Northern Long-Eared Bat Section 7 Documentation

For

ADMINISTRATIVE ACTION
ENVIRONMENTAL IMPACT STATEMENT

Wake and Johnston Counties

STIP Project Nos. R-2721, R-2828, and R-2829
State Project Nos. 6.401078, 6.401079, and 6.401080
Federal Aid Project Nos. STP-0540(19), STP-0540(20), and STP-0540(21)
WBS Nos. 37673.1.TA2, 35516.1.TA2, and 35517.1.TA1

July 2015

DOCUMENTATION

Complete 540 - Triangle Expressway Southeast Extension
Northern Long-Eared Bat Section 7 Documentation
NCDOT STIP Project No. R-2721, R-2828, R-2829
Wake and Johnston Counties

The included documentation relates to coordination efforts relative to the northern long-eared bat (NLEB, *Myotis septentrionalis)* in eastern North Carolina (NCDOT Divisions 1-8). This coordination was conducted primarily between the US Fish and Wildlife Service (USFWS), the US Army Corps of Engineers (USACE), the Federal Highway Administration (FHWA), and the North Carolina Department of Transportation (NCDOT).

The Complete 540 project is located in NCDOT Division 4 and 5. Therefore, the attached documentation applies to this project.

The following documents are attached. A divider page is used to separate the various documents.

A. USFWS letter dated April 10, 2015 to the FHWA and the USACE – this letter adopts the USFWS's March 25, 2015 conference opinion as the Programmatic Biological Opinion for the NLEB in eastern North Carolina (NCDOT Divisions 1-8) effective May 4, 2015.

B. FHWA and USACE letter dated April 9, 2015 to the USFWS – this letter requests that the USFWS confirm their March 25, 2015 conference opinion as the biological opinion.

C. USFWS letter dated March 25, 2015 to the FHWA and the USACE and attached USFWS Programmatic Conference Opinion – this letter and the attached conference opinion applies to all NCDOT activities with a federal nexus in NCDOT Divisions 1-8 relative to the NLEB.

D. FHWA and USACE letter dated January 13, 2015 to the USFWS and attached Programmatic Biological Assessment – this letter initiates formal Section 7 conference relative to the NLEB in eastern North Carolina (NCDOT Divisions 1-8) and includes the Programmatic Biological Opinion for the NLEB as prepared by NCDOT.

ATTACHMENT A

USFWS letter dated April 10, 2015 to the FHWA and the USACE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

April 10, 2015

John F. Sullivan III, PE
Federal Highway Administration
North Carolina Division
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Scott McLendon
US Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403

Dear Mr. Sullivan and Mr. McLendon:

This letter is in response to your letter of April 9, 2015 regarding the U.S. Fish and Wildlife Service (Service) Programmatic Conference Opinion for North Carolina Department of Transportation (NCDOT) activities in eastern North Carolina (Divisions 1-8) and their effects on the northern long-eared bat (NLEB, *Myotis septentrionalis*). The Service issued the Conference Opinion on March 25, 2015. Subsequently, the final rule designating the NLEB as a federally threatened species was published on April 2, 2015 and becomes effective on May 4, 2015. You have requested that the Service confirm our Conference Opinion as the Programmatic Biological Opinion for the NLEB. This response is provided in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543).

Since the issuance of the Conference Opinion, we understand that there have been no significant changes in the action as planned or in the information used during the conference. Therefore, effective May 4, 2015, the Service will officially adopt our Conference Opinion as the Programmatic Biological Opinion for the NLEB.

We believe that the requirements of Section 7(a)(2) of the ESA have been satisfied for the NLEB in eastern North Carolina (NCDOT Divisions 1-8). However, any individual project which may affect any other federally threatened or endangered species must undergo its own Section 7 consultation on a project-by-project basis. Also, obligations under Section 7 consultation must be reconsidered if new information reveals impacts of this identified action that may affect the NLEB in a manner not previously considered in this review or if this action is subsequently modified in a manner that was not considered in this review. If you have any questions concerning the Programmatic Biological Opinion, please contact me at (919) 856-4520 (Ext. 11).

Sincerely,

Pete Benjamin
Field Supervisor

Electronic copy:

Donnie Brew, FHWA, Raleigh, NC
Brian Yanchik, FHWA, Summerville, SC
Richard Hancock, NCDOT, Raleigh, NC
Phil Harris, NCDOT, Raleigh, NC
Felix Davila, FHWA, Raleigh, NC
Ron Lucas, FHWA, Raleigh, NC
Henry Wicker, USACE, Wilmington, NC
Lori Beckwith, USACE, Asheville, NC
Tracey Wheeler, USACE, Washington, NC
Tom Steffens, USACE, Washington, NC
Brad Shaver, USACE, Wilmington, NC
Liz Hair, USACE, Wilmington, NC
Eric Alsmeyer, USACE, Wake Forest, NC
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Neil Medlin, NCDOT, Raleigh, NC
Heather Wallace, NCDOT, Raleigh, NC
Mary Frazer, NCDOT, Raleigh, NC
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Clay Willis, NCDOT, Edenton, NC
Jay Johnson, NCDOT, Greenville, NC
Stonewall Mathis, NCDOT, Castle Hayne, NC
Chad Coggins, NCDOT, Wilson, NC
Chris Murray, NCDOT, Durham, NC
James Rerko, NCDOT, Fayetteville, NC
Jerry Parker, NCDOT, Greensboro, NC
Art King, NCDOT, Aberdeen, NC
Jill Utrup, USFWS, Bloomington, MN
Forest Clark, USFWS, Bloomington, IN
Marella Buncick, USFWS, Asheville, NC
Jason Mays, USFWS, Asheville, NC
Sue Cameron, USFWS, Asheville, NC
Cynthia Van Der Wiele, USEPA, Raleigh, NC
Travis Wilson, NCWRC, Creedmoor, NC

ATTACHMENT B

FHWA and USACE letter dated April 9, 2015 to the USFWS

U.S. Department of Transportation
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, NC 27601

DEPARTMENT OF THE ARMY
WILMINGTION DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTION, NORTH CAROLINA 28403-1343

April 9, 2015

In Reply Refer To:
HDA-NC

Mr. Pete Benjamin
Field Supervisor
U.S. Fish and Wildlife Service
Raleigh Field Office
551F Pylon Drive
Raleigh, NC 27606

Dear Mr. Benjamin:

On January 13, 2015, the Federal Highway Administration (FHWA) and the U.S. Army Corps of Engineers (USACE), Wilmington District, requested the initiation of formal conference for the northern long-eared bat (NLEB). Formal conference was requested for North Carolina Department of Transportation (NCDOT) projects implemented in Divisions 1-8. In response, your office issued a conference opinion (CO) on March 25, 2015.

On April 2, 2015, the northern long-eared bat (NLEB) was formally listed as a threatened species under the Endangered Species Act (ESA). FHWA and USACE, therefore, request that the U.S. Fish and Wildlife Service (USFWS) confirm the conference opinion (CO) as a biological opinion (BO). There have been no significant changes in the proposed action or with the information used in the conference.

If you have any questions, please contact Donnie Brew at (919) 747-7017, or donnie.brew@dot.gov; and/or Lori Beckwith at (828) 271-7980, ext. 223, or loretta.a.beckwith@usace.army.mil.

