidence of Bats	Yes	101	15%
Evidence of Bats	No	87	13%
Evidence of Bats	Yes	53	8%
Total:		*689*	*100%*

Table 7. Evidence of Bats in Culvert with Reported Size.

Culvert size class (reported height)	Culverts with No Evidence of Bats	Culverts with Evidence of Bats	Percent of Size Class with Evidence of Bats	Total number of Culverts	Percent of Total
Under 4ft	34	6	15%	40	26%
4ft and above	67	47	41%	114	74%
Total:	*101*	*53*		*154*	*100%*

TCB surveys conducted in January, February, April, and August 2023 along 2.6 mi (4 km) of road in Caldwell County, North Carolina, in the Grandfather Ranger District, Pisgah National Forest included an assessment of 29 culverts. Several culverts were made of dry-stacked rock/stone that are estimated to be about 100 years old. Some of these had collapsed inlets creating a cave/mine like environment. The inlet in others was retrofitted with a reinforced concrete pipe (RCP) to maintain water flow and function. The rest of the culverts were corrugated metal pipes (CMPs) or CMPs retrofitted with RCP inlets.

Of the 29 culverts assessed, 7 culverts contained TCBs in winter torpor across 7 survey dates in January - April. Six of the 9 stone culverts were occupied by TCBs. Only 1 of the 20 CMPs/RCPs were occupied by TCBs. Within the six stone culverts, one or two TCBs were observed. In the 7th CMP/RCP culvert, 12 TCBs were observed. The study documented that bats were awake and moving during some portion of the time between January 5 and January 24, 2023. The culvert that contained 12 bats in January 2023 still contained 3 TCB on April 11th, some still apparently in winter torpor. Four of the winter occupied culverts along with four culverts not occupied in the winter were assessed in August 2023; no bats or signs of bat use were detected.

The largest entrance height in each occupied culvert ranged from 27 to 56 in (0.7 to 1.4 m). The smallest entrance heights of occupied culverts were as short as 10 in (0.3 m) or were collapsed all together. Occupied culvert lengths varied from 36 to 82 ft (11 to 25 m). The CMP/RCP combo pipe containing 12 TCBs (9 TCBs on the CMP and 3 TCBs on the RCP) was 82 ft (25 m) long; its largest entrance, though only 0.7 m under field conditions due to fill and water, was a 1 m diameter CMP/RCP. This culvert had limited airflow potentially due to a smaller inlet opening measuring 10 in by 24 in (0.25 m by 0.6 m).

Bektas et al. (2018) assessed 517 bridges in Iowa for evidence of bat roosting. The study showed that physical bridge characteristics alone could not be used to identify bat roost potential. Land cover and bat species distribution data combined with physical bridge characteristics help identify structures with the higher probability of bat roosting.

The data compiled from the publications above identifies culverts with day roosting bats to range from 1.3 ft (0.4 m) (Boonman, 2011) to 10 ft (3m) (Keeley and Tuttle, 1999) in height. However, the bat species identified varied widely and thus likely the wide range in size characteristics. Also, the Volpe Center analysis revealed only 15 percent of culverts (6 culverts) under 4 ft (1.2 m) had evidence of bat use, with neither IBAT nor NLEB identified. Only 3 of the 6 culverts under 4 ft (1.2 m) had evidence of TCB, only 1 of which was <3 ft (0.9 m).

Culverts less than 4.5 ft (1.3 m) in diameter/height and shorter than 23 ft (7.01 m) in length will be considered unlikely to provide suitable roosting habitat for the NLEB; culverts shorter than 23 ft in length and less than 4 ft (1.2 m) in diameter/height; and culverts less than 3 ft (0.9 m) in diameter/height and 23 ft in length will be considered unlikely to provide suitable roosting habitat for the TCB. TCBs have been documented in culverts as small as 2 ft (0.6 m) in diameter (as reported above); however, instances of TCBs in culverts this small are expected to be rare and present a potential safety concern for regular assessments. Thus, an assessment will not be required for culverts that do not meet the minimum diameter/height and length standard (refer to the FWS's current survey guidance for minimum culvert dimensions for determining IBAT, NLEB and TCB suitability).

Until further data can rule out low bridges as potential roost sites, it is not possible to exclude them from requiring an assessment. Additionally, excluding broad categories of bridges based on their physical characteristics such as their composition does not seem feasible. It is possible that bridge roosting characteristics change over time as concrete may begin to spall, which would in turn provide roosting sites. Smith and Stevenson (2015) further support the idea that the physical characteristics described by Keeley and Tuttle (1999) are a set of ideal characteristics and not a list of definitive criteria required by bats for roosting.

There may be instances where a bridge/culvert or structure bat assessment fails to initially identify IBAT, NLEB, or TCB but later in time, prior to or during construction, these bats are observed. Also, IBATs, NLEBs and TCBs may unexpectedly roost in smaller culverts than the minimum standard. In both situations, adverse effects (including harm, death or injury) to these bats may occur; therefore, project proponents required to cease activity that could result in take of the covered bat species and notify the local FWS Field Office within two working days of the discovery to determine how to proceed.

5.6 Effects of Roads

5.6.1 Risk of Collisions with Vehicles

Roads pose a risk of vehicle collisions for the IBAT, NLEB, and TCB, although documenting roadkill is difficult, and a combination of factors influence the magnitude of the risk. Important factors include traffic volume and noise, proximity of the road to roosting and foraging sites, and vegetation height near the road. In at least one case, the threat of roadkill to an imperiled bat species prompted a collaboration between biologists and highway engineers to evaluate how the species crossed a highway, to identify and install safe crossing points (Wray et al. 2006).

Bats may be killed or injured if they collide with vehicles when traveling between roosting and foraging areas, and possibly during migration (although migratory movements likely occur at much higher heights). Collision risk to bats varies depending on time of year, location of the road in relation to roosting and foraging areas, the characteristics of their flight, traffic volume, and whether young bats are dispersing (Lesinski 2007, Lesinski 2008, Russell et al. 2009, Bennett et al. 2011). Collisions have been documented in IBATs and other Myotids (Russell et al. 2009, Butchkowski and Hassinger 2002). Russell et al. (2009) documented IBAT mortality at a site where the roost site was separated from the foraging areas by a major highway. In the Czech Republic, Gaisler et al. (2009) noted most bat fatalities were associated with a road section between two artificial lakes. Lesinski (2007) evaluated road kills in Poland and determined that the number of young-of-year bats killed was significantly higher than adults. Also, low-flying gleaners Daubenton's bat (*M. daubentonii*) were killed more frequently than high-flying aerial hawkers common noctule (*N. noctula*). IBATs are considered a low flying gleaner following canopy height and flying lower than the adjacent canopy when there are breaks in the canopy. Foraging behavior for the NLEB is hawking and gleaning (Brack and Whitaker 2001; Fenton and Bogdanowicz 2002, Ratcliffe and Dawson 2003, Feldhamer et al. 2009). TCBs exhibit slow, erratic, fluttery flight while foraging (Fujita and Kunz 1984). Some bat species choose to forage near streetlamps that emit ultraviolet light (white lamps). Bats are attracted to roads by lights independently of adjacent trees or houses (Blake et al. 1994). Lesinski et al. (2011) indicated that a review of previously published literature on factors causing bats to be killed at roads is not consistent, and therefore, it is difficult to predict exact sites where bats may be at risk.

