Standing Analysis and Implementation Plan – Northern Long-Eared Bat and Tricolored Bat Assisted Determination Key

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Midwest and Northeast Region
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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 Federal action agencies 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.) (Act), to the following species: the federally listed endangered northern long-eared bat (*Myotis septentrionalis*; NLEB) and federally proposed endangered tricolored bat (*Perimyotis subflavus*; TCB). Critical habitat has not 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 critical habitat(s). This SA also provides proactive technical assistance to Federal action agencies in making a “no effect” (NE) determination. This SA provides an analytical basis for consultations that is available to Federal agencies for Federal 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, Federal agencies 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 the Federal action agency and used to submit a concurrence request to support their NLAA determination. It also provides technical information to help agencies determine whether an action will have no effect on the species or critical habitat. Formal consultation under ESA Section 7(a)(2) is required for actions that "may affect" a listed species or critical habitat, unless the FWS concurs in writing that actions are NLAA listed species or critical habitat. Actions which an action agency determines will have no effect on species or critical habitat do not require submittal to the FWS.

Federal agencies must consult with U.S. Fish and Wildlife Service under section 7(a)(2) of the Endangered Species Act (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 Guidance would be applicable to the TCB if the final determination is to list the species under the Endangered Species Act.

With the IPaC DKey established for this SA, the action agency 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. Agencies are not required to consult using this SA or follow all the built-in conservation measures. Agencies 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) either species. It only means a FWS biologist needs to review the project, and the Service can concur with NLAA determinations outside of the Dkey.

1.2 Benefits and Justification for Determination Key

For those federal actions that the FWS has accumulated significant knowledge in analyzing previously, the 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 field office personnel to audit Dkey submissions and contact the project proponent if errors are found.

1.3 Eligibility for Predetermined Consultation Outcomes via the Determination Key

An 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 affect relevant 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 critical habitat(s). For projects that do not qualify to use the SA, action agencies/project proponents should coordinate directly with the local Ecological Services Field Office (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 Act. 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 Northern Long-eared Bat and Tricolored Bat Rangewide Determination Key (Dkey), 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 critical habitat. 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 both section 7 consultation for federal agency actions and for proponents of actions that lack a federal nexus.

1.5.1 Federal Agency Actions

Federal agencies must consult with FWS under section 7(a)(2) of the Endangered Species Act (ESA) on any action that may affect an endangered or threatened species or critical habitat. 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 Endangered Species Act (ESA) section 7 consultation for the NLEB and/or TCB via the DKey in IPaC. After completing the DKey, agencies have met their consultation requirement for the NLEB and/or TCB when they receive a verification letter that verifies a determination of NLAA northern long-eared bat and tricolored bat. The NLAA verification letter will be delivered if both species reach the NLAA outcome, or if one species reaches the NLAA and the other species reaches a NE determination. Two other letter types are possible. If the project is consistent with a finding that the action will not affect the NLEB and TCB, the DKey will produce a "no effect consistency letter." The NE consistency letter will only be delivered if both species reach the NE determination. If the action may affect either the NLEB or TCB but does not qualify for either of those pre-determined outcomes, the agency would receive a "may affect consistency letter" which requires direct coordination with the ESFO to complete consultation. The may affect consistency letter will be delivered if either species 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 consistency letter" will provide further instructions for completing consultation.

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 NLEB and/or TCB if they receive a verification letter for a finding of NLAA for both species via the DKey.

1.5.3 Non-Federal Projects

Projects with *no federal nexus* are not subject to the ESA section 7(a)(2) consultation requirements but are subject to Section 9 take prohibitions. Therefore, if non-federal actions are reasonably certain to cause incidental take of the NLEB or TCB, applicants can apply for a Section 10 incidental take permit

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[1] A "no effect" determination is appropriate when either the species is not present in the action area or is not exposed to any possible stressors or impacts 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).

(ITP). To help proponents of non-federal actions determine whether to apply for an ITP, actions eligible for NE or NLAA predetermined outcomes in the DKey would receive a technical assistance letter that would clarify that the action is not reasonably certain to cause incidental take of the NLEB and/or TCB. Projects that are not eligible for predetermined outcomes in the Dkey will receive a technical assistance letter indicating that further coordination may be warranted, though voluntary on the part of the proponent.

1.6 Updating the Standing Analysis

The FWS DKey sponsor 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 and on the FWS species pages for northern long-eared bat (https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis) and tricolored bat (https://www.fws.gov/species/tricolored-bat-perimyotis-subflavus).

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 range is defined can be found in the "Northern Long-eared Bat and Tricolored Bat Voluntary Environmental Review Process for Development Projects" (Consultation Guidance) (https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis

The covered area is the consultation range for the NLEB (Fig. 1). and TCB (Fig. 2) in the United States.

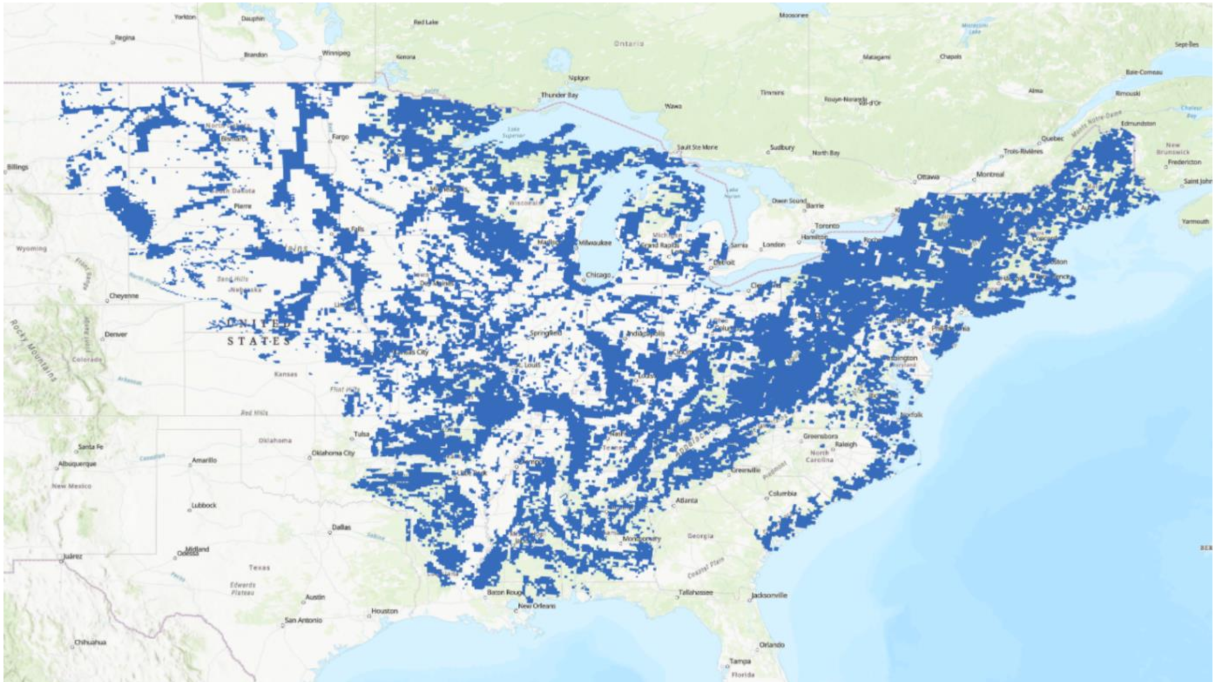

Figure 1. The consultation range of the northern long-eared bat, which is the area where northern long-eared bats may be present.