Sincerely,

Clarence W. Coleman Jr.

for John F. Sullivan, III, P.E.
Division Administrator
North Carolina Division

Sincerely,

Scott McLendon
Chief, Regulatory Division
Wilmington District

CF:
Richard Hancock, NCDOT, PDEA

ATTACHMENT C

USFWS letter dated March 25, 2015
to the FHWA and the USACE
and the
USFWS Programmatic Conference Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

March 25, 2015

John F. Sullivan III, PE
Federal Highway Administration
North Carolina Division
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Scott McLendon
US Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403

Dear Mr. Sullivan and Mr. McLendon:

This document transmits the U.S. Fish and Wildlife Service's (Service) Conference Opinion based on our programmatic review of North Carolina Department of Transportation (NCDOT) activities in eastern North Carolina (Divisions 1-8) and their effects on the northern long-eared bat (NLEB, *Myotis septentrionalis*), a species federally proposed for listing under the Endangered Species Act of 1973 (ESA). This Conference Opinion is provided in accordance with Section 7(a)(4) of the ESA, as amended (16 U.S.C. 1531 *et seq.*). Your January 13, 2015 request for formal conference and accompanying Programmatic Biological Assessment (dated January 9, 2015) were received on January 16, 2015.

The Federal Highway Administration (NC Division) and the U.S. Army Corps of Engineers (Wilmington District) have determined that, collectively, federally funded and federally permitted activities implemented by NCDOT in eastern North Carolina (Divisions 1-8) may affect and are likely to adversely affect the NLEB. Therefore, this programmatic Section 7 conference will consider all NCDOT activities with a federal nexus in NCDOT Divisions 1-8 as a single action. It is understood that the Federal Highway Administration will be the lead federal action agency when individual projects are federally funded, whereas the U.S. Army Corps of Engineers will typically be the lead federal action agency when there is no federal funding for a project and a Clean Water Act Section 404 permit is required.

This Programmatic Conference Opinion only addresses the NLEB and should not, by itself, be necessarily construed as completing Section 7 consultation for any specific project. Any individual project which may affect any other federally threatened or endangered species must undergo its own Section 7 consultation on a project-by-project basis. If you have any questions concerning this Programmatic Conference Opinion, please contact me at (919) 856-4520 (Ext. 11).

Sincerely,

Pete Benjamin
Field Supervisor

Electronic copy:

Donnie Brew, FHWA, Raleigh, NC
Richard Hancock, NCDOT, Raleigh, NC
Phil Harris, NCDOT, Raleigh, NC
Felix Davila, FHWA, Raleigh, NC
Ron Lucas, FHWA, Raleigh, NC
Henry Wicker, USACE, Wilmington, NC
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Jason Mays, USFWS, Asheville, NC
Sue Cameron, USFWS, Asheville, NC
Cynthia Van Der Wiele, USEPA, Raleigh, NC
Travis Wilson, NCWRC, Creedmoor, NC

The following Programmatic Conference Opinion (PCO) is based on information provided in the *Programmatic Biological Assessment: Northern Long-Eared Bat (Myotis septentrionalis) in Eastern North Carolina* (PBA), scientific literature, meetings, emails, and other sources of published and unpublished information. A complete administrative record of this conference is on file at this office.

CONFERENCE HISTORY

March 24, 2014 – Staff from the Service, Federal Highway Administration (FHWA), and North Carolina Department of Transportation (NCDOT) met to discuss the need for a formal Section 7 conference for the proposed listed NLEB.

May 28, 2014 – Staff from the Service, FHWA, NCDOT, and U.S. Army Corps of Engineers (USACE) met to discuss the development of a programmatic formal Section 7 conference.

June 3, 2014 – Staff from the Service, FHWA, NCDOT, and USACE met to discuss the development of a programmatic formal Section 7 conference.

June 11, 2014 – Staff from the Service, FHWA, NCDOT, and USACE met to discuss the development of a programmatic formal Section 7 conference.

June 26, 2014 – Staff from the Service, FHWA, NCDOT, and USACE met to discuss the development of a programmatic formal Section 7 conference.

July 14, 2014 – Staff from the Service, FHWA, NCDOT, and USACE met to discuss the development of a programmatic formal Section 7 conference.

August 4, 2014 – Staff from the Service, FHWA, NCDOT, USACE, and North Carolina Wildlife Resources Commission (NCWRC) met to discuss the development of a programmatic formal Section 7 conference.

August 25, 2014 – The Service provided comments on an early rough draft PBA.

August 25, 2014 – Staff from the Service, FHWA, NCDOT, USACE, and NCWRC met to discuss the development of the PBA.

September 18, 2014 – Staff from the Service, FHWA, NCDOT, USACE, and NCWRC met to discuss the development of the PBA.

October 7, 2014 – Staff from the Service, FHWA, NCDOT, USACE, and NCWRC met to discuss the development of the PBA.

October 30, 2014 – Staff from the Service, FHWA, NCDOT, USACE, and NCWRC met to discuss the development of the PBA.

November 17, 2014 – Staff from the Service, FHWA, NCDOT, USACE, and NCWRC met to discuss the development of the PBA.

October – December 2014 – The Service provided comments on multiple drafts of the PBA.

January 16, 2015 – The Service received a letter from the FHWA and USACE, dated January 13, 2015 with the attached PBA, requesting a formal conference for potential effects to the NLEB that could result from the implementation of NCDOT activities in Divisions 1-8.

January 22, 2015 – The Service sent a letter to the FHWA and USACE stating that all information required for initiation of conferencing was either included with their January 13, 2015 letter or was otherwise available.

March 2, 2015 – The Service provided the FHWA, USACE, and NCDOT with a draft PCO.

PROGRAMMATIC CONFERENCE OPINION

I. DESCRIPTION OF PROPOSED ACTION

NCDOT Program Overview

North Carolina is one of only a few states that have no county highway departments. With about 80,000 miles of state-owned and maintained highways, NCDOT has one of the two largest state-owned and maintained highway systems in the country (USDOT 2013). NCDOT constructs and maintains a wide variety of transportation infrastructure across the state, including aviation, bicycle, pedestrian, ferry, highway, public transportation, and railroad projects. NCDOT has divided the state into 14 geographical divisions. Typically larger projects are planned as part of the Statewide Transportation Improvement Program (STIP), while smaller projects are planned within the local Division Office. Most state transportation projects eventually become the responsibility of the local NCDOT Division Offices to maintain.

NCDOT projects are tracked by project type and a unique number. NCDOT STIP and Division project types, including commonly used prefixes, are listed below (Table 1) with brief descriptions adapted from the STIP (NCDOT 2015).

Table 1. NCDOT STIP and Division Project Types and Descriptions

Prefix	Project Type	Description
B	Bridge Replacement in STIP	Existing bridges are replaced. These projects are generally larger or more complicated than the next two categories.
BD	Bridge Replacement in Division	Existing bridges are replaced. Generally these are two lane bridges.
BP	Bridge Preservation in Division	Existing bridges are preserved by supplementing or replacing compromising elements.