Kerth and Melber (2009) studied barbastelle bats (*Barbastella barbastellus*) and Bechstein's bats (*M. bechsteinii*) and found that roads restricted habitat accessibility for bats, but the effect was related to the species' foraging ecology and wing morphology. Foraging ecology of gleaning and woodland species was more susceptible to the barrier effect than high-fliers that feed in open spaces (Kerth and Melber 2009).

Russell et al. (2009) noted that when IBATs crossed at open fields, they flew much lower than canopy height <6.5 ft (2 m), and when adjacent canopy was low, bats crossed lower and closer to traffic. NLEBs forage at lower heights (3 to 10 ft [1 to 3 m]) than IBATs (6.5 to 98 ft. [2 to 30 m]) (FWS 2014). Observations of TCBs report they emerge early in the evening and forage at treetop level or above (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116) but may forage closer to ground later in the evening (Mumford and Whitaker 1982). To minimize bat collision, several studies suggested maintaining canopy connectivity across the road by restoring or establishing commuting routes (treelines, hedgerows) (Wray et al. 2006, Bennett and Zurcher 2013).

In Europe, efforts to study, design, and test measures to minimize bat roadkill seem to be common relative to the U.S. (e.g., Sołowczuk and Kacprzak 2022). Although risk of bat roadkill, in general, appears to be higher at locations with greater traffic volume (Fensome and Mathews 2016, p. 319), bat roadkill has been detected on roads with as few as 1,100 vehicles per day (Vuk et al. 2014) and bat roadkill may occur even on unpaved roads. DODW facilities are unlikely to reach 1,100 vehicles per day, with even less travel occurring during times when bats are foraging, reducing the likelihood of collision impacts. Speed limits on military installations are generally less than 35 mph (56 kmph), increasing the likelihood that bats foraging near roads are able to avoid collisions. Farmer and Brooks (2012) found speed limit to be the strongest predictor of vertebrate roadkill. Their model indicated that the mean probability of roadkill at a given location increased from less than 0.1 to 0.75 as speed limits increased 12.5mi/h to 31 mi/h (20 km/h to50 km/h). In addition, overall populations of IBAT, NLEB, and TCB have been greatly reduced as a result of WNS, reducing the number of bats exposed to the risk of collision due to smaller populations. The difficulty of finding bat carcasses may result in underestimates of roadkill of IBAT, NLEB, TCB and other bats (Russell et al. 2009, p. 57).

The risk of vehicle collisions for IBAT and NLEB may be highest when forest suitable for foraging or roosting is present along both sides of a road and where traffic volume is not too high to discourage crossing (see Roads as Barriers to Commuting Bats, next section). Risk of collision appears to increase where canopy connectivity has been disrupted and there are no safe bat commuting routes across the road/rail corridor, or where bats use streams as travel corridors across roadways/railways. Collision risk may also be higher in areas with extensive existing road/rail networks where bats have few options but to fly across roads/rails to reach their foraging areas.

In Pennsylvania, IBATs and little brown bats flew through or along the edge of forest when approaching a highway and fewer bats crossed where canopy cover was “lacking adjacent to the highway” (Russell et al. 2009, p. 49). The use of wooded corridors by IBATs was consistent with a study in Michigan where IBATs “did not fly over open areas” (Murray and Kurta 2004, p. 203). In France, increasing distance to trees and decreasing tree height were associated with a decrease in bat density at roads (Roemer et al. 2021, p. 1).

We are not aware of highway crossing studies like that of Russell et al. (2009) for the NLEB, but we would also expect NLEB to remain under, within, or along the edge of forest when near roads. NLEBs are tied heavily to closed canopy and interior forest (Henderson and Broders 2008, p. 952, Pauli et al. 2017, p. 879). Tall canopy on both sides of the road may provide safe places for NLEBs to cross if the distance is not too great. Where the tree canopy was high >66 ft (20m), bats crossed well above traffic. Where it was low ≤20 ft (6m), they crossed the highway lower and closer to traffic and were more likely to be struck by vehicles (Russell et al. 2009, p. 55). Based on their observations, Russel et al. (2009, p. 58) concluded that bats would fly from one high canopy to another without descending to vehicle height as long as the canopy-to-canopy crossing distance was 66 ft (20 m) or less. TCB is not a forest interior species, as a result, these characteristics associated with successful road crossings may not apply to TCB.

5.6.2 Roads as Barriers to Commuting Bats

Major well-established roads have been proven to have significant long-term negative impacts on bat populations such as a decline in species diversity and overall decline in bat activity (to a distance of at least 1-6 km) near roadways (Berthinussen and Altringham 2012, p. 88). Bats’ avoidance of vehicle noise and vehicles themselves could result in roads becoming a barrier, restricting access of commuting bats to foraging habitats (Zurcher et al. 2010, p. 339). NLEBs are likely to avoid or reduce time spent foraging near roads depending on the intensity of noise on the roads, which depends in part on traffic volume (Schaub et al. 2008, p. 3179). When vehicles were present, 60 percent of documented IBATs exhibited avoidance behavior, reversing course at an average of 10 m from automobiles, suggesting that bats perceive vehicles as a threat and are more likely to fly across roads with low traffic volume (Zurcher et al. 2010, p. 337). TCBs are routinely detected using acoustic surveys conducted on road transects, suggesting that they are less likely to avoid or reduce time spent foraging near roads than IBAT or NLEB.

The decline in activity and diversity of bats was only mitigated by roadsides where there was increased continuity in habitat including hedgerows and tree cover lining both sides of the road (Berthinussen and Altringham 2012, p. 85). Roads restricted habitat accessibility for barbastelle bats and Bechstein’s bats, but the effect was related to the species’ foraging ecology and wing morphology (Kerth and Melber 2009,

p. 270). Foraging ecology of gleaning and woodland species were more susceptible to the barrier effect than high-fliers that feed in open spaces (Kerth and Melber 2009, p. 270).

Bennett et al. (2011) indicated that three main road characteristics contribute to the barrier effects of roads: traffic volume, road width, and road surface. Roads with very few vehicles and only two lanes had little effect on IBAT movement (Bennett et al. 2013). Zurcher et al. (2010) concluded that bats perceive vehicles as a threat and were more than twice as likely to reverse course if a vehicle was present than if it was absent. Berthinussen and Altringham (2012) found that bat activity and diversity was lower closer to roads, but that activity and diversity increased where there was continuity in trees and hedgerows. Simulations of bat activity based on IBAT data in relation to road networks found that roads with only moderate traffic volume (e.g., >10 vehicles/5-minutes) may act as partially permeable "filters" where the majority of bats are still able to cross roads, but vehicle collisions may occur. Russell et al. (2009) found that traffic volume at the time of the highway-crossing study (Section 5.6.1) was about 8,569 vehicles per day – about 30 vehicles/5-minutes (Russell et al. 2009, p. 58). Searches of a 6 mi (9 km) section over a year's time documented 35 killed bats of at least 6 species, including 6 NLEBs and 4 TCBs (Russell et al. 2009, p. 58). However, areas with high traffic volume (>200 vehicles/5-minutes) are more likely to act as barriers to movement (Bennett et al. 2013, p. 979). It is important to note that IBAT, NLEB and TCB populations have significantly declined post-WNS, which may result in a proportional decline in vehicle collisions.