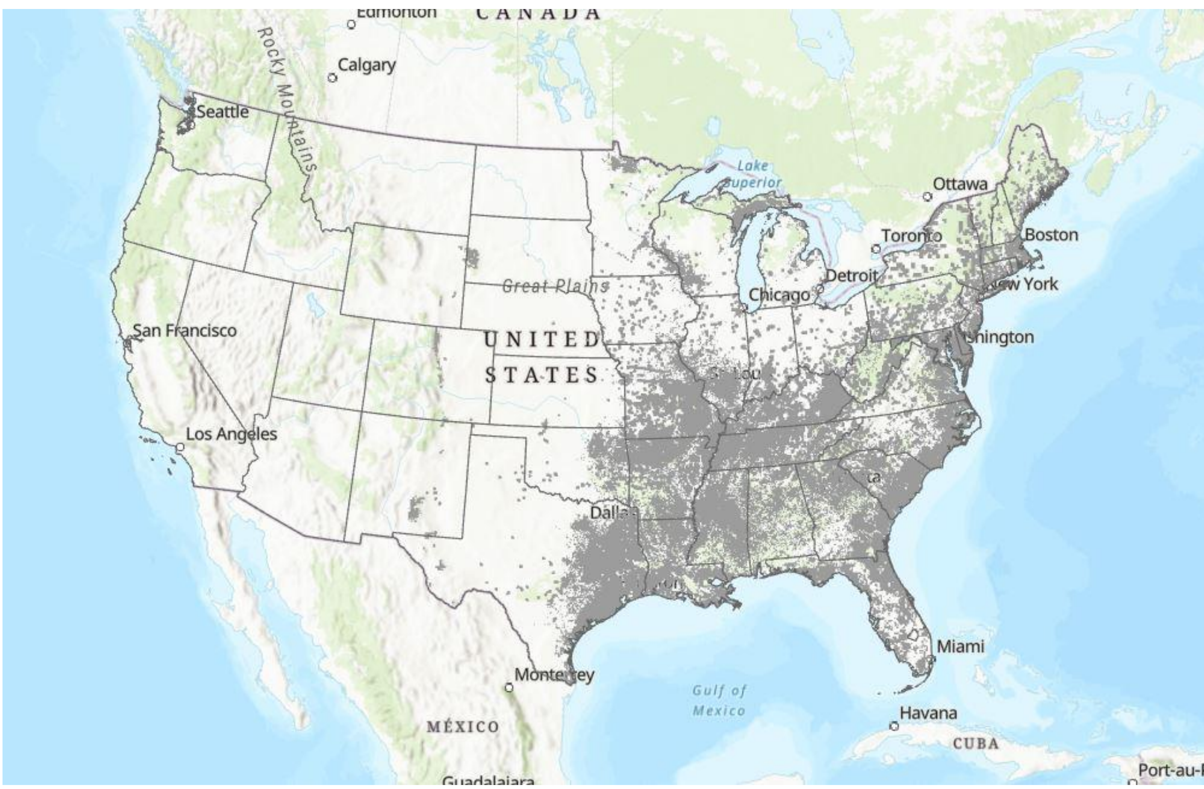

Figure 2. The consultation range of the tricolored bat, which is the area where tricolored bats may be present.

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 3). In the hibernating range, NLEB and TCB 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, NLEB and TCB exhibit year-round activity. During winter, they continue to roost in trees, as well as road-associated culverts and bridges.

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 TCB and NLEB are active year-round in areas where the number of frost-free days is ≥ 200 days. Consequently, we determined TCB and NLEB[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 3). Furthermore, based on a review of winter bat activity data, when temperatures fell below 40 degrees F, TCB were less likely to be detected in mist-net and acoustic surveys. We assume during these colder periods, TCB and NLEB are likely entering a state of prolonged torpor (i.e., a state of lowered body temperature and metabolic activity) and consequently, TCB and NLEB 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 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 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 in Year-Round Active Zone 2, we anticipate these periods would be much shorter in duration than in Zone 1.

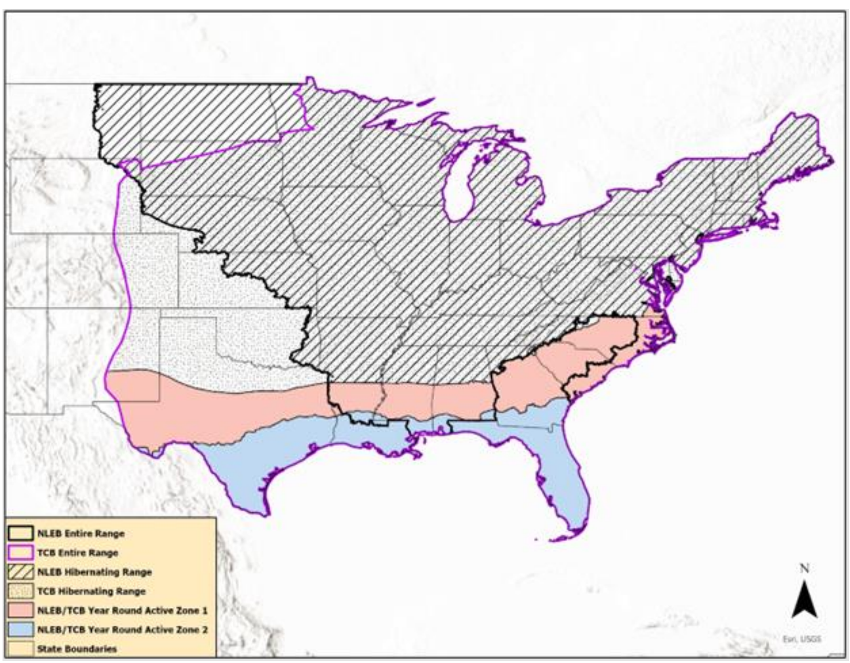

Figure 3. NLEB and TCB hibernating and year-round active ranges.

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

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 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 NLEB and/or TCB.

- Vegetation management – for example, prescribed burning and tree removal
- Construction, maintenance, operation, and/or removal of infrastructure projects including:
    - Roads and trails
    - Communication towers
    - Transmission and utility lines
    - Bridges and culverts
    - Oil and gas pipelines
    - Solar power facilities
    - Hydroelectric facilities/dams
    - Canals, levees, or dikes
- Commercial, residential, and recreational developments
- Agricultural activities
- Habitat restoration and enhancement
- Dredging and filling of wetlands or waterbodies

3.1 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 NLEB and/or TCB based on the impacts associated with the project or through the implementation of conservation measures to avoid impacts to either species. Any actions that are LAA either species do not qualify under this SA and 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.

3.1.1 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 a NLEB or TCB (e.g., capture and handling for surveys or research).
2. Actions that may include leasing, construction or operation of wind turbines.

3.1.2 Location Based Limits/Sideboards

As outlined in the Covered Area Section (2.0) this SA will apply broadly where the NLEB and/or TCB may be present, except in Michigan, where the NLEB and TCB questions will be incorporated into a state specific Dkey for all listed species in Michigan.

Actions that include blasting will also be excluded when they occur in certain geographic areas (e.g., karst landscapes), as will actions that affect areas near a documented hibernaculum. These and other conditional exclusions are addressed below under Conservation Measures.

3.2 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's possible that some users will not fully define the action area. This is addressed by an answer to the 'frequently asked question' 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 FWS 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.

If DKey users define the action area in IPaC according to these instructions, incorrect determination in the DKey would be avoided or minimized due to failure to include the full extent of the affected area.

3.3 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 species or CH and therefore, do not require formal consultation and 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 consistency 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 reaching a may affect determination which will result in a project not qualifying to use this SA.

3.3.1 Protection of Known and Potential Hibernacula and hibernating bats

3.3.1.1 Known Hibernacula

The Dkey results in a may affect consistency letter if the project would affect any area within 0.5 mile of an entrance to a hibernaculum. For most states within the species' ranges, the DKey will use embedded GIS data to identify actions that fall within 0.5-mile of a known hibernacula opening. Bat location data in the Dkey is hidden to protect sensitive species locations. For a few states within the species' ranges, the DKey will direct users to a webpage where they can find one or more information sources for their state to determine whether their action area occurs within the 0.5-mile hibernaculum "buffer".

3.3.1.2 Potential Hibernacula

When an action area does not overlap with a known hibernaculum buffer, the Dkey prompts the user to evaluate the area for potential hibernacula by using the recommended assessment process in the FWS survey guidelines (FWS 2024*a*, p. 57). These guidelines direct users to assess and report any potential NLEB or TCB hibernation habitat in the action area – caves and their associated sinkholes, fissures, and other karst features, as well as anthropogenic features such as abandoned mines and tunnels. Therefore, the Dkey is sensitive to the possibility that an action will affect an area that is within 0.5-mile of an opening to a *potential* NLEB or TCB hibernaculum - a hibernaculum in which the NLEB or TCB has not been recorded.

3.3.1.3 Culverts or Bridges

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, NLEB and TCB are most likely to be found roosting in culverts or bridges during the summer season. In southern portions of their range, NLEB and TCB 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, the Dkey results in a may affect consistency letter if the project would affect any area within 0.25 mile of a bridge or culvert that is known to be occupied by either NLEB or TCB at any time of year.

3.3.2 Protection of Northern Long-Eared Bats and Tricolored Bats in "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 et al. 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 field offices for individual coordination when actions may affect these 'atypical' potential hibernacula in those states.

3.3.3 Blasting and drilling

The DKey includes a series of questions to ensure that blasting is not carried out where it could damage hibernacula, harm hibernating NLEBs or TCBs, or harm roosting NLEBs or TCBs in suitable roosting habitat due to noise or vibration. In some states (Alabama, Arkansas, Kansas, Kentucky, Michigan, Nebraska, New York, and Ohio) all blasting and drilling actions are excluded from the DKey for individual review. In those states FWS staff concluded that the risk posed to NLEBs and/or TCBs by blasting may be too great even when known or potentially suitable hibernacula were not known to occur within the affected area. In other states, DKey users may only proceed with the key if the action will not include drilling, 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 (section 3.3.1.1) or suitable hibernacula (section 3.3.1.2) will ensure that blasting or drilling activities will not impact hibernacula structures or harm hibernating NLEBs 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, TOYRs 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. Drilling is a cutting process where a drill bit is spun to cut a hole of circular cross-section in solid materials. Drilling that does not result in noise or vibrations above the baseline conditions at the site does not need to be considered.