Prefix	Project Type	Description
C	Congestion Mitigation	Addition of lanes, sidewalks, greenways, trails, intersections, and associated crosswalks and signage for improved movement
E	Enhancement	Installation of interactive signage, visitor's exhibits and/or gateway or interruptive markers intended for scenic beautification
EE	Mitigation	Wetland and stream mitigation in the form of enhancement, restoration, or preservation is conducted to offset losses due to project construction
EB, ER	Bike Route and Pedestrian Enhancement	New or additional lanes for bike or pedestrian traffic
EL	Enhancements – Multi-use Path	Ramp, parking lot, or visitor center improvements, preservation, or maintenance
F	Ferry	Dock, ramp, engine, ferry, parking lot, or visitor center improvements, preservation, or maintenance
FS	Feasibility Study	Conducted to determine the degree to which the project is justified (economically, environmentally, socially, financially)
I	Interstate	Pavement preservation or maintenance, access improvement, widening, upgrading intersections, bridge preservation and/or adding lanes along interstates
K	Rest Area	Existing or new rest area ramp, parking, sewer, fixtures and finishes installation or preservation
L	Landscape	Plantings or replantings along NCDOT projects.
P	Passenger Rail	Rail grade separations, track realignment, track improvement, track and station right of way acquisition, and track bypass installation
R, A, M	Rural	Improvements to existing and new locations, road widening, intersection or interchange improvements, traffic circles, and weigh stations improvements
S, SB	Scenic Byway	Waysides, overlooks, interpretive signs, land conservation to implement resource protection and heritage tourism development to enhance and preserve scenic vistas and tourism corridors
SF, SI, W	Highway Safety and Hazard	Realign curves, install median barriers, install shoulders or turn lanes to improve safety
SR	Safe Routes to School	Improve safety and/or reduce traffic, fuel consumption, and air pollution in vicinity of schools; also includes education, training, and other non-infrastructure needs
U	Urban	Roadway improvements including new lanes, new location extensions, bridge replacements, grade separations, interchange and intersection conversion
X	Special Projects	New location and new structures
Y,Z	Railroad-Highway Crossings	Grade separation and crossing safety improvements

For the purposes of this programmatic consultation, NCDOT projects (STIP and Division) have been grouped and categorized as follows:

1. New Construction
2. Safety and Mobility
3. Maintenance and Preservation
4. Disaster Response, Bank Stabilization, and Sinkhole Repair
5. Transportation Enhancements

The proposed action evaluated in this PCO includes all of the NCDOT activities in NCDOT Divisions 1-8 (eastern North Carolina) with a federal nexus.

NCDOT Program Details

In order to conduct a thorough effects analysis of the NCDOT activities on the NLEB, each of the above categories of projects was broken down into a list of potential activities and sub-activities and are described below.

1. New Construction (category)
New construction includes activities for roadway and railway construction and improvements, bridge and culvert construction and replacement, and the development of construction staging areas. Vehicle and heavy equipment use are involved in all aspects of new construction. New construction projects typically reduce and modify habitat, increase impervious surface area, and increase disturbance. Many of these projects affect undeveloped or undisturbed property, require the acquisition of additional right-of-way (ROW), and involve impacts to native vegetation. Contractors may need to establish project equipment staging areas and parking areas. Often, existing road surfaces or parking areas can be utilized. However, if heavy equipment staging is necessary in vegetated areas, temporary impacts to sensitive habitats can occur.

The NCDOT anticipates there will be approximately 1,436 projects within this category over the next five years within the action area.

Staging areas/site prep (activity)
Staging areas/project site prep covers preparations at the project site itself and staging areas. Staging areas are places where equipment, a temporary field office, and materials are temporarily stored or located in preparation for their use during construction. These areas are typically located within or closely adjacent to the construction site.

Lighting (subactivity under staging areas/site prep)
The use of lighting to illuminate project work involves installing permanent highway illumination and traffic signals. Lighting may also be used temporarily in order to conduct construction activities during the evening and nighttime hours.

Tree clearing and grubbing (subactivities under staging areas/site prep)
Tree clearing and clearing of other vegetation is performed to prepare the project area for construction activities. Clearing generally takes place within pre-marked areas in the project area necessary for construction purposes. The initial access into work areas for clearing activities will be via existing public roads, but clearing for temporary access roads may also be needed. Clearing consists of cutting and removing above-ground vegetation such as grasses, brush, and trees; removing downed timber and other vegetative debris; and salvaging marketable timber. Grubbing will follow clearing operations to remove any remaining surface vegetation and buried debris. Clearing and grubbing are required prior to earthwork in order to remove vegetative and other debris from work areas so that design specifications (e.g. for compaction) can be met. Trees, stumps, and large roots will be removed from excavation areas to a depth sufficient to prevent such objectionable material from becoming mixed with the material being incorporated in the embankment. All extraneous matter will be removed and disposed of in designated waste areas on or off-site by chipping, burying, or other methods of disposal, including burning. Various methods and equipment will be used for this work. Clearing and grubbing takes place within construction limits, but may also occur in temporary construction easements used to assemble and store the construction vehicles that are too large to travel on the highway in one piece (e.g. haul trucks, earthmovers, large dozers, large excavators, hoes, etc.). These areas are also used to store supplies (erosion control materials, steel rebar and mesh, small diameter culverts, traffic signs and posts, office trailers, etc.).

Earthwork (subactivity under staging areas/site prep)
Earthwork is all earth moving activities that will occur for road and interchange construction, access road construction/relocation, utility placement and relocation, construction of drainage structures, and preparation of staging, maintenance, waste, and borrow areas. Earthmoving activities will include excavating (cutting), filling, ditching, backfilling, grading, embankment construction, auguring, disking, ripping, grading, leveling, borrowing and wasting of materials, and any other earth-moving work required in the construction of the project. Earthmoving equipment to be used includes haul trucks, dozers, excavators, scrapers, and backhoes. Earthwork may be conducted as part of the preparation of staging areas, bridge approaches, alignments, embankments, fills, backfills, foundations, toe trenches, road grades, utility relocation, stormwater treatment, ditch construction, bank stabilization, landscaping, restoration, and mitigation.

Blasting (subactivity under staging areas/site prep)
Blasting may be required on a limited number of projects. Timing and duration of the blasting will vary on a project-by-project basis. Blasting consists of excavating in rock to achieve smooth, unfractured backslopes. It can also involve blasting to facilitate excavation. Bridgework may require blasting during the construction or removal of bridge abutments. Debris or rock disposal may be required after blasting.

Dust control (subactivity under staging areas/site prep)
Performing earthwork activities may necessitate the use of dust control measures. This work consists of applying water for the alleviation or prevention of dust nuisance originating from earthwork construction operation from within the project construction limits.

Install erosion and sediment control best management practices (BMPs) (subactivity under staging areas/site prep)
This work includes the installation of silt fences, check dams, sediment basins, coir blankets and temporary seeding.

Structure demolition (subactivity under staging areas/site prep)
Structures within the project ROW will be purchased and either demolished or moved (intact) off-site prior to the commencement of construction work. Structures include commercial, residential, and public buildings and facilities. After demolition, structure debris is hauled off-site for disposal.

Installation of drainage features (subactivity under staging areas/site prep)
This work may include work area isolation; stream diversion; dewatering; excavation for pipe trenches, ditch creation and stream relocation; culvert jacking or drilling; laying and covering pipe; constructing headwalls on the outlet side of flow diversion; installing armoring; and restoring flow.

Utility relocation (subactivity under staging areas/site prep)
Utility relocation or placement can involve both above and below-ground work, including tree clearing, mowing, trenching, and horizontal or directional bore. When water, sewer, electric, or gas lines need to be relocated, these impacts are typically accounted for during project planning and permitting. In the rare event that utility lines would need to be relocated outside a project right of way, the utility company will be responsible for obtaining their own permits. In this rare instance, tree clearing would not be accounted for by NCDOT.