5.7 Effects of Prescribed Fire

The impact of fire suppression on populations of IBAT, NLEB and TCB is unclear, but it is apparent that fire may affect individual bats adversely through exposure to heat, smoke, and carbon monoxide, and positively through habitat modifications and resulting changes in their food base. Prescribed fire is also necessary to maintain suitable habitat for these species in many parts of the range.

5.7.1 Effects of Prescribed Fire on Tree Roosting Bats

5.7.1.1 Direct Impacts of Fire

IBAT and NLEB

Little is known about the direct effects of fire on cavity and bark roosting bats, such as IBAT and NLEB, and few studies have examined escape behaviors, direct mortality, or potential reductions in survival associated with fire. Bats roosting in snags may be impacted by direct disturbance from fire if roost trees burn (Boyles and Aubrey 2006, p. 109), but injury is not likely unless flames are intense enough to burn the roost quickly at temperatures when the bat is in deep torpor (Carter et al. 2002, p. 139). Non-volant pups can be impacted by burning as they are not able to flush from burning roost sites (Carter et al. 2002, p. 139). Dickinson et al. (2009, p. 55-57) monitored two NLEBs (one male and one female) in roosts during a controlled summer burn. Within 10 minutes of ignition near their roosts, both bats flew to areas that were not burning. Among four bats they tracked before and after burning, all switched roosts during the fire, with no observed mortality. It was presumed that roosting sites (e.g., exfoliating bark, crevices) used by bats offer little protection from hot gases released by fire (Dickinson et al. 2009, p. 59; Guelta and Balbach 2005). By extrapolating from other species, carbon monoxide exposure would cause incapacitation at concentrations of >1000 PPM for 25 minutes or more (Dickinson et al. 2009, p. 59; Speitel 1996, p. 174). Rodrigue et al. (2001) reported flushing a Myotis bat from an ignited snag during an

April controlled burn in West Virginia. Carter et al. (2002, p .139-140) suggested that the risk of direct injury and mortality to southeastern forest dwelling bats resulting from summer prescribed fire is generally low. Silvis et al. (2016) noted NLEBs aroused from short-term torpor in late April during prescribed fires; however, the authors acknowledged how nonvolant bats and adults with pups respond to fire is unknown. Adults in torpor during cold temperatures and non-volant pups are likely the most vulnerable to death and injury from prescribed fire. IBATs and NLEBs flushing from trees during the day may be exposed to greater risk of predation, however predation of bats during the day is rare and the presence of heat and smoke during prescribed burning is likely to displace predators from the area along with the bats. As a result, likelihood of predation of IBATs and NLEBs flushed from trees during prescribed fire is expected to be discountable. To reduce potential harm to torpid bats, the Dkey does not allow for prescribed fire in suitable habitat when temperatures are below 40 degrees F (4.4 degrees C). To reduce harm to non-volant pups, the Dkey does not allow for prescribed fire in suitable habitat during the pup season. Additionally, average flame heights must remain below 6 ft (1.8 m) to reduce the likelihood of fire accessing the canopy and burning snags, avoiding direct impacts to roosting bats.

<u>TCB</u>

During spring, summer, and fall, and winter in the year-round active Zone 2 area, TCBs typically roost in live and dead leaf clusters of live and recently dead deciduous hardwood trees (Veilleux et al. 2003, p. 1071; Perry and Thill 2007b, pp. 976-977; Thames 2020, p. 32). Although the species has been captured within a variety of forest types, studies on forest associations of this species are limited (Silvis et al. 2016, p. 32). TCBs roost almost exclusively in hardwood trees and often roost in forest stands that contained abundant deciduous hardwoods (Perry et al. 2007, p. 164). TCBs switch roost trees regularly. In Indiana, 18 pregnant or lactating female TCB monitored for an average of 9.1 days ± 1.7 used an average of 2.8 ± 1.7 roost trees and remained at roosts for an average of 3.9 ± 2.5 days (Veilleux et al. 2003, p. 1072). Young start flying at three weeks of age and achieve adult-like flight at four weeks of age (Lane 1946, p. 59; Whitaker 1998, pp. 654–655).

We expect TCBs capable of flight to flush from roosts when physically disturbed. While adult TCBs are capable of flushing during disturbance, impacts of smoke or heat from prescribed fire may result in direct injury or mortality when flightless young are present (i.e., pup season) or when temperatures when TCBs may be in prolonged torpor (i.e., winter torpor season). Flightless young are not capable of flight and cannot independently flush from a tree because of disturbance. Female TCBs typically have two pups and during the first few nights after birth, females carry pups (Lane 1946, p. 60). When disturbed, adult females will “carry much larger young” (Lane 1946, p. 60). Although mothers can carry/move young, pups may ultimately become too heavy to move as they grow, especially in the haste of escaping a prescribed fire. Similar to NLEBs, injury is not likely unless flames are intense enough to burn the roost quickly at temperatures when the bat is in deep torpor (Carter et al. 2002, p. 139). Adult TCB in torpor during cold temperatures and non-volant pups are likely the most vulnerable to death and injury from prescribed fire. To avoid direct effects to TCBs, the Dkey does not allow for prescribed fire in suitable habitat when temperatures are below 40 degrees F (4.4 degrees C). To reduce harm to non-volant pups, the Dkey does not allow for prescribed fire in suitable habitat during the pup season. Additionally, average flame heights must remain below 6 ft (1.8 m) to reduce the likelihood of fire accessing the canopy, avoiding direct impacts to roosting bats.

5.7.1.2 Effects of Heat and Smoke

During warm temperatures, bats are able to escape to unburned areas. IBATs, NLEBs and TCBs use multiple roosts, switching roost trees often, and could likely use alternative roosts in unburned areas should fire destroy the current roost. Silvis et al. (2016, p. 16) noted NLEBs aroused from torpor in late April during prescribed fires; however, the authors acknowledged how non-volant bats and adults with pups respond to fire is unknown. Non-volant pups are likely the most vulnerable to death and injury from prescribed fire.

Exposure to heat and smoke can cause death or injury. However, because these species typically roost high in trees, low-intensity fires are less likely to cause injury compared to high intensity fires (Rodrigue et. al. 2001, Dickinson et al. 2010). Indirect harm may also occur from increased predation risk when IBATs, NLEBs or TCBs flee prescribed burns. We expect this to occur when IBATs, NLEBs and TCBs are more concentrated during the maternity season and the swarming/staging season, but we only anticipate direct harm from heat and smoke during the pup season or during cold temperatures (<40 degrees F [<4.4 degrees C]) when bats are in deeper torpor.

At least some IBATs, NLEBs or TCBs roosting in burned areas may be harmed by carbon monoxide or heat. Dickinson et al. (2010) used a fire plume model, field measurements, and models of carbon monoxide and heat effects on mammals to explore the risk to the IBAT and other tree roosting bats during prescribed fires in mixed-oak forests of southeastern Ohio and eastern Kentucky. Their research suggested that blood carboxyhemoglobin concentrations from CO exposure only approach critical levels just above flame heights in the most intense prescribed burns. However, if bats are in torpor during a fire and cannot arouse quickly enough to escape, thermal injury could occur up to the height of at which crown scorch occurs. Most prescribed fires for forest management are planned to avoid significant tree scorch.