3.3.4 Protection of spring staging/fall swarming habitat

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-miles for NLEB or 3-miles for TCB. In other states, the DKey will direct users to a webpage to help with this determination.

Tree removal that occurs within 0.5 mile 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 fall swarming or spring staging for both species within the hibernating range. Proximity to hibernacula (unless it occurs within 0.5 mile of a hibernacula entrance) is not considered in Zone 1 (Figure 3) 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.

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).

3.3.5 Protection of 'summer' Habitat and Tree-roosting NLEBs and TCBs

3.3.5.1 Tree Removal

3.3.5.1.1 Summer Occupancy Season Tree Removal

<u>NLEB</u>

To ensure that tree removal does not affect NLEBs directly (crushing or injury), the DKey results in a may affect consistency letter if the action includes tree removal 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 removal relative to the potential presence of the NLEB in the affected area, the DKey directs users to Bat Activity Periods for each state in Appendix L of the FWS's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines (FWS 2024a). 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.

In Zone 1 of the year-round active areas, where NLEB 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 Fahrenheit (F) 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.

Actions that include tree removal during the active season may be eligible for a pre-determined consultation outcome of NLAA if there is sufficient information that the NLEB is probably absent, based on a presence/probable absence summer bat survey that targeted the northern long-eared bat in the action area. The survey must have followed the FWS Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (FWS 2024*a*), must have been conducted within the last five years, and the results will have to have been confirmed as valid by the ESFO. To ensure that the ESFO has recognized the survey results as valid, DKey users will be prompted to upload that confirmation. If the survey was conducted without pre-approval of the methods by FWS, the DKey user will have to coordinate with the

ESFO and receive and upload both survey results and field office authorization of the survey design – the same coordination and approval will be needed for any survey that is older than five years.

TCB

To ensure that tree removal does not affect TCBs directly (crushing, injury), the DKey results in a may affect consistency letter 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 L of the FWS's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines (FWS 2024a). 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.

In Zone 1 of the year-round active area where TCB 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 exist tree roosts. These dates have been calculated to include the timeframe when mean winter temperatures fall below 40 degrees F 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.

Actions that include tree removal during the pup season may be eligible for a pre-determined consultation outcome of NLAA if there is sufficient information that the TCB is probably absent, based on a presence/probable absence summer bat survey that targeted the TCB in the action area. The survey must have followed the FWS Range-wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (FWS 2024a), must have been conducted within the last five years, and the results will have to have been confirmed as valid by the ESFO. To ensure that the ESFO has recognized the survey results as valid, Dkey users will be prompted to upload that confirmation. If the survey was conducted without pre-approval of the methods by FWS, the Dkey user will have to coordinate with the ESFO and receive and upload both survey results and field office authorization of the survey design – the same coordination and approval will be needed for any survey that is older than five years.

3.3.5.1.2 Winter Tree Cutting

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, the Dkey results in a may affect consistency letter if the action includes tree cutting above the acreage specified for the action area depending on the forest density category of the 5x5 km grid that the action area is located within (see Section5.4.3). 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, entire). 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 particular forest density categories, from 0-9.9%, 10-19.9%, 20-29.9% and 30-100%. Projects will be eligible for a predetermined consultation outcome of NLAA if the tree cutting acreages are less than or equal to 0.5 acres for the 0- 9.9% category, 5 acres for the 10- 19.9% category, 40 acres for the 20-29.9% category or 100 acres for the 30- 100% category for both NLEB and TCB. The action area may intersect with multiple forest density categories, which are shared as viewable maps in the Dkey where the user can see their project area in relation to the areas included in each forest density map. The Dkey will default to the lowest forest density category that the action area intersects with. The Dkey does not have an ability to average the forest density categories that the action area intersects with. As a result, the lowest category intersected with may represent a small portion of the action area. Projects where this is the case can choose to use the traditional consultation process through the ESFO.

3.3.5.1.3 Protection of Known Roost Trees

The Dkey results in a may affect consistency letter if the project would affect any area within 150 feet of a known NLEB or TCB roosts tree. For most states within the species' ranges, the DKey will use embedded GIS data to identify actions that fall within 150 feet of a known roost tree. Bat location data in the Dkey is hidden to protect sensitive species locations. For a few states within the species' ranges, the DKey will direct users to a webpage where they can find one or more information sources for their state to determine whether their action area occurs within the 150-foot roost tree "buffer".

3.3.5.2 Tree Cutting in Utility Rights-of-Way

To avoid direct impacts to NLEBs and TCBs from tree cutting, limbing and trimming in already established and currently maintained Utility ROWs, the Dkey results in a may affect consistency letter if the action would occur during the time of year restrictions provided for this activity. This is not expected to be applied to roads, only to already established and currently maintained utility ROWs.

1. Pup Season – hibernating range away from hibernacula and year-round active Zone 2.
2. Pup Season plus Fall Swarming and Spring Staging - within 5.0 miles of a hibernacula for NLEB, and within 3.0 miles of a hibernacula for TCB.
3. Pup season plus Winter Torpor- year-round active range Zone 1.

NLEB is a forest-interior species that is not expected to be found roosting in trees within or directly adjacent to or along the edges of a previously cleared and established utility right-of-way (ROW). If NLEB are occasionally roosting in trees along the edges of currently maintained utility ROWs, the time of year restrictions described above further reduce the likelihood of effect to the NLEB because they should be able to rouse and flush from the trees before direct impacts occur. The time-of-year restrictions (TOYR) applied to currently maintained utility ROWs will ensure that non-volant pups and bats in torpor are not harmed as a result of tree cutting.

In addition to TOYRs, tree cutting, trimming and limbing will be limited to actions within already established and currently maintained utility 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 ROWs are small, which further limits the potential effects. If these conditions are met, tree cutting, trimming and limbing will not be restricted to the acreage limits imposed on tree cutting outside currently maintained utility ROWs. 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 NLEB or TCBs, and direct impacts will be avoided by implementing TOYR.

3.3.5.3 Prescribed Fire

To avoid the likelihood that prescribed fire could adversely affect NLEBs and TCBs, the Dkey results in a may affect consistency letter if the action includes prescribed fire that is conducted within suitable habitat for NLEB or TCB unless they include certain conservation measures. Actions that include prescribed fire may be eligible for a 'NLAA determination when they include the following measures:

1. Prescribed fire plan includes average flame length of ≤ 4 feet in western states (CO, KS, MT, NE, ND, NM, OK, SD, UT, WY) or ≤ 8 feet in eastern states (AL, AR, CT, DE, GA, IL, IN, IO, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NH, NJ, NY, OH, PA, RI, SC, TN, TX, VA, VT, WI, WV). These flame lengths are anticipated to be equivalent to conducting prescribed fire at low to medium intensity.
2. Fire is only conducted when temperatures are ≥ 40 degrees F.
3. Fire is conducted outside the pup season.

Unless surveys adequately demonstrate the probable absence of the NLEB or TCB, prescribed fire that will affect suitable summer habitat for the NLEB or TCB during the pup season will not be eligible for a NLAA outcome in the Dkey. This will minimize the likelihood that NLEB 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 affect area, the Dkey directs user to Bat Activity Periods for each state in Appendix L. of the FWS's Range-wide Indiana Bat and Northern long-eared Bat Survey Guidelines (FWS 2024a).

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. In the eastern U.S., fires with average flame length ≤ 8 feet will result in a fire of low to moderate intensity. In the western U.S the prescribed fire plan should include an average flame length of ≤ 4 feet to ensure that prescribed fire will be low to moderate intensity. The designation of average flame lengths accounts for regional variability in conditions, that include, but are not limited to topography, fuel types, and weather conditions. 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 because bats present on the landscape may be in deep torpor at these temperatures. For other activities (e.g., tree cutting), the Dkey implements additional TOYR to avoid impacts to bats that may be in deep torpor while roosting in trees. These TOYR include 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 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.

3.3.6 Protection of Northern Long-Eared Bats and Tricolored Bats in Bridges and Culverts

3.3.6.1 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. The Dkey mostly excludes actions that are eligible to be covered under the Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat, Northern Long-eared Bat, and Tricolored Bat (Transportation Programmatic; FWS 2018, entire). Many of the bridge actions that may affect the NLEB and/or TCB will be covered under the procedures adopted for that programmatic consultation.

Dkey users may have actions, however, that do not have a nexus to any of those three agencies or for which project proponents choose to use the range-wide key. This may include, for example, bridge actions carried out by a federal land management agency or actions carried out by state or local governments that lack federal assistance.

3.3.6.2 Geographically Specific Measures and Transportation Structure Assessments

In several states, the FWS opted to direct any action that may affect a bridge and that was not covered by the Transportation Programmatic to the field office for individual review – those states include Georgia, Michigan, Mississippi, Missouri, and North Dakota. In New Jersey, the Dkey will direct users online to bridge evaluation guidelines specific to the state. In all other states within the range, proponents of bridge actions will have to carry out a site-specific bridge/structure assessment, coordinate directly with the FWS field office, or both. For assessments of bridge and certain other transportation structures that NLEBs or TCBs may inhabit (e.g., culverts), the Dkey directs users to Appendix K of the Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines (FWS 2024a). The DKey instructs users to coordinate with ESFOs before applying the results in the key to ensure that they use only valid results.