Other project site prep subactivities

- portable fence installation/removal
- temporary access road construction, which requires installation of geofabric and rock
- gravel workspace

Offsite use areas (activity)
Waste and borrow areas that are used to dispose of and obtain materials for earthwork are also subject to clearing and grubbing, but the contractor is responsible for addressing federally listed threatened and endangered species issues per NCDOT standard specifications. Most borrow and waste areas are sited in areas of previously disturbed habitat where tree removal is minimal.

Road surface preparation and construction (activity)
The activity of road surface preparation and construction also includes the construction of bicycle and pedestrian facilities. This activity may include the following sub-activities:

- construct stormwater facilities
- final grading and road/trail bed preparation
- construct barrier wall and retaining wall (mechanically stabilized earth, soil nail, sheet pile, soldier pile, etc.)
- application of course aggregate, concrete, or asphalt
- striping, pavement markers, and signage
- guard rail installation
- noise wall construction
- sidewalk installation

New rail track construction (activity)
This activity includes the following subactivities:

- subgrade installation (building up ballast/rail bed)
- laying track

Bridge/culvert construction (activity)
Work included in this activity includes bridge construction and replacement, construction and replacement of culverts over three feet in diameter, and widening of existing bridges and culverts.

Many of NCDOT's traditional bridge replacement projects take as little as 9 months, and low-impact bridges can be completed in as little as 3-6 months. Culvert replacements are typically even shorter in duration. Installation of new bridges may require the installation of an on-site detour bridge. Occasionally, half of the new bridge is constructed adjacent to the old bridge and acts as the detour bridge while the original bridge is removed and replaced.

Geotechnical investigations (drilling) are necessary for any type of construction work that requires a level of underground stability. They are normally needed to determine appropriate designs for bridge foundations.

Foundations are required elements of every bridge construction and replacement project. Bridge foundations consist of three general types: 1) drilled shafts, 2) columns on spread footings, and 3) driven piles and pile-supported caps or walls. Driven piles are normally used to support temporary structures such as detour bridges and work bridges. However, driven piles are also used to provide additional support to spread footings.

In-water work may take place during many activities associated with bridge construction, excluding superstructure construction. Best Management Practices (BMPs) are used to protect water quality during in-water work, and special BMPs apply in High Quality Waters, Outstanding Resource Waters, and in N.C. Carolina Coastal Area Management Act counties (NCDOT 2003).

Bridge and culvert construction include the following subactivities:

- barge use - anchor spud installation, mooring, operation
- temporary work trestle/platform/detour bridge/causeway construction and removal
    - impact/vibratory pile driving
    - deck installation
    - pile removal (vibratory hammer, direct pull, etc.)
- bridge demolition (for replacement)
    - work area isolation (cofferdam installation, impact/vibratory pile driving, dewatering)
    - remove piles, footings, piers, bridge decking, rail bed, etc. (vibratory pile driver, clamshell bucket, containment boom)
    - wire saw concrete cutting, crane use
    - hoe ram use, debris containment, excavation
- substructure construction (piers, shafts, shaft caps, footings, abutments, foundations)
    - work area isolation (cofferdam installation, impact/vibratory pile driving, dewatering)
    - drilled shaft construction (auger drills hole within casing) or impact pile driving
    - install casing and rebar
    - pour concrete
    - spread footing construction
    - riprap installation
- superstructure construction
    - pier tables, cantilevers, decking, pre-cast concrete or steel girders, crane use

Post-construction activities

In addition to temporary BMPs used during construction, NCDOT implements a post-construction stormwater program in accordance with its National Pollutant Discharge Elimination System (NPDES) permit. Post-construction structural BMPs are permanent controls that treat stormwater runoff from stabilized drainage areas to protect water quality, reduce pollutant loading, and minimize post-construction impacts to water quality. Because post-construction BMPs are permanent, they require a long-term maintenance commitment to function as designed. Subactivities include:

- temporary BMP removal (silt fencing, check dams, sediment basin)
- fence installation
- landscaping/beautification/site stabilization

Billboards (activity)

NCDOT has entered into an agreement with the FHWA regarding the control of outdoor advertising in areas adjacent to any highway which is or becomes a part of the National Highway System. No person shall erect and/or maintain any outdoor advertising within 660 feet of the highway ROW without first obtaining a permit from NCDOT. Constructing or maintaining a billboard may involve tree removal along highways. Vegetation cutting, thinning, pruning, or removal by billboard owners cannot be conducted without a permit by NCDOT.

The current tree clearing limit along federal primary highways is 380 feet for rural roads and 340 feet for roads within city limits. Statewide, there are an estimated 8,000 billboards. Up to 750 permits may be issued annually for vegetation removal statewide (Coleman 2012). In addition to tree clearing, billboards may also involve long-term lighting.

2. Safety and Mobility Improvement (category)
Safety and mobility improvement projects include many of the same activities and subactivities described under the New Construction category such as tree clearing and grubbing. Vehicle and heavy equipment use will be required for all projects and portable lighting may be used for some projects.

Safety projects are designed to improve the safety of the highway system and not to add capacity. These include signal and illumination improvements, sign installation, installation of sidewalks, tree removal from the clear zone, guard rail installation, railroad grade separation, and alignment modifications. Alignment modifications may include adding auxiliary lanes (e.g. truck climbing and acceleration lanes), channelization (turn lanes), on and off ramp extensions, or realigning an intersection to improve the sight distance.

Mobility improvement projects are designed to improve traffic operations and/or capacity on existing roadways. Typical projects include construction of high occupancy vehicle (HOV) lanes in urban areas, reconstructing existing interchanges, construction of new interchanges, adding additional lanes, and sidewalk, curb and shoulder construction. Overpass, bridge, and culvert replacement and widening may occur as part of a mobility improvement project.

Most mobility improvement projects generally occur in heavily developed urban areas. Many of these projects affect very little undeveloped or undisturbed property, and many occur in the existing ROW in heavily urbanized areas.

The NCDOT anticipates there will be approximately 601 projects within this category over the next five years within the action area.

Intelligent transportation systems (activity)
Intelligent transportation systems are advanced applications that strive to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and smarter use of transport networks. This includes all modes of transport and incorporates current and evolving computer and communication technologies with the goal of improving traffic conditions, minimizing delays, and increasing safety for all commuters. This primarily involves the following subactivities: sign and camera installations.

Railroad protective device installation (activity)
This activity involves the installation of signals and other safety features where railroads intersect at grade or where railroads intersect roads at grade.

Railroad grade separation (activity)
Railroad grade separation involves the alignment of two or more surfaces, associated with similar or dissimilar transport types of differing elevations. This typically consists of the creation of an overpass or underpass to allow for continued flow of activity at the axis/intersection of the transport facilities. Subactivities include:

- staging areas
- project site prep
- install drainage features
- utility lines
- pre-watering of roads and exposed areas in construction site for dust control or grading

Road surface, railroad bed preparation and construction (activity)
The preparation of and construction of road surfaces and railroad beds may involve the following subactivities:

- construct stormwater facilities
- final grading and road/rail bed preparation
- retaining wall construction
- course aggregate application, concrete or asphalt application
- striping, pavement markers and signage
- railroad crossing gate installation
- guard rail installation
- sidewalk, curb, and shoulder construction

Signal system improvements (activity)
Signal system improvements involve changes or upgrades to signaling system.

3. Maintenance and Preservation (category)
All activities under this category will require the use of vehicles. Many will require the use of heavy equipment and portable lighting. Minor tree clearing and grubbing may be required on some maintenance, preservation, and facilities preservation projects.