5.7.1.3 Effect on Roost Availability

Fire can affect availability of roosting sites for IBATs and NLEBs (cavities, crevices, loose bark) by creating or consuming snags, which typically provide these features. Although stand-replacing or other intense wildfires may create large areas of snags, the effects of multiple, low-intensity prescribed burns on snag density are less obvious, especially for forests consisting mostly of fire-adapted tree species. Low-intensity, ground-level fire may injure large hardwood trees, creating avenues for pathogens such as fungi to enter and eventually form hollow cavities in otherwise healthy trees (Smith and Sunderland 2006). Fire may scar the base of trees, thus promoting the growth of basal cavities or hollowing of the bole in hardwoods (Nelson et al. 1933, p. 829; Van Lear and Harlow 2002, p. 8). Repeated burning could potentially create forest stands with abundant hollow trees. Trees located near down logs, snags, or slash may be more susceptible to damage or death, and aggregations of these fuels can create clusters of damaged trees or snags (Brose and Van Lear 1999; Smith and Sutherland 2006). Bats are known to take advantage of fire-killed snags to roost in burned areas. Boyles and Aubrey (2006, p. 111- 112) found that, after years of fire suppression, initial burning created abundant snags, which evening bats (*Nycticeius humeralis*) used extensively for roosting. Johnson et al. (2010) found that after burning, male IBATs roosted primarily in fire-killed maples. In the Daniel Boone National Forest, Lacki et al. (2009) radio-tracked adult female NLEBs before and after prescribed fire, finding a greater percentage (74.3 percent) of roosts in burned habitats than in unburned habitats. NLEB behavior is consistent with being fire tolerant – that is, they frequently forage and roost in live trees and snags in early stages of decay in post-burn sites (Lacki et al. 2009, p. 1172). NLEB post-burn roost selection was based on bole condition – they selected trees with higher number of cavities and a higher percentage of bark cover on the bole than random snags, likely due to a wider range of roosting options within a tree (Lacki et al. 2009, p. 1172). Burning may create more suitable snags for roosting through exfoliation of bark (Johnson et al. 2009, p.240), mimicking trees in the appropriate decay stage for roosting bats. The extent to which preferred roosts are limiting in forested habitats is unclear (Lacki et al. 2009, p. 1172; Crampton and Barclay 1998, p. 1355; Kunz and Lumsden 2003, p. 16). There is evidence, however, for competition for roost availability among similar and closely related species of tree-roosting bats (Lacki et al. 2009, p. 1172; Boonman 2000, p. 385; Lumsden et al. 2002, p. 207). In addition to creating snags and live trees with roost features, prescribed fire may enhance the suitability of trees as roosts by reducing adjacent forest clutter. Perry et al. (2007, p. 162) found that five of six species, including NLEB, roosted disproportionally in stands that were thinned and burned 1-4 years prior but that still retained large overstory trees.

5.7.2 Effects of Prescribed Fire on Bats Using Winter Roosts and Hibernacula

Fires conducted during the winter within 0.25 mi (400 m) of an NLEB or TCB hibernacula, or within 0.5 mi (800 m) of an IBAT hibernacula, could affect hibernating IBATs, NLEBs and TCBs if they generate gases that drift or are blown into hibernacula. Whether this occurs depends on local airflow characteristics and weather conditions (Carter et al. 2002, p. 141; Perry 2012, p. 178). Smoke from prescribed fire may not reach toxic levels in caves and mines, but introduced gases could arouse bats from hibernation, causing energy expenditure and reduced fitness (Dickinson et al. 2009, pp. 61- 62). Caviness (2003) observed smoke intrusion into hibernacula during winter burning in Missouri but did not observe any bat arousal. All bats present in caves at the beginning of the burn were still present and in "full hibernation" when the burn was completed, and bat numbers increased in the caves several days after the burn. There were minute changes in relative humidity and temperature during the burn and elevated short-term levels of some contaminants from smoke were noted (Caviness 2003).

Fire could also alter vegetation surrounding the entrances to caves and mines, which could indirectly affect temperature and humidity regimes of hibernacula by modifying airflow (Carter et al. 2002, p. 141; Richter et al. 1993). Fire may proactively trim and remove vegetative access barriers to mine openings. Vegetation can obscure entrances leading to declining hibernacula use. Vines and shrubs can also pose threats through thorns and other impalements (Jacomassa et al. 2017, Norquay et al. 2010, Sparks and Choate 2000), and predator concealment (Sparks et al. 2000). To avoid impacts to hibernacula, all projects within 0.25 mi (800 m) of known hibernacula entrances will go to field offices for individual review. In addition, all projects within 0.25 mi (400 m) of known occupied bridges and culverts will go to field offices for individual review. As a result, impacts to bats from prescribed fires in proximity to hibernacula and known roosts in structures will be avoided within the Dkey.

5.7.3 Effects of Prescribed Fire on Food Resources

Adult insects are the predominant prey of IBATs, NLEBs and TCBs. On the Daniel Boone National Forest, Lacki et al. (2009, p. 1170) found that abundance of coleopterans (beetles), dipterans (flies), and all insects combined captured in black-light traps increased following prescribed fires. The mechanism of this increase is related to the insects' ability to use regrowth of ground vegetation stimulated by the burns (Swengel 2001, p. 1141). In NLEB fecal samples, Lepidopterans (moths), Coleopterans, and Dipterans were the three most important groups of insect prey, with dipteran consumption increasing in the year after burning. NLEBs appeared to track the observed changes in insect availability – home ranges were closer to burned habitats than to unburned habitats after fires, but home range size did not change.

5.8 Effects of Smoke and Obscurants

Smoke and obscurants may include, but are not limited to, fog oil, colored smoke grenades, graphite smoke, and other smoke/obscurants, which may include white phosphorus, simulated rockets and missiles, or artillery simulators. Research has indicated that prolonged dermal and respiratory exposures to smoke and obscurants could have adverse effects on roosting and foraging IBAT (USFWS 1998, USFWS 2009, USFWS 2010, USFWS 2012, USFWS 2017). Projects that utilize white phosphorous will not be eligible for a predetermined outcome of NLAA because white phosphorus has an increased risk of toxicity to wildlife. White phosphorous ignites when it is exposed to air and may cause burns. It is important to note in terms of expected impacts to bats, older smoke grenades used in some previous studies were more toxic than equipment that is currently in use. Buffers used to avoid impacts associated with old equipment models will be more protective of bats when equipment with lower toxicity is utilized. Older models have been discontinued from use due to storage and disposal issues.

Few bat studies on the effects of volatile gases or suspensions have been conducted. Dickinson et al. (2010) modeled the potential harm of carbon monoxide from controlled burns on roosting bats and determined that dangerous levels were only reached in immediate proximity to intense fires. Guelta and Balbach (2005) found that smoke and obscurants have the potential to infiltrate bat roost trees, which may expose volant and non-volant bats to potentially harmful chemicals via ingestion, inhalation, or through the skin. It may further cause bats to abandon roosts, potentially leaving non-volant young behind, and exposing escaping bats to greater likelihood of predation. Bats encountering smoke and obscurants while foraging may be exposed to potentially harmful chemicals with the same effects as for roosting bats. Most effects are minor throat irritation or fleeing from roosts, which, though resulting in impacts to individual bats, do not rise to the level of take because feeding, breeding and/or sheltering activities are not impaired.