There is no record of the NLEB using bridges for roosting in either New Hampshire or Vermont, except for covered bridges (S. Von Oettingen, FWS, pers. comm. 2022). In areas that only include 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. The Dkey will present bridge questions for actions affecting bridges in NH and VT where TCB is present on the official species list.

Compared to bridges, culverts are addressed differently in the DKey. In no state are actions automatically kicked out for ESFO coordination due to effects to a culvert. 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 Appendix K in the FWS's Rangewide Indiana Bat and Northern Long-eared Bat Survey Guidelines at https://www.fws.gov/library/collections/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 feet tall and 23 feet in length. For NLEB, a structure assessment should be conducted if the culvert is greater than 4.5 feet tall and 23 feet 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 NLEB or TCB has 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 the section 5.6. The smallest-diameter and shortest culverts in which NLEBs have been documented was in Louisiana and were 4.5 feet tall and 131 feet long (Nikki Anderson, unpublished data, March 23, 2022). The smallest-diameter and shortest culverts in which TCBs have been documented were in Louisiana. The shortest culvert for TCB was 5.0 feet tall and 23.3 feet long. The smallest-diameter culvert was 2.5 feet tall and 377 feet long. The smallest culvert overall was 3 feet tall and 49.2 feet 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 feet in length do not need to be surveyed. 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 NLEB were based on the height of the shortest culvert where NLEB were found. TCBs have been documented in culverts as small as 2.0 feet in diameter (FWS 2022), however, instances of TCB 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 feet or larger in diameter be considered for assessments for TCB.

3.3.7 Protection of Northern Long-Eared Bats and Tricolored Bats in Buildings

3.3.7.1 Intentional Exclusion of Bats from Buildings

To ensure that intentional exclusion of bats from a building or structure is NLAA NLEBs or TCBs, the DKey will not provide a predetermined consultation outcome for any action that includes this activity. The DKey directs users to seek assistance from FWS to help determine whether bats may be present. The key also provides guidance to ensure that the exclusion, if eventually carried out, is done in a way that would avoid harm to bats.

3.3.7.2 Removal, Modification, or Maintenance of Buildings with Bats

To help ensure that removal, modification, or maintenance of human-made structures (barns, houses, or other buildings) does not adversely affect NLEBs or TCBs, 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.

3.3.8 Potential Impacts of Increased Vehicle Traffic – Ensuring Adequate Review

Increased vehicle traffic may pose a risk to NLEBs and TCBs due to effects of increased risk of collision and noise. Actions eligible for the national bat transportation programmatic will be addressed outside of the range wide key. Therefore, this conservation measure will apply to those transportation actions that fall outside the scope of that consultation.

To ensure that risks to the NLEB caused by increased vehicular traffic are adequately considered by action proponents and FWS, the range wide DKey poses the following questions for actions whose effects occur within 1000’ of suitable NLEB habitat:

1. Will the action directly or indirectly cause construction of one or more new roads that are open to the public? Or, will the action include or cause any construction or other activity that is reasonably certain to increase average daily traffic on one or more existing roads? Or, will the action include or cause any construction or other activity that is reasonably certain to increase the number of travel lanes on an existing thoroughfare?

2. Will any new road, increased traffic, or new lands go through any area of contiguous forest that is greater than or equal to 10 acres in total extent or will any new road pass between two patches of contiguous forest that are each greater than or equal to 10 acres in extent and are separated by less than 1,000 feet?
3. If the answer is 'yes' to each question, 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 feet 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 feet (10 meters) between trees whose tops are at least 66 feet (20 meters) higher than the road surface?"

To ensure that risks to the TCB caused by increased vehicular traffic are adequately considered by action proponents and FWS, the range wide DKey poses the following question for actions whose effects occur within suitable TCB habitat:

1. Will the action directly or indirectly cause construction of one or more new roads that are open to the public? Or will the action include or cause any construction or other activity that is reasonably certain to increase average daily traffic on one or more existing roads? Or will the action include or cause any construction or other activity that is reasonably certain to increase the number of travel lanes on an existing thoroughfare?

The additional questions included for NLEB (questions 2 and 3 above) were not included for TCB due to differences in the biology of the two bat species. NLEB tend to forage within forests or close to forested/wooded edges, therefore, new roads, travel lanes or increases in traffic that are not associated with forested areas are not likely to result in collisions for NLEB. TCB will forage in more open landscapes, therefore, they may be at risk of collision in open areas. As a result, questions to exclude activities in open areas are not referenced for TCB.

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

3.3.9 Addressing Exposure to Water-Borne Contaminants

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 NLEBs and TCBs also drink routinely from surface water sources (Adams and Hayes 2008, p. 1115; Geluso et al. 2018, p. 288). Although NLEBs may prey primarily on terrestrial insects, they do sometimes prey on aquatic insects (Broders et al. 2014, p. 321).

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 be kicked out for individual coordination:

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?

3.3.10 Lighting

To avoid or minimize the likelihood that artificial lighting could adversely affect NLEBs and TCBs, the DKey results in a may affect consistency letter if the action that includes temporary or permanent lighting within 1000' of suitable NLEB or TCB habitat unless they include certain conservation measures. In other words, actions that include lighting may be eligible for a NLAA determination when they include the following measures:

1. The use of downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting) when installing new or replacing existing permanent lights.
2. Or, if using the Backlight, Uplight, Glare (BUG) system developed by the Illuminating Engineering Society, will all three ratings (backlight, uplight, and glare) be as close to zero as is possible, with a priority of "uplight" of 0?

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

1. Will the action direct any temporary lighting away from suitable NLEB or TCB roosting habitat when bats may be present?

4 COVERED SPECIES

The following section includes a summary of relevant background information on the species and critical habitat(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 critical habitats 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 NLEB and proposed endangered TCB.

4.1 SPECIES HABITS AND HABITATS

NLEB

Within the hibernating portion of the NLEB's 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), NLEB 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 breast height (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 1985). 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-miles 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 2024a, p. 52). A 1.5-mile buffer encompasses 4,524 acres.

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). The NLEB has 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 NLEBs 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). NLEB has experienced severe declines following the arrival of WNS. WNS has caused estimated population declines of 97–100 percent across 79 percent of 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 2007b, 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). Juvenile volancy (flight) often occurs by 21 days after birth (Kunz 1971, p. 480; Krochmal and Sparks 2007, p. 651) and has been documented as early as 18 days after birth (Krochmal and Sparks 2007, p. 651).

<u>TCB</u>

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 TCB 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 2007a, 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). Tricolored bats rarely roost in buildings, and when they do, they are often in well-lit or full daylight areas (Barbour and Davis 1969, p. 116). TCB 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-inch [10 centimeter]; 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 feet [5 meters] 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 2007a, 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). Tricolored bats 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). TCB 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). TCB 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).

TCB 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 1.5 miles (2.4 kilometers) of roost trees (Veilleux et al. 2003, p. 1073; Leput 2004, p. 28; Helms 2010, p. 14; Wisconsin DNR 2017b, unpaginated; Wisconsin DNR 2018, p. 11). Maximal distance traveled from roost areas to foraging grounds was 5.6 miles [9.1 kilometers] for a pregnant adult female in Tennessee (Cable and Willcox 2024, p. 6) and 15.2 miles [24.4 kilometers] for 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-miles of known roost trees (Veilleux et al. 2003, p. 1073; Leput 2004, p. 28; Helms 2010, p. 14; Wisconsin DNR 2017b, 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 2024a, p. 52). A 1.5-mile buffer encompasses 4,524 acres.

In the hibernating portion of their range, fall swarming near hibernacula occurs between the summer and winter seasons when male and female TCB converge at cave and mine entrances. 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. TCB 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 tricolored bats 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

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 white-nose syndrome. Due to declines caused by white-nose syndrome 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 (FWS 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 white-nose syndrome, a disease of bats caused by a fungal pathogen. Other primary factors that influence NLEB's viability include wind energy mortality, effects from climate change, and habitat loss (FWS 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 (FWS 2022, p. iv).

For additional information on the NLEB, including the SSA, visit: https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis.

TCB

The TCB's 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 white-nose syndrome (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 (FWS 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 (FWS 2021, p. ii). 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 TCB is also proving to be a consequential stressor at local and regional levels. TCB are killed at wind energy projects primarily through collisions with moving turbine blades (FWS 2021, p. ii; Arnett et al. 2008, p. 64). Loss of roosting, foraging, and commuting habitat may lead to minor or significant impacts to TCB depending on the timing, location, and extent of the removal. Loss or modification of winter habitats may also result in negative impacts to TCB, especially given the species' high site fidelity and narrow microclimate requirements for hibernation. Disturbance during hibernation results in increased arousals in TCB, 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: https://www.fws.gov/species/tricolored-bat-perimyotis-subflavus.

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 critical habitat. 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 critical habitat 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 both NLEB and TCB unless otherwise noted.