The NCDOT anticipates there will be approximately 392 projects within this category over the next five years within the action area.

Bridge painting (activity)
Steel bridges or bridges with steel sections require painting on an as-needed basis, approximately every 10 years. Bridge painting involves abrasive blasting to remove all corrosion, washing the bridge, and then applying a number of coats of paint. Bridge painting and rehabilitation both require human presence above and below bridges. Bridge painting involves the following subactivities:

- construct scaffolding
- install full containment (includes vacuum system for capturing wash water)
- pressure wash bridge

- sandblast bridge
- prime/paint bridge
- remove containment and scaffolding

Bridge rehabilitation (activity)
Bridge deck repairs occur regularly while bridge deck replacement is infrequent. Bridge decks that are made of concrete are partially removed and replaced. Removal may involve jackhammers, concrete saws, and hydro milling (high-pressure water). Longer bridges have expansion joints that must be repaired and replaced as needed. Bridge repair, painting, and retrofit projects may involve hanging scaffolding and containment devices under and around the bridges.

Bridge repair and maintenance activities include washing, sandblasting, patching, bonding, and filling voids in concrete with epoxy. Similar washing, sandblasting, and patching may be implemented for maintenance of guardrails and other infrastructure. In addition, this action may occasionally include minor replacement and repair of bridge structural elements, such as individual trusses, stringers, and girders. Generally, this work requires the use of light equipment, primarily handheld power tools. However, replacement or repair of bridge structure elements, such as individual trusses, stringers, and girders may require the use of heavy equipment. In-water work similar to that previously described under **Bridge/culvert construction** may take place during many activities associated with bridge rehabilitation projects.

Bridge rehabilitation subactivities include:
- install scaffolding and containment
- replace rivets, degraded steel, bridge railing, joint seals, bearing work
- seal cracks (Shotcrete)
- repair concrete spalling
- repair bridge approaches
- repair/replace electrical system
- bridge deck replacement
- bridge demolition
    - install scaffolding and containment
    - mill, break up, or use hydro-demolition to remove existing deck
    - use vacuum truck or sweeper to remove debris
    - repair/replace finger joints
    - pour new deck
    - remove containment and scaffolding

Culvert cleaning/repair (activity)
This activity includes regular removal of debris, vegetation, and sediment. Culvert cleaning/repair includes the following subactivities:
- divert flow, dewater as previously described
- clean culvert

- install culvert liner (complete or invert)
- patch repair (metal or concrete, coat and seal)
- headwall or outfall repair (concrete work or riprap installation)
- repair joints (band installation, inject grout)
- line with Shotcrete or Gunnite
- sandblast/repaint/recoat

Drainage improvements (activity)
This activity includes all work necessary to maintain roadside ditches and channels, cross culverts, catch basins and inlets, and detention/retention basins. Slope and ditch repair involves re-grading ditches and slopes to the appropriate contour and filling in or repairing sides of the ditches where necessary. Regular maintenance of roadside ditches is required to remove built up sediments, debris or blockages, re-slope the sides, and maintain capacity. Removal of newly constructed beaver dams is often necessary when the dams affect the effectiveness of storm drainage facilities. Each construction project has an associated staging area which contains the construction company job site headquarters, parking, equipment, materials storage, refueling tanks, etc.

Catch basins and inlets and retention facilities are part of the storm drain system of the highway. These are designed to trap sediments and liquids, and require regular cleaning. Material is removed by manual clearing methods or by using a vacuum truck. Solids are stored on NCDOT property, tested, and then disposed of at an approved disposal facility or recycled as fill material if suitable. Regular cleaning improves water quality and minimizes sediments that enter the natural stream systems. Drainage improvement subactivities include:

- clean and reshape ditches (remove vegetation, sediment, debris)
- culvert repair work
- clean catch basins/inlets (manually or vacuum truck)
- remove beaver dams from culvert ends
- remove sediment from retention/detention facilities
- dispose of debris and vegetation

Guardrail replacement (activity)
Guardrail replacement includes the following subactivities:

- remove damaged guardrail
- install posts with post driver
- install steel beam

Pavement rehab and resurfacing (activity)
This activity involves patching, repairing, and replacing of roadway surfaces and pavements. Each section of highway paved with asphalt or concrete must be repaved every 10 to 14 years. If the pavement is in good shape, it may be overlaid with a new layer of asphalt, but badly deteriorated pavement requires the replacement of the foundation material. Typically, the existing asphalt pavement is ground off and replaced or simply overlaid with new asphalt. Ground off pavement is normally recycled and used to make new asphalt pavement.

Since paving may result in a slightly higher road surface, manholes, drainage inlets, valves, guardrails, and survey monuments may require raising. Ditches and slopes may be repaired, and culverts may be cleaned. Culverts may also require extension as part of pavement rehab and resurfacing projects. Pavement rehab and resurfacing include the following subactivities:

- seal cracks with liquid asphalt
- blanket application of liquid asphalt
- apply aggregate
- finish with power roller
- grind (mill) existing pavement
- collect and dispose of pavement grindings/slurry
- dowel bar placement (if concrete)
- apply new pavement

Herbicidal spraying within ROW (activity)
This activity involves treating roadside vegetation using chemical control treatment methods that are applied by hand or by vehicle-mounted sprayers. Herbicide is used to control vegetation where manual or mechanical means would be cost-prohibitive or result in excessive soil disturbance or other resource damage. All herbicides are used according to manufacturer's label direction for rates, concentrations, exposure times, and application methods. Only formulations approved for aquatic-use will be applied in or adjacent to wetlands, lakes, and streams. The use of spot herbicide applications is periodically used to control tree limb growth.

Mowing (activity)
Mowing occurs regularly along roadside shoulders during the growing season and extends less frequently to the back of roadside ditches.

Mechanical branch removal along ROW (activity)
This is regular maintenance targeted at woody vegetation that occurs along the edges of existing transportation corridors. The NCDOT maintains a safety recovery zone of 40 feet from the edge of the travel lane to allow errant vehicles to recover. The use of A-boom mowers has been the routine method of limb removal along the tree line. NCDOT also contracts the use of machinery equipped with a series of high speed rotary saws on a heavy-duty skidder apparatus which cuts the limbs smoothly as it moves along the ROW. There is no set schedule for addressing limb removal, and trimming limbs may wait until there is a complaint or problem. NCDOT also periodically contracts for the removal of a swath of roadside trees to set the woods line back to the original desired safety recovery distance when it has become overgrown over the course of several years. This generally requires the removal of 10 to 20 feet of wooded buffer area.

Hazard tree removal (activity)
This occurs along the edges of existing transportation corridors and involves the removal of individual trees with the potential to fall or drop branches in areas that may cause safety issues.

Repair ROW fence (activity)

Facility rehabilitation (activity)
This activity includes the preservation, maintenance, and construction of new weigh stations, rest areas, rail stations, and maintenance facilities. Rehabilitation of historic buildings and other historic structures may also occur. Subactivities at these facilities may include:

- paving
- expansion of buildings and parking areas
- septic upgrades
- minor vegetation alteration and removal (including trees)
- installation of erosion and sediment control
- overlay, paving
- excavation
- herbicide application
- painting/striping/signing
- rehab historic rail buildings and other non-bridge structures

Reconstruct existing rail (activity):
Reconstructing existing rail includes the following subactivities:

- install new rail, concrete ties, and resurface stone ballast
- pavement resurfacing at crossings and approaches
- upgrade signals and warning systems

Snow removal/deicers (activity)
Snow removal and deicing is conducted sporadically in eastern North Carolina. Stormwater pollution prevention plans are developed for NCDOT maintenance facilities where deicers are stored and loaded, and where equipment repair is conducted.