5.8.1 Fog Oil

Fog oil exercises are primarily conducted during daylight hours while bats are roosting, limiting potential impacts to foraging bats. Research has shown that fog oil has low potential for acute toxicity to animals through dermal exposure, little potential for acute lethality from ingestion, and may cause slight to moderate irritation after a single exposure directly to the skin (National Research Council 1997). Fog oil has a very low oral toxicity (3D/International, Inc. 1996b). Given this, individual bats would need to ingest large quantities of fog oil to cause any significant impacts. Bats are not anticipated to ingest fog oil during foraging or drinking because fog oil does not persist in soil, sediment, or surface water (3D/International, Inc. 1996b). Direct exposure of IBATs, NLEBs or TCBs to large amounts of fog oil, which would be ingested while grooming, would not be expected because we do not anticipate repeated exposure of any individual bat to fog oil. Individuals are also expected to flush from trees during fog oil deployment, minimizing the likelihood of high-level exposure to fog oil.

Inhalation is the most likely path of exposure of fog oil for bats. Inhalation effects from a given smoke exercise are predicted to be transitory, at most 2 hours in duration. The concentration of fog oil aerosols and rates of deposition are dynamic and highly dependent on local conditions, such as the length of the military training exercise, distance from the source (I.e., generator), wind currents, temperature, humidity, local terrain and precipitation.

The highest level of fog oil recorded was 140 mg/m^3 (upper level of range for a 30-minute release) with a concentration of 51.8 mg/m^3 concentration at 200 m from the source. A 120 min release recorded a maximum level of 105 and 102 mg/m^3 at 656 ft (200 m) and 328 ft (100 m), respectively, from the source of release (USFWS 2012, 2015). At 328 ft (100 m), fog oil is unlikely to reach high enough concentrations to result in the death of bats, however, fog oil may reach sufficient levels to result in sublethal effects for some individuals. Studies have examined acute and chronic exposure concentrations of fog oil to small mammals (e.g., mice, guinea pigs, hamsters, and rats). Although limited in scope and applicability, these studies do provide some estimates of impact, should IBAT, NLEB or TCB be exposed to fog oil at various concentrations. Single 4-hour exposures of 200 mg/m^3 of motor oil smoke to mice and 1-hour exposure of 10-250 mg/m^3 of light lubricating oil smoke to guinea pigs resulted in minor respiratory irritation (USFWS 2015). Driver et al. (2002) concluded that red-winged blackbirds can sustain fog oil exposures of about 400 mg/m^3 for 4 hours with no detectable adverse effects. Fog oil concentrations of 400 mg/m^3 would represent a worst-case exposure scenario of birds remaining in close proximity to a generating system for extended periods (up to 4 hours), while typical field concentrations range from 50 to 100 mg/m^3 and disperse more quickly. Compared to control birds, no mortality, body weight loss, clinical signs of toxicity, or behavior abnormalities were observed in any of the fog oi-treated birds (Drive et al. 2002). These concentrations were 2-4 times greater than the modeled concentrations at 328 ft (100 m) from the source of deployment and 12-50 times greater than the observed concentration of fog oil at 328 ft (100 m) from the source of deployment. Roosting bats would most likely be exposed to fog oil levels that have no detectable adverse effects on red-winged blackbirds. Therefore, we would not anticipate any risk of acute toxicity (only minor respiratory irritation) from fog oil inhalation, even as close as 328 ft (100 m) from deployment (USFWS 2009, 2015). As the distance increases to 328 ft (100 m), the average concentrations decrease, suggesting that at this distance fog oil is unlikely (discountable) to reach high enough concentrations to result in the death of any roosting IBAT, NLEB or TCB. In order to protect bats in roosts from high concentrations of fog oil, a conservation measure prohibits smoke operations using fog oil within 328 ft (100 m) of known or potential maternity roosts trees.

Deployment of fog oil smoke near roosts could cause adult bats to similarly flush from the roost with minor or no direct injury. In early spring, however, bats are more likely to enter torpor. At this time adults within 100 m may be exposed to smoke long enough and at high enough concentrations to experience respiratory irritation before they are able to fly away. If smoke operations occur during June or July, non-volant pups within 100 m could be injured or killed directly by the fog oil exposure or harmed indirectly as a result of adult abandonment of roosts. To avoid impacts as a result of smoke inhalation, fog oil will not be released within 100 m of known or potential maternity colonies, or within 250 m of known or assumed hibernacula. The 100 m buffer serves to minimize the effects of smoke and obscurants by providing distance between known or potential roosts and the densest amount of the smoke and/or obscurants. At this distance, IBATs, NLEBs or TCBs (including pups) are unlikely to suffer acute effects. Minimizing the concentration of smoke around known or potential maternity roosts will reduce the risk that adults will abandon roosts or non-volant pups. As a result, impacts on adults, whether roosting or hibernating, and pups are expected to be insignificant or discountable. Effects from chronic exposure are not expected because IBATs, NLEBs and TCBs are not anticipated to sustain repeated exposure of fog oil smoke. There is only a small probability that any bats will be in proximity (< 328 ft [100 m]) to fog oil deployment. Foraging bats can avoid areas where fog oil is deployed by foraging in adjacent areas, thus limiting exposure. We do not anticipate any short-term displacement (should it occur) to rise to the level of an adverse effect to IBATs, NLEBs or TCBs given the amount of suitable foraging area available on most military installations that support listed bat populations. The likelihood that fog oil would have adverse effects to foraging bats in discountable.

5.8.2 Graphite Smoke

Graphite smoke inhalation studies have shown to cause only mild respiratory tract inflammations in rats even at high graphite concentrations (100 mg/m^3) (National Research Council 1999a). Repeated inhalation exposure also produced minimal effects in rats, and all noted symptoms were reversible after two weeks. Dermal exposure to rabbits showed no signs of toxicity, including no skin irritation (National Research Council 1999a). Graphite was not acutely toxic when given orally to rats at 5 g/kg of body weight. Given the low toxicity to experimental animals, it is unlikely that known or potential maternity colonies will be negatively affected by exposure to graphite smoke and its toxicity impacts are discountable.

5.8.3 Smoke grenades

Terephthalic acid (TPA) is typically ignited and burned to produce the smoke emitted from M18 colored smoke grenades. TPA is noncarcinogenic and its combustion products are less toxic than those of other smoke grenades (USFWS 2010). Military smoke grenades produce a 40-90 second release of smoke. The primary combustion products of TPA are carbon monoxide, carbon dioxide, sulfur dioxide, benzene, toluene, and formaldehyde. It is used alone, or in combination with fog oil to fill in incomplete fog oil screens. Colored smoke and TPA could result in dermal and respiratory-tract sensitization in NLEBs (National Research Council 1999b). Some symptoms that were observed in mammals after a variety of exposure trials (e.g., ingestion, dermal application, and inhalation) included reduced growth rate in juveniles, respiratory afflictions, and sensitization of skin.