5.1 Effects of Noise

5.1.1 Effects of Noise to Foraging and Drinking Bats

<u>NLEB</u>

Exposure to intense night-time noise could have adverse effects on NLEBs 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. 2009, 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. 2009, 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. 2009, 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. 2009, 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 50 meters 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. 2009, p. 3179).

Other sources of night-time noise, like loud music, can have a similar and distracting effects on foraging and also drinking (Domer et al. 2021, p. 499). 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 (Bunkley and Barber 2015, p. 1; Allen et al. 2021, p. 1). 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 50-150 meters (m) from the noise source (Schaub et al. 2009, p. 3179; Bonsen et al. 2015, p. 355). Pallid bats’ foraging efficiency was reduced when exposed to “noise playbacks replicating acoustic conditions as far away as 640 m from a major road and 320 m from a natural gas compressor station bunk (Bunkley and Barber 2015, p. 1120).

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. 4). They found no evidence of habituation across the approximately 2-3 month duration of the two study periods in 2017 and 2018 (Finch et al. 2020, p. 3-5). 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 simulated conditions 7.5 meters from a road (Siemers and Schaub 2011, p. 1646). Similar results were found for pallid bats (*Antrozous pallidus*) “when exposed to played-back traffic and gas compressor station noise in the laboratory” (Bunkley and Barber 2015, p. 1116). Pallid bats are a gleaning species, a trait shared by the NLEB, and increased time needed to locate prey generated sounds by two- to threefold when exposed to both types of noise. Like the findings of Finch et al. (2020) for *Myotis* species, Luo et al. (Luo et al. 2015, p. 3278) found that noise acted as an aversive stimulus and did not mask prey echoes.

Some bats – for example, the piscivorous *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).

<u>TCB</u>

Exposure to intense night-time noise could have adverse effects on TCBs ability to use affected areas for foraging by impairing use of echolocation or causing bats to abandon noisy feeding patches. Luo et al. (2015, entire) 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. 2009, 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. 2009, 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. 2009, 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. 2009).

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 54- 164 yards (y) [50-150 meters (m)] from the noise source (Bonsen et al. 2015, p. 347, 355). Pallid bats' foraging efficiency was reduced when exposed to "noise playbacks replicating acoustic conditions as far away as 700 y [640 m] from a major road and 350 y [320 m] from a natural gas compressor station bunk (Bunkley and Barber 2015, p. 1120).

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 yards [7.5 m] from a road (Siemers and Schaub 2011, p. 1650). Similar results were found for pallid bats (*Antrozous pallidus*) "when exposed to played-back traffic and gas compressor station noise in the laboratory" (Bunkley and Barber 2015). Pallid bats increased time needed to locate prey generated sounds by two- to threefold when exposed to both types of noise. 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 *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 bats *Antrozous pallidus* and *M. myotis* 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).

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 NLEBs or TCBs to respond adversely. Adverse responses could include increased exposure to predators, energy depletion, and physiological stress (Luo et al. 2014, entire). 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.

Day-time noise could cause NLEBs or TCBs to flush from roosts where they may face an increased risk of predation. Clutter-adapted gleaning species, like the NLEB may be particularly vulnerable to predators due to their typically low and slow flight (Mariton et al. 2023, p. 7).

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 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 progress 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. 2009, 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. 2009, p. 3178).

5.1.3 Sources of Chronic or Intense Anthropogenic Noise

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).

5.2 Effects of Artificial Lighting

Artificial lighting at night can fluctuate depending on location, with light pollution tending to be highest in urban areas and lower in rural areas. Natural environments have approximately 0.1 to 0.3 lux illuminance on a night with a full moon. In contrast, artificial light produced from a typical shopping center can be about 200 times more than a full moon at 20- 30 lux (Falchi et al. 2011, p. 2716).

Lighting may deliver both costs and benefits to individual bats, making the net impact difficult to estimate. Avoidance of areas with artificial light may result in increased energy expenditure and reduced opportunity to forage (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 may result in changes in the use of established flight routes and delaying 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 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).

Some bat species use vision for prey capture. Vision may improve when artificial light is present, which may improve a bats ability to orient in these conditions (Polak et al. 2011. p. 25). Bat species that are fast flying may be attracted to white lights due to the high numbers of insects near light sources (Blake et al. 1994; Stone et al. 2009, p. 1125). Insect density tends to be higher under illumination. In addition to light attracting large numbers of insects (Perkin et al. 2014), white streetlights appear to impair the ability of nocturnal insects (particularly moths) to hear bat calls and show evasive flight maneuvers (Polak et al. 2011, p. 25; Stone et al. 2012, p. 2462).

Projects that incorporate certain conservation measures that will limit the ‘spill’ of light into habitat suitable for the 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>NLEB</u>

Bat species such as the 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 areas lit artificially (Threlfall et al. 2013; Pauwels et al. 2019, p. 1; Voigt et al. 2021). As a clutter-adapted, gleaning (picking insects from surfaces) species, we presume NLEB would also be characterized as a “late species.” Late species tend to be “gleaning or flutter-detecting” clutter-adapted species with a prey base that are abundant throughout the night (Threlfall et al. 2013; Mariton et al. 2023, p. 7). This presumed tendency is consistent with NLEB activity patterns analyzed by Gorman (2023, p. 41). Artificial light can delay onset of nightly activity in these “late species”, which are active mostly during the darkest hours (Mariton et al. 2022; 2023). Late species are also typically slow flyers, which may be vulnerable to predation at higher light levels (Lacoeuilhe et al. 2014, p. 7).

Numerous studies involving bat species like the NLEB suggest that artificial light could reduce the suitability of an area for foraging and cause them to avoid lit areas. 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 (Seewagen and Adams 2021, p. 5640). In England, activity of *Myotis* species declined significantly under orange, white, and green light – impacts of red light were also negative, but not significantly so (Zeale et al. 2018, p. 5912). In France, lighting had a significant negative effect on *Myotis* species activity whether the lighting was on for the entire night or for only partial nights (Azam et al. 2015, p. 4336-4337). In Italy, bat activity declined at lit sites “mainly due to the response of the most abundant species, *Myotis daubentonii*” (Russo et al. 2019, p. 1671). In France, lighting intensity had mixed effects on bats, but the effect was significantly negative for *Myotis* species (Lacoeuilhe et al. 2014, p. 3). The light-negative species included aerial hawking and primarily gleaning bats, the two foraging habits used by NLEBs – no gleaning bat species were among light-tolerant species (Lacoeuilhe et al. 2014, p. 4). In the Netherlands, feeding of pond bats (*M. dasycneme*) was reduced by 60% on nights when they were exposed to artificial light versus dark control nights (Kuijper et al. 2008, p. 37). In England and Wales, experimental exposure even to low levels of LED lights reduced activity of *Myotis* species (Stone et al. 2012, p. 2458).

Citing Azam et al. (2018) and Pauwels et al. (2019), Schroer et al. (2020, p. 11) stated that “The behavior of light-sensitive bats can be impaired within the radius of up to 50 m distance to the light source, even if the luminance level is as low as 1 lux” (lx). Azam et al. (2018, p. 130) actually detected streetlight avoidance at values <u>below</u> 1 lux[3] by *Myotis* species and Serotine bat (*Eptesicus serotinus*) at 50 m from a streetlight (Azam et al. 2018, p. 123). They did <u>not</u> detect avoidance at 100 m and recommended “separating streetlights from ecological corridors by at least 50m and to limit vertical light trespass on vegetation to less than 0.1 lx to allow their effective use by light-sensitive bats” (Azam et al. 2018, p. 130).

<u>TCB</u>

Streetlights can have a positive impact on the feeding abilities of some bat species by concentrating a large number of 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. Slow-flying bats that forage in more confined spaces, like NLEB, are often light-averse (Rowse et al. 2016, p. 200). As artificial lighting became common, 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

[3] A lux is “a unit of illumination equal to the direct illumination on a surface that is everywhere one meter from a uniform point source of one candle intensity or equal to one lumen per square meter” (“lux,” Merriam-Webster.com Dictionary, https://www.merriam-webster.com/dictionary/lux. Accessed 1/11/2023).

forraging activity was approximately 4 times higher at sites without artificial night lighting than at sites with artificial light at night, suggesting that TCB show higher activity levels in dark areas.

Illuminated streets and roads have been found to be frequently used as feeding sites by insectivorous bats (Blake et al. 1994, p. 453). Impacts on bats and insects depend on the light spectra associated with streetlamps with ultraviolet wavelengths attracting the most insects (Rowse et al. 2016, p. 187). Blake et al. (1994) found that roads with white streetlamps attracted three times more foraging bats (mostly *Pipistrellus pipistrellus*) than roads with orange streetlamps or unlit roads.