Bridge inspections (activity)
This activity involves a detailed review of each bridge's superstructure, deck, supports, railing, and pavement to check the functionality and safety of each bridge. This activity requires the presence of humans in close proximity to where bats may be roosting. Each bridge is inspected every 24 months on average, but a few older structures may be inspected every 12 months.

4. Disaster Response, Bank Stabilization and Sinkhole Repair (category)
There is no way to accurately predict all the activities that may occur within this category since they are entirely dependent on the extent and type of damage and level of repair that will be needed. Minor tree clearing and grubbing may be required on some disaster response, bank stabilization, and sinkhole repair projects in order to provide access for equipment. Vehicles, heavy equipment, and portable lighting may be used.

Since it is not possible to accurately predict or account for projects in this category, an estimated number of projects in this category cannot be determined. However, most NCDOT divisions report dealing with disaster situations once every 3-10 years. One exception to this is NCDOT Division 1 which incurs hurricane and other severe storm damage more frequently than other Divisions.

Disaster response (activity)
Disasters are usually weather-driven events from flooding, ice-storms, or hurricanes. Disaster response activities involve emergency work to repair and stabilize eroding banks or shoulders on sections of rivers, streams, and the ocean adjacent to existing highways. Emergency repairs to bridges and roadbeds may also be necessary. Temporary bridges may be constructed. High water flows during floods can cause erosion of the bank to the point that the adjacent highway is undermined. Other flood damage can include clogged culverts and deposition of debris along transportation corridors. Immediate repairs normally involve protection or reconstruction of the highway and associated infrastructure such as bridges, culverts, and utilities. Disaster response includes the following subactivities:

- debris removal
- construct temporary access road
- vegetation removal/disposal
- grading
- install/remove temporary erosion control
- barge use
- riprap installation
- road reconstruction (rebuild roadbed, add drainage structures, repave, paint)
- fill newly created breaches
- sandbag installation/replacement
- water removal (pumping water from flooded areas)
- culvert cleaning/repair

Bank stabilization/flood damage/scour repair - non-emergency (activity)
These activities stem from the result of natural changes in river or stream morphology over time. These activities normally involve protection of the highway and associated infrastructure such as culverts and utilities. Clogged culverts often require cleaning or may need upgraded to a larger size to prevent further flow restrictions. Other repairs involve river training techniques to redirect the thalweg away from the road. These techniques include placing riprap, barbs, drop structures, groins, or large woody debris in the waterway. Subactivities include:

- debris removal
- construct temporary access road
- vegetation removal/disposal
- grading
- barge use
- riprap installation
- willow staking
- in-stream structure installation (weirs, barbs, logjams, etc.)
- road reconstruction (rebuild roadbed, add drainage structures, repave, paint)
- retaining wall construction
- landscaping/site stabilization
- install/remove temporary erosion control

Sinkhole repair (activity)
Sinkhole repair will involve some level of earthwork and may rarely include tree clearing and grubbing, depending on the extent of damage. Sinkhole repair subactivities include:

- excavate and/or flush loose material
- place non-concrete fill material
- place concrete fill
- compact fill
- restore roadway

5. Transportation Enhancements (category)
Transportation enhancements can include bicycle and pedestrian facility construction and historic bridge rehabilitation. Other activities include the construction of turnouts, overlooks, historic markers, and viewpoints. Such activities could be consistent with new roadway construction; however, these are much smaller in scale with less vegetation removal, disturbance, etc. Minor tree clearing, grubbing, and earthwork may be required on some transportation enhancement projects. Portable lights, vehicles, and heavy equipment may also be used.

The NCDOT anticipates there will be approximately 154 projects within this category over the next five years within the action area.

Subactivities include:

- permanent lighting installed
- install/remove portable fence
- prepare project site
- install drainage features
- utility lines
- pre-watering of roads and exposed areas for dust control or grading
- road and parking lot surface preparation and construction
- construct stormwater facilities
- final grading
- construct retaining wall (mechanically stabilized earth, soil nail, sheet pile, soldier pile, etc.)
- course aggregate application, concrete or asphalt application
- striping, pavement markers and signage
- guard rail installation
- sidewalk installation
- information kiosk construction
- post-construction work

Conservation Measures

Conservation measures represent actions, pledged in the project description, that the action agency will implement to minimize the effects of the proposed action and further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agency. Since conservation measures are part of the proposed action, their implementation is required under the terms of the consultation. The NCDOT has agreed to implement the following conservation measure:

NCDOT will conduct a five-year NLEB research study with four objectives. First, acoustic surveys will be conducted to determine the distribution of NLEB in eastern North Carolina. Second, results from acoustical surveys will be used to guide mist-netting surveys. Captured NLEB will be equipped with radio transmitters and tracked to aid in the characterization of summer and winter roosting habitat and activity. Third, NLEB will be checked for presence and severity of white nose syndrome. Finally, structures (bridges, culverts, and buildings) will be assessed to determine frequency and seasonality of NLEB use. See Appendix B for details of the research.

Action Area

The action area is the 59 eastern-most counties of North Carolina, which comprises NCDOT Divisions 1-8 (out of the 14 total Divisions). North Carolina counties within the action area are listed by NCDOT Division in Table 2 and shown in Figure 2 (Appendix A).

Table 2. NCDOT Divisions and Counties within Action Area

Division 1	Bertie, Camden, Chowan, Currituck, Dare, Gates, Hertford, Hyde, Martin, Northampton, Pasquotank, Perquimans, Tyrrell, Washington
Division 2	Beaufort, Carteret, Craven, Greene, Jones, Lenoir, Pamlico, Pitt
Division 3	Brunswick, Duplin, New Hanover, Onslow, Pender, Sampson
Division 4	Edgecombe, Halifax, Johnson, Nash, Wayne, Wilson
Division 5	Durham, Franklin, Granville, Person, Vance, Wake, Warren
Division 6	Bladen, Columbus, Cumberland, Harnett, Robeson
Division 7	Alamance, Caswell, Guilford, Orange, Rockingham
Division 8	Chatham, Hoke, Lee, Montgomery, Moore, Randolph, Richmond, Scotland

The action area is a mosaic of federal, state, and private lands. Using Level III EPA Ecoregions (USEPA 2013), the action area can be divided into the Middle Atlantic Coastal Plain, Southeastern Plains, and the Piedmont (see Figure 1 in Appendix A).

Middle Atlantic Coastal Plain (Ecoregion 63)

Ecoregion 63 is found primarily in the Carolinas and other states to the north. It consists of low elevation, flat plains, with many swamps, marshes, and estuaries. Forest cover in the region, once dominated by longleaf pine, is now mostly loblolly and some shortleaf pine, with patches of oak, gum, and cypress near major streams. Its low terraces, marshes, dunes, barrier islands, and beaches are underlain by unconsolidated sediments. Poorly drained soils are common, and the region has a mix of coarse and finer textured soils. Ecoregion 63 is typically lower, flatter, more poorly drained, and marshier than Ecoregion 65 (see below). Pine plantations for pulpwood and lumber are typical, with some areas of cropland (USEPA 2002).