An Ecological Risk Assessment prepared by 3D/International (1997a) found there may be possible effects of inhalation of M18 colored smoke to IBAT from acute exposure (minor respiratory inflammation) and/or chronic exposure (slight decrease in body weight gain or minor respiratory irritation). We would expect similar effects to NLEB and TCB. M18 colored smoke grenades have >98 percent burn efficiency, indicating that nearly all chemical components are converted to smoke, leaving little residue that could end up on fur and possibly be ingested (3D/International 1997b). An ecological risk assessment of M18 colored smoke grenades found that ingestion and dermal absorption were unlikely, and inhalation is the most likely path of exposure of colored smoke for IBAT (3D/International 1997b). While these studies focused on the IBAT, FWS assumes similar exposure-response to the NLEB and TCB. Colored smoke typically lasts only two minutes in duration, which is unlikely to cause bats to flush from roosts. In addition, colored smoke is generally only used as a signaling/marking tool, further limiting exposure to bats. If colored smoke or other smoke grenades are deployed within 30 m of unknown roosts, bats may inhale unsafe quantities of smoke, which could result in minor respiratory effects (3D/International 1997b). Unsafe concentrations of smoke produced by M18 grenades last approximately one minute (3D/International 1997b). Military smoke grenades will not be used within 50 m of known or assumed maternity colonies, maintaining sufficient distance buffers to ensure that impacts to bats from smoke grenades are insignificant or discountable. Effects from chronic exposure are not expected because

IBATs, NLEBs or TCBs are not anticipated to sustain repeated exposure of smoke. There is only a small probability that any bats will be in close proximity (< 98.4 ft [30 m]) to a given smoke grenade deployment. If smoke grenades are deployed near where IBATs, NLEBs, or TCBs are foraging, bats have the ability to avoid these areas and are expected to forage in adjacent areas, thus limiting exposure. We do not anticipate any short-term displacement (should it occur) to rise to the level of an adverse effect to IBATs, NLEBs or TCBs given the amount of suitable foraging area available on most military installations that support listed bat populations. The likelihood that smoke grenades would have adverse effects on foraging bats is discountable.

5.9 Air Operations

While helicopter and vertical take-off and landing (VTOL) training operations on DoD sites will often follow fixed patterns and stay above 500 ft (152 m) from ground level, maneuvering and hovering regularly occur below this level and near the ground. Impacts of day-time air operations over fields and open areas are expected to be insignificant or discountable to roosting bats. Downdrafts have minimal effects while aircraft are at speed, but hovering aircraft may produce enough force to eject bats from roosts or cause damage to the roosts themselves.

Given that IBATs and NLEBs forage in the canopy layer, collisions during nighttime flight operations are very unlikely to occur. TCBs forage at treetop level or above early in the evening (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116) but may forage closer to ground later in the evening (Mumford and Whitaker 1982). Based on the nature and implementation of air operations and the assumed level of habituation to flight training activities, it is determined that sound generated by ongoing training activities at existing ranges is not likely to adversely affect the three bat species. For ongoing nighttime operations, foraging bats will continue to be exposed to sound levels that have been shown not to alter foraging behavior (USFWS 2010). Similar conclusions were made regarding training operations at Fort Leonard Wood, (3D/International 1996b), Fort Drum, (USFWS 2009); and at Camp Atterbury (USFWS 2010).

Fire operations using rotary-winged aircraft typically include the use of bambi buckets for training and actual fire events. This involves the helicopter lowering a suspended container into a large water source such as a pond, lake, or potentially even a swimming pool, until it fills. The pilot then raises the aircraft and transports the water to active fire or fire-retardant opportunities. Between 72-2,600 gallons of water may be released from heights as high as 23-115 ft (7-35 m). This typically has enough force to debark and potentially drop dead and dying trees. The operation also involves extended hovering and rotor wash on lakeside tree lines and structures, often very low to the water surface (longer cables result in more pendulum action in flight). Not a major training component for attack aircraft, this action is typical for cargo aircraft. These operations typically occur in daylight for training and suppression missions but are also effective at night for fire suppression. Due to the danger and weight of the payload, aircraft typically move slower than normal in these conditions, and flight distances are minimized as much as possible, reducing collision potential. Larger aircraft and water payloads could be used to assist in wildland fire operations or fire training on Defense lands. Bambi bucket and similar aerial fire support training will only be employed in open space pickup and drop off locations (>330 ft [100 m] from the tree line), avoiding known roosts and hibernacula. Dumping water from the bambi buckets will only occur outside of the active season or in open areas with no suitable habitat.

5.10 Effects of Military Training – Firing Ranges, Maneuver Areas, Field Training, Bivouac and Explosive Ordnances

5.10.1 Noise and Vibration Associated with Military Training

Primary impacts of military training include noise of irregular frequency and source location, as well as ground vibration. Noise levels are expected to be similar to activities like pile driving, blasting, or vehicle traffic over bridges containing roosting bats. Pile driving at a bridge project in Sonoma County, CA, within 300 ft of an active maternity colony did not result in the departure of roosting Yuma myotis and Mexican free-tailed bats (Johnston et al. 2019). Results into the investigation of the effects of sound at Fort Leonard Wood, Missouri also suggest that sound generated by training events (simulated artillery and small-arms fire) do not startle, frighten, or cause bats to flee the area (USFWS 2010). Radiotelemetic monitoring of IBATs near active night training ranges at Fort Leonard Wood indicated that bats did not avoid active ranges or alter foraging behavior during night-time maneuvers (3D/International 1996a). Bats in areas that are repeatedly exposed to predictable, loud noise (e.g., the maternity colony at the Indianapolis Airport) are believed to habituate to noise over time (USFWS 2010).

5.10.2 Direct Impacts

Live-fire training and explosions have the potential to cause death or injury of bats through impacts associated with ammunition fire. For direct fire training, trees more than 110 yds (100 m) away from targets may only be infrequently struck by ammunition fire. At this distance, occasional ammunition strikes will most likely cause minimal damage to trees (USFWS 2010). Significant damage could occur within 110 yds (100 m), but generally the land around firing points is maintained to be clear of trees. Risks to bats are also reduced because the same firing points are repeatedly used and no new firing points or explosive ordnance activities will be located within 110 yds (100 m). In addition, illumination artillery and mortar rounds will not be fired during the maternity season and periods of high fire danger and demolition pits and OBOD areas will not be used during nighttime hours, or during conditions when smoke may be sent downwind into known or assumed maternity colonies or hibernacula.

Wildfires may occur in impacts areas as a result of military training exercises or ammunition fire. Fuels management is a major influence on fire behavior because it modifies the size, arrangement, and kind of vegetative fuels. This modification reduces the ignition potential, flame length, and rate of spread of a fire. A system of strategic roads and fire and fuel breaks are located throughout each installation for fire control and management.

Mortar and artillery fire from fixed firing points to remote targets also has the potential to adversely affect listed bats, in that errant artillery may explode and kill roosting bats and/or significantly damage habitat. However, occurrences such as these are expected to be extremely rare, and should they occur, the likelihood that these activities overlap with suitable habitat occupied by listed bats is discountable.

6 Ongoing Review of the Determination Key's Accuracy and Validity

This SA will be reviewed annually and updated as needed to ensure the analysis contains the best scientific and commercial data available. This update process will include regular reviews to ensure that the analysis is accurate and valid, and that the SA still meets the requirements of the ESA. All updates will also ensure that the logic is sound and determinations are appropriate for covered activities. If there are changes, updates will be signed under an updated cover.