Studies have observed certain species being attracted to artificial light while foraging, including common pipistrelle (*Pipistrellus pipistrellus)* (Blake et al. 1994. p. 406) and northern bats (*Eptesicus nilssoni)* (Rydell 1991, p. 206). Li and Wilkins (2022, p. 829) recorded more acoustic activity and increased foraging rates for big brown bats (*Eptesicus fuscus*), red bats (*Lasiurus borealis*) and silver-haired bats (*Lasionycteris noctivagans*) as artificial light levels increased. Cravens and Boyles (2019, p. 72) observed that red bats are more likely to be observed foraging around lights, while other species avoid lit areas. In southern Sweden, Rydell (1992, p. 744) observed fast-flying species that use long-range echolocation systems (*Nyctalus noctula*, *Vespertilio murinus*, *Eptesicus nilssonii* and occasionally including *Pipistrellus pipistrellus)* were regularly foraging around streetlamps, while *Myotis* spp. did not. In this study, the energy intake of *E. nilssonii* feeding around streetlamps was more than twice as high than when feeding in woodlands (Rydell 1992, p. 744).

The time of evening emergence for bat species may reflect the light level that is tolerated by the bat (Jones and Rydell 1994, p. 452). TCB 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) but may forage closer to ground later in the evening (Mumford and Whitaker 1982, p. 170). They 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). Despite their small size, TCB foraging behavior may have more similarities to larger tree bats than to *Myotis* bats. In a study of managed pine forests in North Carolina, TCB presence was positively related to edges, while *Myotis* species were negatively related to edges (Morris et al. 2010, p. 31). Bats in the genus *Myotis* consistently foraged within stand interiors and avoided edges.

Artificial lighting may result in changes in the use of established flight routes and delaying 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. This suggests 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 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).

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). For *Pipistrellus pygmaeus*, artificial lighting was found to delay roost emergence, but also to provide foraging locations (Hale et al. 2015, p. 2468). Emerging later in the evening may provide open-air flying bat species some protection from diurnal predators (Rydell et al. 1996, p. 249).

An increase in night-time artificial light may result in a delay in foraging, which can cause foraging bats to miss the peak abundance of insects. As a result, TCB 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 *Pipistrellus pygmaeus*, artificial lighting was found to delay roost emergence, but also to provide foraging locations (Hale et al. 2015, p. 2468).

TCB may be less likely to avoid lit areas when foraging and commuting than NLEB. As a result, TCB are less likely to use additional energy attempting to avoid lit areas and artificial light may be less likely to result in negative impacts to foraging suitability. However, artificial light may influence direct impacts to TCB because of the location of the light. Blake et al. (1994, p. 234) showed that for every 1-km section of road, the mean number of bat flight passes was positively correlated with number of white streetlamps as well as to the number of trees and hedgerows. This suggests that bats may be selectively foraging near white streetlamps, which are likely to be positively correlated with proximity to roads. In these cases, bats that are attracted to white streetlamps to forage may be spending more time foraging near roads, and therefore, be at higher risk of collision with road traffic.

Although artificial lighting may have a positive impact on foraging for some bat species, it has been shown to reduce the commuting activity of bats. Stone et al. (2012, p. 2464) showed that disturbance from lights along commuting routes can result in species-specific responses and can vary based on the type of lighting used. The fitness consequences of changes to commuting behavior are hard to quantify. In some instances, artificial lighting is not sufficient to change commuting behavior but is enough to deter crossing, which may reflect perceived predation risk from crossing a gap with higher light levels (Hale et al. 2015, p. 2475). Avoidance of lit areas may cause increased energetic costs, which could impact individual fitness and reproduction.

5.3 LOSS AND DEGRADATION OF AQUATIC RESOURCES

NLEBs and TCB 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 during construction, could reduce the densities of aquatic insects that bats consume. 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. We expect the effects of sedimentation of aquatic resources to be temporary and minimal due to the scale of qualifying actions, the temporary nature of the activity, and the use of the BMPs.

5.4 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, or tree trimming. When tree removal or tree cutting is used, it should be interpreted to mean cutting, or other means of knocking down or bringing down trees, tree topping, or tree trimming.

5.4.1 Northern Long-Eared Bat and Tricolored Bat Roost Trees

<u>NLEB</u>

NLEBs roost in live trees and snags (standing dead trees) ≥3 inches DBH that have exfoliating bark, cracks, crevices, and/or cavities; however, maternity roost trees are typically larger (≥ 9 in DBH). NLEBs typically 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). Roosting habitat is typically within the forest interior and away from 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, etc.) vary with difference in ambient temperatures based on weather and climate (Patriquin et al. 2016, p. 53). NLEBs typically 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; 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). Individual trees may be considered suitable roosting habitat when they exhibit characteristics of suitable roost trees and are within 1,000 feet 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 of trees 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. To a lesser extent, NLEBs have also been observed roosting in colonies in human-made structures, such as in buildings, in barns, on utility poles, behind window shutters, in bridges, and in bat houses (Mumford and Cope 1964, p. 72; Barbour and Davis 1969, p. 77; Cope and Humphrey 1972, p. 9; Burke 1999, pp. 77–78; Sparks et al. 2004, p. 94; Amelon and Burhans 2006, p. 72; Whitaker and Mumford 2009, p. 209; Timpone et al. 2010, p. 119; Bohrman and Fecske 2013, pp. 37, 74; Feldhamer et al. 2003, p. 109; Sasse et al. 2014, p. 172; USFWS 2015, p. 17984; Dowling and O'Dell 2018, p. 376).

<u>TCB</u>

TCB predominantly roost in the foliage of deciduous hardwood trees. TCB 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 2007a, 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 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 2007a, 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-inch [10-centimeter]; 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 feet [5 meters] 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). 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 2016, 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 2007a, 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. Silvas 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 TCB from the removal of suitable roost trees.

5.4.2 Avoiding Effects of Roost Removal in Occupied Habitat during the Active 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. In addition, this may increase the risk of day-time predation compared to TCBs due to differences in roosting ecology. To avoid direct effects to NLEBs while they are roosting in trees, suitable roost trees[4] will only be removed in habitat that may be inhabited by the NLEB during the timeframe when the species is not likely to be present unless site-specific information (e.g., survey) demonstrates probable absence from the Action Area. In addition to avoiding direct effects to NLEB from suitable roost tree cutting, potential indirect effects will be avoided by limiting the amount of habitat removed.

In summer use areas, time of year restrictions are applied during the summer occupancy season to avoid direct effects to the NLEB. This period is longer than TCB restrictions, which are focused on the pup season, because NLEBs may be less likely to flush as easily or effectively as TCBs given their differences in roosting ecology (i.e., propensity to form larger colonies, remain in colonies longer, and roost in tree cracks/crevices). 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 (respond by flying away) when disturbed.

TCB

To avoid direct effects to TCB 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 TCB are in torpor when temperatures are below 40 degrees F in areas where TCB do not hibernate. Within 3.0 miles of known TCB hibernacula, time of year restrictions 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 years are more likely to be below 40 degrees F, 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 TCB 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

[4] Examples of habitats that are *not* suitable for the northern long-eared bat include: 1) individual trees that are greater than 1,000 feet from suitable forested/wooded areas; 2) individual trees in predominantly unforested, developed portions of urban areas (e.g., street trees, downtown areas, scattered yard trees); and stands of trees or shrubs less than 3-inch dbh that do not contain larger trees.

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. We also do not expect additional risk of predation after flushing given TCB are likely more adapted to day-time roost flushing and can find cover quickly, especially compared to NLEB. 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 TCB, 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.

5.4.2.1 Avoiding Effects of Roost Removal during Spring Staging and Fall Swarming

Within the hibernating portion of the range (Figure 3), bats spend the winter season hibernating in caves, then emerge in the spring to migrate back to their summer roosts in trees. NLEB and TCB are emerging from hibernation during the spring. At this time, NLEB and TCB 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, NLEB and TCB will be concentrated in trees near hibernacula (i.e., fall swarming).

To avoid direct effects to NLEB and TCB, in addition to avoiding tree cutting during the summer occupancy season and pup season respectively, suitable roost trees will not be cut during spring staging and fall swarming within 5.0 miles of hibernacula entrances for NLEB and within 3.0 miles 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 years are more likely to be below 40 degrees F, 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.

5.4.2.2 Avoiding Effects of Roost Removal when Bats are in Winter Torpor

NLEB and TCB 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, NLEB and TCB 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). TCB will also roost in cavities in live trees, live and dead leaf clusters, and/or Spanish moss (Sandel et al. 2001, pp. 174–176; Newman et al. 2021, pp. 1335–1336).

To avoid effects to NLEB and TCB 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 are likely to be limited and brief. As a result, the tree cutting TOYRs are limited to the summer occupancy period for NLEB and the pup season for TCB, which are the most vulnerable timeframes. We recognize NLEB and TCB use torpor at other times of the year, especially during cooler spring and fall weather; consequently, protections are in place to avoid effects to TCB 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; FWS 2011, pp. 14–16). Effects of roost tree removal to NLEB and TCB 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 NLEB and/or TCB 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 (FWS 2021, FWS 2022).

To determine whether forest loss within NLEB and TCB home range areas effect 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 of 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 tricolored bats 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 NLEB and TCB, tree removal should be avoided during spring staging/fall swarming periods near hibernacula, and when NLEB or TCB 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).