Southeastern Plains (Ecoregion 65)
These irregular plains with broad inter-stream areas have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation was historically predominantly longleaf pine, with smaller areas of oak-hickory-pine. On some moist sites, southern mixed forest occurred with beech, sweetgum, southern magnolia, laurel and live oaks, and various pines. The Cretaceous or Tertiary sands, silts, and clays of the region contrast geologically with the metamorphic and igneous rocks of the Piedmont (see below). Streams in this area are relatively low-gradient and sandy-bottomed (USEPA 2002).

North Carolina Piedmont (Ecoregion 45)
Considered the non-mountainous portion of the Appalachians Highland by physiographers, the northeast-southwest trending Piedmont ecoregion comprises a transitional area between the mostly mountainous ecoregions of the Appalachians to the northwest and the relatively flat coastal plain to the southeast. It is a complex mosaic of Precambrian and Paleozoic metamorphic and igneous rocks with moderately dissected irregular plains and some hills. Once largely cultivated, much of this region is in planted pine or has reverted to successional pine and hardwood woodlands. The historic oak-hickory-pine forest was dominated by white oak, southern red oak, post oak, and hickory, with shortleaf pine, loblolly pine, and to the north and west, Virginia pine. The soils tend to be finer-textured than in coastal plain regions (USEPA 2002).

II. STATUS OF THE SPECIES

A. Species/critical habitat description

The northern long-eared bat (NLEB) is a medium-sized bat species, with an average adult body weight of 5 to 8 grams, with females tending to be slightly larger than males (Caceres and Pybus 1997). Average body length ranges from 77 to 95 mm and wingspan between 228 and 258 mm (Barbour and Davis 1969, Caceres and Barclay 2000). Pelage (fur) colors include medium to dark brown on its back, dark brown ears and wing membranes, and tawny to pale-brown fur on the ventral side (Nagorsen and Brigham 1993, Whitaker and Mumford 2008). As indicated by its common name, the NLEB is distinguished from other *Myotis* species by its long ears (average 17 mm, Whitaker and Mumford 2008) that, when laid forward, extend beyond the nose but less than 5 mm beyond the muzzle (Caceres and Barclay 2000). The tragus (projection of skin in front of the external ear) is long (average 9 mm), pointed, and symmetrical (Nagorsen and Brigham 1993, Whitaker and Mumford 2008).

The NLEB was once considered a subspecies of Keen's long-eared Myotis (*Myotis keenii)* (Fitch and Schump 1979), but was later recognized as a distinct species by van Zyll de Jong (1979) based on geographic separation and difference in morphology (Nagorsen and Brigham 1993, Caceres and Pybus 1997, Whitaker and Hamilton 1998, Caceres and Barclay 2000, Simmons

2005, Whitaker and Mumford 2008). No subspecies have been described for this species (van Zyll de Jong 1985, Nagorsen and Brigham 1993, Whitaker and Mumford 2008).

The range of the NLEB includes much of the eastern and north-central United States, and portions of all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and eastern British Columbia. Within the United States, this area includes all or portions of the following 39 States: Alabama, Arkansas, Connecticut, Delaware, the District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming (USFWS 2014a). However, throughout the majority of the species' range it is patchily distributed and historically was less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

The Service proposed to list the NLEB as an endangered species on October 2, 2013 (USFWS 2013). On June 30, 2014, the Service reopened the comment period and announced a six-month extension for making a final listing determination for the NLEB, extending the due date until April 2, 2015 (USFWS 2014c). The Service subsequently proposed listing the NLEB with a rule under Section 4(d) of the ESA on January 16, 2015 (USFWS 2015). No critical habitat for the species has been proposed at this time.

B. Life history

NLEBs predominantly overwinter in hibernacula that include caves and abandoned mines. Hibernacula used by NLEBs are typically large, with large passages and entrances (Raesly and Gates 1987), relatively constant and cooler temperatures (32° to 48° F) (Raesly and Gates 1987, Caceres and Pybus 1997, Brack 2007), and with high humidity and no air currents (Fitch and Shump 1979, van Zyll de Jong 1985, Raesly and Gates 1987, Caceres and Pybus 1997). NLEBs are typically found roosting in small crevices or cracks in cave or mine walls or ceilings, often with only the nose and ears visible, thus are easily overlooked during surveys (Griffin 1940, Barbour and Davis 1969, Caire *et al.* 1979, van Zyll de Jong 1985, Caceres and Pybus 1997, Whitaker and Mumford 2008). Caire *et al.* (1979) and Whitaker and Mumford (2008) commonly observed individuals exiting caves with mud and clay on their fur, also suggesting the bats were roosting in tighter recesses of hibernacula. They are also found hanging in the open, although not as frequently as in cracks and crevices (Barbour and Davis 1969, Whitaker and Mumford 2008).

To a lesser extent, NLEBs have been found overwintering in other types of habitat that resemble cave or mine hibernacula, including abandoned railroad tunnels. Also, in 1952 three NLEBs were found hibernating near the entrance of a storm sewer in central Minnesota (Goehring 1954). Kurta and Teramino (1994) found NLEBs hibernating in a hydro-electric dam facility in

Michigan. In Massachusetts, NLEBs have been found hibernating in the Sudbury Aqueduct (French 2012). Griffin (1945) found NLEBs in December in Massachusetts in a dry well.

During the summer, NLEBs typically roost singly or in colonies underneath bark or in cavities or crevices of both live trees and snags (Sasse and Perkins 1996, Foster and Kurta 1999, Owen *et al.* 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone *et al.* 2010). Males and non-reproductive females' summer roost sites may also include cooler locations, including caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006). NLEBs have also been observed roosting in colonies in manmade structures such as buildings, barns, a park pavilion, sheds, cabins, under eaves of buildings, behind window shutters, and in bat houses (Mumford and Cope 1964; Barbour and Davis 1969; Cope and Humphrey 1972; Amelon and Burhans 2006; Whitaker and Mumford 2008; Timpone *et al.* 2010; Joe Kath 2013, pers. comm. cited in USFWS 2013).

The NLEB appears to be opportunistic in tree roost selection, selecting varying roost tree species and types of roosts throughout its range, including tree species such as black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*) (Mumford and Cope 1964, Clark *et al.* 1987, Sasse and Pekins 1996, Foster and Kurta 1999, Lacki and Schwierjohann 2001, Owen *et al.* 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone *et al.* 2010). NLEBs most likely are not dependent on certain species of trees for roosts throughout their range; rather, certain tree species will form suitable cavities or retain bark and the bats will use them opportunistically (Foster and Kurta 1999). Carter and Felhamer (2005) speculated that structural complexity of habitat or available roosting resources are more important factors than the actual tree species.

Many studies have documented the NLEB's selection of live trees and snags, with a range of 10 to 53% selection of live roosts found (Sasse and Perkins 1996, Foster and Kurta 1999, Lacki and Schwierjohann 2001, Menzel *et al.* 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone *et al.* 2010). Foster and Kurta (1999) found 53% of roosts in Michigan were in living trees, whereas in New Hampshire, 34% of roosts were in snags (Sasse and Pekins 1996). The use of live trees versus snags may reflect the availability of such structures in study areas (Perry and Thill 2007) and the flexibility in roost selection when there is a sympatric bat species present (*e.g.,* Indiana bat, *Myotis sodalis*) (Timpone *et al.* 2010). In tree roosts, NLEBs are typically found beneath loose bark or within cavities and have been found to use both exfoliating bark and crevices to a similar degree for summer roosting habitat (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Menzel *et al.* 2002, Owen *et al.* 2002, Perry and Thill 2007, Timpone *et al.* 2010).