Projects reviewed under this SA must rely on the version that is current on the date consultation is completed. For reference, both current and previous versions of the SA will be maintained jointly by the Dkey sponsor

If we revise the SA and determine reinitiation is required for any ongoing activities that used the previous SA, the FWS will contact the respective action agencies that may be affected and advise them of their need to reinitiate.

6.1 Annual Review of the Dkey – Ensuring Use of Best Available Information

6.1.1 Dkey Question Review

Each year, no later than March 31, FWS will determine what questions need to be asked across the range of IBAT, NLEB and TCB relative to any potential new information associated with DODW activities. We will record the answers in the administrative record for the Dkey and take appropriate action to revise the key to ensure accurate outcomes, as needed. The Dkey sponsor will send an email to each FWS ESFO with the questions needed. In addition to seeking out key information directly from FWS ESFOs, the Dkey sponsor will also review published scientific literature for new and relevant information – see 6.1.3, below.

The Dkey sponsor will also ensure that appropriate revisions are made to the key considering any new information that indicates additional or more stringent conservation measures are needed to ensure correct conservation outcomes. The Dkey sponsor will use this SA to assess any new information for potential revisions to the DODW Dkey. The sponsor will evaluate new information during the annual reviews and revise the Dkey, as needed.

6.1.2 Ensuring use of Accurate GIS Data

In addition to addressing each of the questions listed above, each year no later than March 31, the DKey sponsor will also reach out to each of the ESFOs in the range of the IBAT, NLEB and TCB to determine whether the GIS data incorporated into the DODW Dkey is still accurate and based on the best available information. If revisions or updates are necessary, the sponsor will request the updated information from the ESFO and will incorporate it into the Dkey. Updates to the underlying GIS data will also be made as needed throughout the year.

6.1.3 Ensuring the Use of an Accurate Consultation Range

The consultation range maps that indicate where NLEB or TCB may be present were determined using a combination of direct and modeled occurrence data. First, we buffered locations of known occurrences directly observed in recent years. We then developed species-specific occurrence predictions using the North American Bat Monitoring Program's (NABat) Integrated Summer Species Distribution Models (models) for each species. These multivariate models predict occupancy by integrating all available acoustic and capture presence/absence records with a variety of environmental factors to predict occupancy, while also accounting for survey effort and differences in detection. The models also account for significant declines in NLEB and TCB numbers due to WNS across much of their ranges. The FWS plans to incorporate new data annually to improve the NABat models over time. The consultation range maps that indicate where IBAT may be present were developed using different methods. As a result, IBAT does not need to utilize methods described for NLEB and TCB. However, FWS plans to incorporate areas where new IBAT observations indicate that the species may be present on an annual basis.

6.1.4 Reinitiation of Consultation

Determinations obtained through the Department of Defense-War Determination Key for IBAT, NLEB and TCB do not expire unless reinitiation of consultation is required for actions where discretionary Federal involvement or control over the action has been retained or is authorized by law. The following "triggers" for reinitiation of consultation (50 CFR 402.16) apply to projects evaluated in the Dkey: 1) new information reveals effects of the project that may affect listed species or CH in a manner or to an extent not previously considered [50 CFR 402.16(a)(2)]."; or 2) the project is subsequently modified in a manner that causes an effect to the listed species or CH that was not considered previously.

For the first trigger, FWS will change the Dkey due to new information as needed annually. After we implement a major update to the Dkey, users will see a notification in IPaC that there has been a change in the Dkey that may affect the accuracy of the prior determination. These notifications will be visible when users view their project list in IPaC or are looking directly at an individual project. For the second trigger, it is the responsibility of the action agency to re-evaluate the project in IPaC or contact the local ESFO if the project is modified. For example, if the scope or location of the project changes, you should re-evaluate the project in IPaC.

6.1.5 Field Office Auditing Use of the Key

ESFOs within the covered area will have the opportunity to audit DODW Dkey submissions to ensure that users are answering Dkey questions accurately and that errors in the Dkey are not causing the wrong determinations to be delivered to users. The Dkey has established a 15-day waiting period associated with NLAA Concurrence letters to allow the appropriate ESFO to apply local knowledge to the evaluation of the Action. FWS will notify the user within 15 calendar days if the ESFO determines that the proposed action does not meet the criteria for a NLAA determination. If the FWS does not notify the user within that timeframe, the user may proceed with the Action under the terms of the NLAA determination provided in the concurrence letter. Each ESFO will establish their own process for auditing Dkey submissions, but across all ESFOs, a sufficient number of Dkey submissions will be audited to ensure accurate use. The auditing process will allow ESFOs to assess the aggregate effects of the projects that have used the Dkey.

6.1.6 Review of Cumulative Effects

The process of auditing DODW Dkey submissions and FWS's project tracking system will provide an opportunity for ESFO biologists to assess cumulative effects associated with the projects submitted through the Dkey. Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to section 7 of the ESA. Project review reports will facilitate the review of Dkey submissions at the local, regional, or range-wide level to assess whether State, tribal, local or private actions that are reasonably certain to occur have been identified within the action area. ESFO biologists will be trained in the use of Ecosphere in order to facilitate their review of cumulative effects and ensure that Dkey submissions are considered appropriately.

7 SUMMARY AND CONCLUSION

After considering the relevant information pertaining to the species, reviewing the covered activities and associated required conservation measures, and evaluating their anticipated effects, we conclude that the actions subject to this SA will support a Federal action agency determination of NE or support a section 7(a)(2) determination pursuant to the ESA of NLAA as appropriate, for the subject species as described above. This SA is based on the consultation provisions of section 7(a)(2) of the ESA and the information cited and will undergo review and revision, as needed, if any of the following conditions have been met: 1) If new information reveals the effects of the covered action(s) to the covered species or CH are occurring in a manner or to an extent not considered in this SA based on applied use; or 2) If the species or CH covered by the SA has a change in status.

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9 APPENDIX A: GLOSSARY

Action Area - All areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action.

Active Season – The time period when bats are not in hibernation. This includes spring emergence, young rearing, and breeding (swarming). Specific dates and extent of bat activity are defined by geographical location. Installations shall consult UFWS regarding dates of active and/or inactive season for the particular location. Bat activity periods are available in USFWS's Rangewide Indiana Bat and Northern Long-eared Bat Survey Guidelines.

Assumed Presence - Assumption made when activities are 1) located within the range of the IBAT, NLEB, or TCB; 2) suitable habitat is present, and 3) no bat surveys have been conducted. If no surveys have been conducted, DODW installations will assume presence of the NLEB in all suitable habitat and will be required to apply Conservation Measures to reach NLAA for the NLEB or trigger additional consultation with USFWS.

Assumed Use/Colonies/Hibernacula – Assumption made when there are leading indicators of above normal use in season, but either telemetry studies were not attempted or failed to find the roost. Further studies can reduce the restriction. Leading indicators include:

- Baseline activity rates significantly higher than background rates of detection in suitable habitat and suitable season as detected during acoustic surveys (assumed occupation)
- Capture of multiple pregnant or lactating females in or adjacent to suitable habitat (assumed maternity colony)
- Significantly higher than baseline activity recorded during post-maternity acoustic surveys in the previous pupping season (assumed maternity colony)
- Sign noted around a potential roost site or hibernaculum (e.g., guano, urine-staining, emerging but unidentified bats) with IBAT, NLEB, or TCB acoustics or recent capture in the nearby area (assumed occupation, roost, maternity colony, or hibernacula)
- Swarming behavior in season (assumed hibernacula)

Bambi Bucket - A bambi or helicopter bucket is a specialized bucket suspended on a cable carried by a helicopter to deliver water for aerial firefighting. The design of the buckets allows the helicopter to hover over a water source, such as a lake, river, pond, or tank, and lower the bucket into the water to refill it.