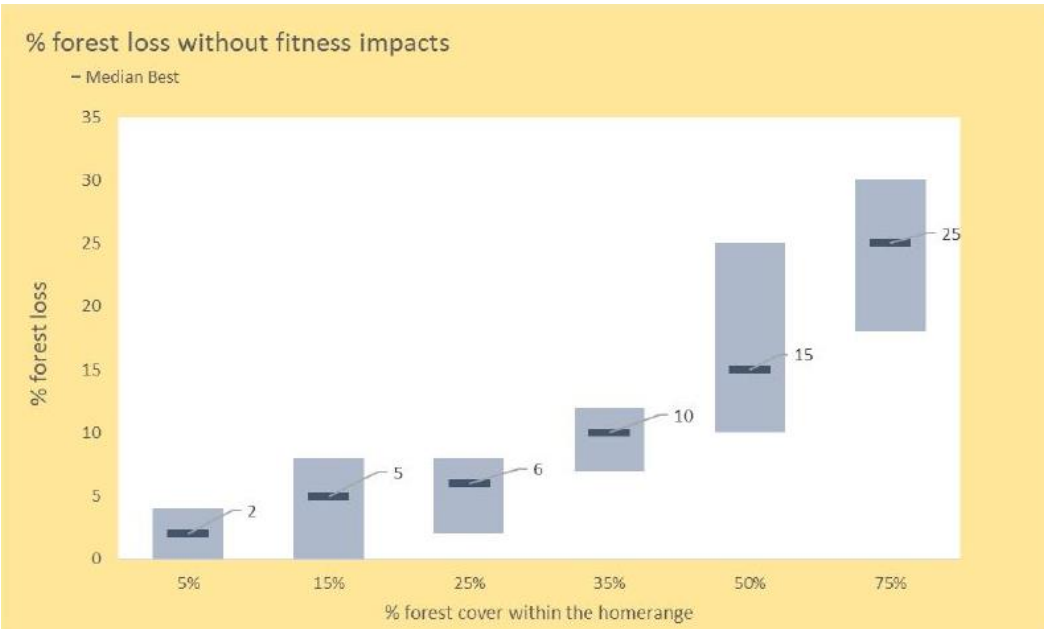

Figure 4. Median estimates of forest loss that can occur without negative impacts incurred. Box represents median lowest (bottom of box), median best (dash line), and median highest (top of box) estimates. X-axis represents the percent forest cover within the hypothetical TCB home range (source: Figure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

Based on the expert's median best estimates of forest loss[5] and our knowledge of the home range size for NLEB and TCB, to avoid effects to NLEB and/or TCB, forest removal will not exceed the following number of acres in each of 4 forest density categories. As described above, we assumed a 4,524-acre 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 if the tree cutting occurs outside the time of year restrictions and acreages are less than or equal to 0.5 acres for the 0- 9.9% category, 5 acres for the 10-19.9% category, 40 acres for the 20-29.9% category or 100 acres for the 30- 100% category.

These thresholds also apply within 5 miles of a known hibernaculum in the hibernating range. In addition, qualifying actions will not remove trees within 0.5-mile of a known NLEB hibernaculum. 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

[5] 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 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.

(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, NLEB 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 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. 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, 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 range from 50 – 200 feet 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. NLEBs are a forest-interior species (Caceres and Pybus 1997). Roosting and foraging habitat are typically within closed intact forest stands (Sasse and Perkins 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.

TCBs may be more likely to be found roosting along established forest edges than NLEB 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 are equivalent to those applied for all tree cutting, trimming or limbing activities, without regard to the activity location.

In summer use areas and year-round active Zone 2, TOYR are applied to avoid direct effects during the pup season for both 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 are implemented within 5.0 miles of NLEB hibernacula and within 3.0 miles 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 a NLEB or TCB home range, and if intersect, 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 TCB or NLEB. Tree cutting may result in the removal of a number of potentially suitable roosts trees for TCB, however, TCB capable of flight are expected to be able to switch roosts without adverse fitness consequences. NLEB 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 Northern Long-Eared and Tricolored 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* – as revised in 2024.

5.5.1 Occurrences of Bats in Transportation Structures

Twenty-four of the 45 U.S. species of bats have been documented using bridges, culverts, and other structures as artificial roosts (Keeley and Tuttle 1999), including Indiana bats, NLEBs and TCBs. 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 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); culverts in at least five states: Indiana (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). TCBs have been documented using bridges in at least three states: Louisiana (Ferrara and Leberg 2005), South Carolina (Newman 2020), and Minnesota (Christopher E. Smith, MnDOT, pers. comm. 2023), and culverts in southeastern states along the Gulf of Mexico and Atlantic coastlines. TCBs have been documented using bridges in at least four states: 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), and culverts in southeastern states along the Gulf of Mexico and Atlantic coastlines.

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. Feldhamer et al. (2003) surveyed 232 bridges in southern Illinois and found four species of bats using 15 bridges. NLEBs comprised 3 percent of the bats found and TCBs comprised 18.4 percent of the bats found. In Louisiana, Ferrara and Leberg (2005) documented 7 NLEBs and 79 TCBs, during 902 bridge surveys, which were conducted from 2002 to 2003. TCB represented 4% of total bats detected, while NLEB represented 0.4% of total bats detected. Of 53 bridges surveyed at night, only 15 percent were occupied, and the only species was Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) (i.e., the 7 NLEBs and 79 TCBs detected were using the bridges as day roosts). 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), two NLEBs were found under two different concrete bridges (one was a 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).

Katzenmeyer (2016) conducted a comprehensive assessment of transportation structures in Mississippi between November and March from 2010 to 2015. Although neither Indiana bats 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 TCBs second most abundant. More recently, as part of the 2023 Mississippi Bats and Bridges Initiative, 113 culverts and 33 bridges were surveyed in seven Mississippi counties from late August – October. Twenty-nine culverts and three bridges were occupied by NLEBs (representing a 26 percent and 9 percent occupancy rate respectively out of the total number of culverts/bridges surveyed) in six counties (McCartney et al. 2024). A total of 76 NLEBs were documented in the 29 culverts and three bridges, with 18 of the culverts containing one individual each. Thirteen of the sites contained two – five individuals each and one site (a bridge) contained 17 individuals.

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 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 tall by 200 ft long. The following species were documented using culverts as roosting sites in North Carolina: gray bat, southeastern bat (*M. austroriparius*), 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 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 (CD17) 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 NLEBs, TCBs, cave myotis, big brown bats, and gray bats roosting in culverts (P. Crawford, ODOT, pers. comm.)

TCBs utilize both bridges and culverts in many parts of the range, and they have been detected in both structure types 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. 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.

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 11 +/- 4.6 degrees Celsius (C) in accessible tree cavities, with temperature fluctuations of and 4.0 +/- 1.9 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).

TCBs usage of nontraditional roost sites such as 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. 2022) and potentially proximity to other roosts and suitable summer habitat (Sandel et al. 2001). Meierhofer et al. (2022) suggested ambient weather conditions, including humidity, determine occupancy of culverts by TCBs. In culvert hibernacula in Texas, maximum and minimum temperatures ranged from -6 to 27 degrees C for 1995–1996 and -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 of Mexico 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 2022, 2019; Sandel et. al 2001). 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.

Ferrara et al (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). 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 35-40 degrees F (1.7-4.4 degrees C) with some large culvert roosts located within 50-100 kilometers north of this zone. The TCB year-round active range (Figure 3) was defined by a team of FWS biologists, where bat data was available, by cross-referencing documented "winter" activity (e.g., captures, acoustics, and culvert use) with the number of frost-free days >/= 200 (https://fws.maps.arcgis.com/home/item.html?id=edd2f5723d3a47df9c71ac8ddbf8f277). In the absence of bat data, the team of FWS biologists relied on the best information available from states with data and more loosely followed the number of frost-free days line (see Section 2.0).

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 Indiana bats 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 deep, 0.5 -1.25 in wide, 10 ft or more above the ground, and typically not located over busy roadways. The Feldhamer et al. 2003 study reported an average height for 9 of the roosts of 16.7 ft (5.1 m) above the ground. 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 unreported) 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 miles (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 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) 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 0.4 m (1.3 ft) and 1.2 m^2 (3.9 ft^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 1.2 – 2.2 m (3.9-7.2 ft) height, 1.2-1.8 m (3.9-5.9 ft) width, and 60-120 m (197-394 ft) 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 0.6 m (2 ft) and .93 m (3 ft) 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 NLEB in the 2023 Mississippi Bats and Bridges Initiative survey were all cement box culverts ranging in length from 40 – 400 ft long and 2 – 12 ft high and wide.

A July 2014 survey in Missouri found two NLEBs in a culvert with an entrance measuring approximately 9 ft 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 NLEBs 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. NLEBs co-occurred in these culverts with southeastern myotis, TCBs, 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 TCBs 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 Federal Highway Administration, in collaboration with the FWS, conducted an analysis of bridge/culvert and structure bat assessment forms that had been uploaded through the Information for Planning and Consultation (IPaC) system between 2016-2019. Data were also provided by 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%) of these structures (see Table 3). Where evidence of bats was observed, 184 structures (71%) included information on the species present (Table 4). While Indiana bats and NLEBs have been observed using bridges and culverts, none were reported in this analysis[6]. However, TCBs were documented as a species found using both bridges and culverts.

Table 1. 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%*

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

Table 2. 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**
Rafin'sque'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 1 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 Indiana bat 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) (one culvert), and the maximum was 9 ft (2.74 m). TCBs were found in the minimum and maximum culvert heights. Only three culverts of the 53 with evidence of bats were ≤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 ≥ 4 ft (1.22 m) in height (southeastern myotis, TCB, Rafinesque's big-eared bat, and gray bat).

Table 3. 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 4. 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 miles 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 one of the 20 CMPs/RCPs were occupied by TCBs. Within the 6 stone culverts, 1-2 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 TCBs 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''. The smallest entrance heights of occupied culverts were as short as 10'' or were collapsed all together. Occupied culvert lengths varied from 36 to 83 ft. The CMP/RCP combo pipe containing 12 TCBs (9 TCBS on the CMP and 3 TCBSs on the RCP) was 83 ft long; its largest entrance, though only 29'' under field conditions due to fill and water, was a 3 ft diameter CMP/RCP. This culvert had limited airflow potentially due to a smaller inlet opening measuring 10'' by 24''.

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 distinguish 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 (0.4m – 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% of culverts (6 culverts) under 4 ft (1.2 m) had evidence of bat use, with neither Indiana bats nor NLEBs identified. Only 3 of the 6 culverts under 4 ft (1.2 m) had evidence of TCBs, only 1 of which was <3 ft (0.9 m).

Culverts less than 4.5 ft (1.2 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; 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 in diameter (as reported above); however, instances of TCB 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 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 (2016) 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 NLEBs, or TCBs but later in time, prior to or during construction, these bats are observed. Also, 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 NLEB, TCB and at least some other imperiled bats, 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 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. 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). 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 (*M. daubentonii*) were killed more frequently than high-flying aerial hawkers (*N. noctula*). 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 (*B. 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 bats crossed at open fields, they flew much lower than canopy height (<2 m), and when adjacent canopy was low, bats crossed lower and closer to traffic. The NLEB forages at lower heights (3 to 10 ft [1 to 3 m]) than Indiana bats (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 is likely to occur even on unpaved roads. Ramalho et al. (2021) did not find bat carcasses along the dirt roads they surveyed but suspected that bat-vehicle collisions on dirt roads are "especially underestimated" due to low carcass detectability. The difficulty of finding bat carcasses may result in significant underestimates of roadkill of NLEB, TCB and other bats (Russell et al. 2009, p. 57).

The risk of vehicle collisions for NLEBs 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 cross roads/rails to reach their foraging areas.

In Pennsylvania, Indiana bats 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 Indiana bats were consistent with a study in Michigan where Indiana bats "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 NLEBs 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 (>20m), bats crossed well above traffic. Where it was low (≤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 20 meters or less.

5.6.2 Roads as Barriers to Commuting Bats

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). 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 Indiana bat 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 Indiana bat data in related to road networks founds that roads with only moderate traffic volume (e.g., >10 vehicles/5-minutes) may act as "filters" where vehicle collisions may be the primary concern whereas those with high traffic volume (>200 vehicles/5-minutes) act as barriers to movement (Bennett et al. 2013, p. 979). For comparison, traffic volume at the time of the highway-crossing study discussed in the previous section was about 8,569 vehicles per day – about 30 vehicles/5-minutes (Russell et al. 2009, p. 58). Searches of a 5.5 mi 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). In this study the road did not function as a barrier – but as a partially permeable filter.

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. 2009, p. 3179). When vehicles were present, 60% of documented Indiana bats 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 cross roads with low traffic volume (Zurcher et al. 2010, p. 337). Well-established major 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). 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 (*Barbastella barbastellus*) and Bechstein's bats (*Myotis bechsteinii*), 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).

5.6.3 Effects of Roads and the Determination Key

<u>NLEB</u>

In the DKey, we assume that NLEBs are unlikely to fly across an unforested area that is greater than 1000 feet wide and that NLEBs are unlikely to inhabit forest unless it is present as a contiguously forested area of 10 acres or more. This is based on the propensity for NLEBs, a forest-interior species, to remain in or near forested habitat and to generally avoid open areas. It is consistent with studies along roads that have found evidence that clutter-adapted Myotis species "may be deterred by the road-gap due to risks associated with sensory limitations and preference towards flying close to vegetation" (Chapman 2022, p. 44-45).

We explain in the DKey that contiguous forest may consist of multiple forest patches that are separated by less than 1000 feet of non-forested area – for example, two forest patches of 5 acres each would constitute 10 acres of contiguous forest if the two patches were within 1000 feet of one another. If a new road, new travel lanes, or other actions that are likely to increase vehicle traffic are proposed for an area where suitably large, forested habitat patches are present, we assess whether NLEB would be able to cross the road safely by flying less than 33 feet between forest patches on either side of the road.

TCB

TCB are more likely to fly across an unforested area than NLEB. TCBs forage at treetop or above (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116). TCB will forage 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; Kurta 1995; Lacki and Hutchinson 1999; Ford et al. 2005; Menzel et al. 2005; Thames 2020). Therefore, assumptions made in the key about road or traffic proximity to forest and a bat's ability to successfully cross a road in forested areas have not been applied to TCB. As a result, projects that include new roads, new travel lanes on existing roads, or additional daily traffic on existing roads are referred to the FO for additional review.

5.7 Effects of Prescribed Fire

Forest-dwelling bats, including the wide-ranging NLEB and TCB, were presumably adapted to the fire driven disturbance regime that preceded European settlement and to the habitat types that resulted from fire suppression in many parts of the eastern U.S. The impact of fire suppression on populations of NLEBs and TCBs 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

NLEB

Little is known about the direct effects of fire on cavity and bark roosting bats, such as the 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; Spietel 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 non-volant bats and adults with pups respond to fire is unknown. Non-volant pups and NLEBs in torpor during cold temperatures are likely the most vulnerable to death and injury from prescribed fire. NLEBs flushing from trees during the day may be exposed to greater risk of predation, however, 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 NLEBs flushed from trees during prescribed fire is expected to be discountable.

<u>TCB</u>

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 2007a, 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). Tricolored bats 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 tricolored bats 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 NLEB, 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 and TCBs in torpor during cold temperatures are likely the most vulnerable to death and injury from prescribed fire. To avoid direct effects to TCB, prescribed fire will not be conducted when flightless young are present unless site-specific information (e.g., survey) demonstrates probable absence from the Action Area.

5.7.1.2 Effects of Heat and Smoke

During warm temperatures, bats can arouse from short-term torpor quickly. Most adult bats are quick, flying at speeds > 30 km/hour (Patterson and Hardin 1969, p. 153) and able to escape to unburned areas. NLEB and TCB 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 harm from death or injury directly or from predation that could occur when NLEBs or TCBs flee prescribed burns. We expect this to occur when 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 (<4.5 degrees C or 40 degrees F) when bats are in deeper torpor.

At least some 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 Indiana bat 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 of Roost Availability

Fire can affect availability of roosting sites for NLEB (cavities, crevices, loose bark) by creating or consuming snags, which typically provide these features, or by creating these features in live trees. 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, 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 Indiana bats 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 et al. 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 could affect hibernating 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 mine, 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). To avoid impacts to hibernacula, all projects within 0.5 mile of known hibernacula entrances will go to field offices for individual review. In addition, all projects within 0.25 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 NLEB. 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 stimulate 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. NLEB 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.

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 Act's requirements. 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 lead field offices for the NLEB and TCB.

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, the FWS will determine what questions need to be asked across the range of both species relative to any potential new information. 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 ES Field Office with the questions needed. In addition to seeking out key information directly from FWS field offices, the DKey sponsor will also review published scientific literature for new and relevant information – see 6.1.3, below.

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 standing analysis to assess any new information for potential revisions to the 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 NLEB and TCB to determine whether the GIS data incorporated into the 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.

6.1.4 Reinitiation of Consultation

Determinations obtained through the Northern Long-eared Bat and Tricolored Bat Range-wide Dkey 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 critical habitat 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 critical habitat that was not considered previously.

For the first trigger, the 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

Ecological Services Field Offices within the covered area will have the opportunity to audit 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 field office 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 field office will establish their own process for auditing Dkey submissions, but across all field offices, a sufficient number of Dkey submissions will be audited to ensure accurate use. The auditing process will allow FOs to assess the aggregate effects of the projects that have used the Dkey.

6.1.6 Review of Cumulative Effects

The process of auditing Dkey submissions and FWS’s project tracking system will provide an opportunity for field office 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 Act. EcoSphere 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. Field Office 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 Act 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 Act 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 critical habitat are occurring in a manner or to an extent not considered in this SA based on applied use; or 2) If the species or critical habitat covered by the SA has a change in status.

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