Conservation Measures- Measures that contribute to the conservation of the IBAT, NLEB or TCB and include, but are not limited to, avoidance measures, minimization measures, mitigation measures, and proactive measures. Conservation measures may be required to reach NLAA for the IBAT, NLEB or TCB.

Emergency - An emergency is a situation involving an act of God, disasters, casualties, national defense or security emergencies, etc., and includes response activities that must be taken to prevent imminent loss of human life or property.

Emergency Consultation – A formal or informal consultation performed concurrently or directly after an unforeseen event to include incidental discovery of take, consultation after a major disaster, or consultation for an immediate threat to the species.

Forest Fragmentation - The process by which large, unbroken tracts of forest are split into separate, smaller parcels of forest.

Hibernaculum (plural **hibernacula)** - A site, usually a cave or mine, where bats hibernate during the winter (see suitable habitat). A hibernaculum will be "assumed present" if it is within suitable habitat and no surveys have been conducted.

Inactive Season - The time period when bats are typically in hibernation. Specific dates and extent of bat activity are defined by geographical location. Installations shall consult UFWS regarding dates of active and/or inactive season for the particular location. Bat activity periods are available in USFWS's Rangewide Indiana Bat and Northern Long-eared Bat Survey Guidelines.

Incidental Take – take of listed fish or wildlife species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by a Federal agency or applicant [50 CFR 402.02].

Intentional Take – take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling or encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species.

May Affect, likely to adversely affect (LAA) – The appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or it's interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial.

Known Habitat - Refers to suitable summer or winter habitat located within a determined distance of an occurrence record for a bat species. Distances will vary based on species and record type (e.g., maternity, swarming, winter, etc.).

- **Spring staging/fall swarming**: All suitable habitat located within 10 miles of a documented P1 or P2 hibernaculum for IBAT, within 5 miles of a documented P3 or P4 hibernaculum for IBAT, within 5 miles of a documented hibernaculum for NLEB, and/or within 3 miles of a documented hibernaculum for TCB. If multiple species are present in a hibernaculum, the spring staging/fall swarming distance applied should default to the largest size (e.g., IBAT buffer > NLEB buffer > TCB buffer).

- **Summer**: All suitable habitat located within 3 miles of a documented IBAT, NLEB or TCB occurrence. All suitable habitat located within 1.5 miles of a documented maternity roost tree (unless site-specific foraging data is available).

- **"Documented" roost trees and foraging** –A subset of known habitat; the trees and patches of suitable habitat to which IBATs, NLEBs or TCBs have been tracked during radio tracking or by visible observation. In some cases, there is sufficient information to determine core roosting and/or foraging areas and estimate home ranges.

- **Winter**: Hibernacula with known IBAT, NLEB or TCB occurrences or is otherwise identified by the USFWS as important to future IBAT, NLEB or TCB recovery efforts.

- **Year-round Active:** In some areas in the southern portion of the range (see Figure 4), NLEBs or TCBs may be present and roosting in trees year-round (e.g., winter roosts). In these areas, habitat that shows the characteristics of summer habitat will be used during winter as well.

Maternity Colony - A group of reproductively active female bats and their young that occupy the same summer habitat. Males may also occur in maternity colonies. The maternity colony is comprised of both primary and alternate maternity roost trees. A maternity colony will be Assumed Present if it is within suitable habitat and no surveys have been conducted.

Maternity Roost - a summer roost, usually a tree, used by reproductively active female bats and their young (males may also roost there). They can be described as "primary" or "alternate" based upon the proportion of bats in a colony consistently occupying the roost site or how often it is used.

May Affect - The appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat.

No Effect - The appropriate conclusion when the action agency determines its proposed action will not affect a listed species or designated critical habitat**.**

Non-volant – Not capable of flight. The term generally refers to pups prior to weaning that are not physically performing sustained flights and depend on their mother for feeding. Abandonment at this stage is fatal.

May Affect, Not Likely to Adversely Affect (NLAA) - The appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. **Beneficial effects** are contemporaneous positive effects without any adverse effects to the species. **Insignificant effects** relate to the size of the impact and should never reach the scale where take occurs. **Discountable effects** are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

Occupied Habitat - Known and suitable habitat that is expected or assumed to be in use by bats at the time of the activity.

Population - A group of bats occupying a specific geographic area.

Pup – A juvenile bat from birth to the age when phalange joints ossify.

Recruitment - The number of young-of-the-year bats entering a population each year; the process by which juvenile bats enter the population.

Reproductively Active Female - A pregnant, lactating, or post-lactating adult female bat.

Roost Tree - Any tree in which bats roost (see suitable roost tree). See section 5.4.1 for additional information.

Snag - A standing dead (or mostly dead) tree, generally with <10 percent living canopy.

Staging - The departure of bats from hibernacula in the spring, including processes and behaviors that lead up to departure (see suitable habitat).

Suitable Habitat – Year-round habitat that is appropriate for use by IBAT, NLEB, or TCB (may be known or assumed in terms of documented use). Suitable forested/wooded habitat contains potential roosts as well as forested linear features such as wooded fencerows, riparian forests, and other wooded corridors. Individual trees may be suitable habitat when they exhibit characteristics of potential roost trees and are within 1,000 feet (305 meters) of other forested/wooded habitat.

- **Winter** (hibernacula) includes underground caves and cave-like structures (e.g., sinkholes, fissures, or other karst features, abandoned mines, railroad tunnels). These hibernacula typically have large passages with significant cracks and crevices for roosting; relatively constant, cooler temperatures (0-9 degrees C) and with high humidity and minimal air currents.

- **Summer** consists of the variety of forested/wooded habitats where IBAT, NLEB or TCB roost, forage, and travel. This includes forested patches as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow. May also include structures for roosting (e.g., barns).

- **Spring Staging/Fall Swarming** consists of the variety of forested/wooded habitats where bats roost, forage, and travel within 3 to 10 miles of a hibernaculum, depending on the species and size of the hibernaculum. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow.

Suitable Roost Tree – Any known or assumed roost tree in which bats roost when they emerge from the hibernacula or winter season. Females gather in maternity colonies and males may roost singly or in small groups.

Survey - A method of sampling, such as mist netting and acoustic monitoring, that provides data concerning the presence/absence of bats at a site; also, the act of enumerating the bats hibernating in a cave or mine. This action will be performed by qualified biologists as determined by the USFWS.

Swarming - A phenomenon in which, during late summer and autumn, numerous bats are observed entering and exiting entrances to caves and mines, but few, if any, of the bats may roost within the site during the day. Swarming probably is related to fall breeding activities and locating potential hibernation sites. (See suitable habitat).

Unoccupied Habitat - Refers to known or suitable habitat not expected to be in use by bats at the time of impact.

Take - Take is defined in Section 3 of the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct [50 CFR 17.3].

Volant - Able to fly.