Canopy coverage at NLEB roosts has ranged from 56% in Missouri (Timone *et al.* 2010), 66% in Arkansas (Perry and Thill 2007), greater than 75% in New Hampshire (Sasse and Pekins 1996), to greater than 84% in Kentucky (Lacki and Schwierjohann 2001). Studies in New Hampshire and British Columbia have found that canopy coverage around roosts is lower than in available stands (Sasse and Pekins 1996, Caceres 1998). Females tend to roost in more open areas than males, likely due to the increased solar radiation, which aids pup development (Perry and Thill 2007). Fewer trees surrounding maternity roosts may also benefit juvenile bats that are learning to fly (Perry and Thill 2007). However, in southern Illinois, NLEBs were observed roosting in areas with greater canopy cover than in random plots (Carter and Feldhamer 2005). Roosts are also largely selected below the canopy, which could be due to the species' ability to exploit roosts in cluttered environments; their gleaning behavior suggests an ability to easily maneuver around obstacles (Foster and Kurta 1999, Menzel *et al.* 2002).

Female NLEBs typically roost in tall, large-diameter trees (Sasse and Pekins 1996). Studies have found that the diameter-at-breast height (dbh) of NLEB roost trees was greater than random trees (Lacki and Schwierjohann 2001), and others have found both dbh and height of selected roost trees to be greater than random trees (Sasse and Pekins 1996, Owen *et al.* 2002). However, other studies have found that roost tree mean dbh and height did not differ from random trees (Menzel *et al.* 2002, Carter and Feldhamer 2005). Lacki and Schwierjohann (2001) have also found that NLEBs roost more often on upper and middle slopes than lower slopes, which suggests a preference for higher elevations due to increased solar heating.

NLEBs hibernate during the winter months to conserve energy from increased thermoregulatory demands and reduced food resources. In general, NLEBs arrive at hibernacula in August or September, enter hibernation in October and November, and leave the hibernacula in March or April (Caire *et al.* 1979, Whitaker and Hamilton 1998, Amelon and Burhans 2006). However, hibernation may begin as early as August (Whitaker and Rissler 1992a). In Copperhead Cave in west-central Indiana, the majority of bats enter hibernation during October, and spring emergence occurs mainly from about the second week of March to mid-April (Whitaker and Mumford 2008). In Indiana, NLEBs become more active and start feeding outside the hibernaculum in mid-March, evidenced by stomach and intestine contents. In northern latitudes, such as in upper Michigan's copper-mining district, hibernation for NLEBs may begin as early as late August and may last for 8 to 9 months (Stones and Fritz 1969, Fitch and Shump 1979). NLEBs have shown a high degree of philopatry (using the same site multiple years) for a hibernaculum (Pearson 1962), although they may not return to the same hibernaculum in successive seasons (Caceres and Barclay 2000).

Contrary to the species' documented behavior in the rest of its range, Grider (2014) found NLEBs to be active during the winter at a location in coastal North Carolina, an area which is devoid of known hibernacula and of any caves/mines which could potentially serve has hibernacula. The relatively mild winter temperatures of coastal North Carolina appear to allow some level of insect activity, thus providing winter foraging opportunities for NLEBs.

Typically, NLEBs are not abundant and compose a small proportion of the total number of bats hibernating in a hibernaculum (Barbour and Davis 1969, Mills 1971, Caire *et al.* 1979, Caceres and Barclay 2000). Although usually found in small numbers, the species typically inhabits the same hibernacula with large numbers of other bat species, and occasionally are found in clusters with these other bat species. Other species that commonly occupy the same habitat include:

little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibii*), tri-colored bat (*Perimyotis subflavus*), and Indiana bat (Swanson and Evans 1936, Griffin 1940, Hitchcock 1949, Stones and Fritz 1969, Fitch and Shump 1979). Barbour and Davis (1969) found that the species is never abundant and rarely recorded in concentrations of over 100 in a single hibernaculum.

NLEBs often move between hibernacula throughout the winter, which may further decrease population estimates (Griffin 1940, Whitaker and Rissler 1992b, Caceres and Barclay 2000). Whitaker and Mumford (2008) found that this species flies in and out of some of the mines and caves in southern Indiana throughout the winter. In particular, the bats were active at Copperhead Cave periodically all winter, with NLEBs being more active than other species hibernating in the cave. Though NLEBs fly outside of the hibernacula during the winter, they do not feed; hence the function of this behavior is not well understood (Whitaker and Hamilton 1998). However, it has been suggested that bat activity during winter could be due in part to disturbance by researchers (Whitaker and Mumford 2008).

NLEBs exhibited significant weight loss during hibernation. In southern Illinois, weight loss during hibernation was observed in male NLEBs, with individuals weighing an average of 6.6 grams prior to January 10, and those collected after that date weighing an average of 5.3 grams (Pearson 1962). Whitaker and Hamilton (1998) reported a weight loss of 41–43% over the hibernation period for NLEBs in Indiana. In eastern Missouri, male NLEBs lost an average of 3.0 grams during the hibernation period (late October through March), and females lost an average of 2.7 grams (Caire *et al.* 1979).

While the NLEB is not considered a long-distance migratory species, short migratory movements between summer roost and winter hibernacula between 35 miles and 55 miles have been documented (Griffith 1945, Nagorsen and Brigham 1993). However, movements from hibernacula to summer colonies may range from 5 to 168 miles (Griffin 1945). Several studies show a strong homing ability of NLEBs in terms of return rates to a specific hibernaculum, although bats may not return to the same hibernaculum in successive winters (Caceres and Barclay 2000). Individuals have been known to travel between 35 and 60 miles between caves during the spring (Griffin 1945, Caire *et al.* 1979).

NLEBs switch roosts often (Sasse and Perkins 1996), typically every 2–3 days (Foster and Kurta 1999, Owen *et al.* 2002, Carter and Feldhamer 2005, Timpone *et al.* 2010). In Missouri, the longest time spent roosting in one tree was 3 nights; however, up to 11 nights spent roosting in a manmade structure has been documented (Timpone *et al.* 2010). Similarly, Carter and Feldhamer (2005) found that the longest a NLEB used the same tree was 3 days; in West Virginia, the average time spent at one roost was 5.3 days (Menzel *et al.* 2002). Bats switch roosts for a variety of reasons, including temperature, precipitation, predation, parasitism, and ephemeral roost sites (Carter and Feldhamer 2005). In Missouri, Timpone *et al.* (2010) radio-tracked 13 NLEBs to 39 roosts and found the mean distance between the location where captured and roost tree was 1.1 miles (range 0.04–3.0 miles), and the mean distance traveled between roost trees was 0.42 mile (range 0.03–2.4 miles). In Michigan, the longest distance the same bat moved between roosts was 1.2 miles and the shortest was 20 feet (Foster and Kurta 1999). In New Hampshire, the mean distance between foraging areas and roost trees was 1975 feet (Sasse and Pekins 1996). In the Ouachita Mountains of Arkansas, Perry and Thill (2007) found that individuals moved among snags that were within less than 5 acres.

Some studies have found tree roost selection to differ slightly between male and female NLEBs. Male NLEBs have been found to more readily use smaller diameter trees for roosting than females, suggesting males are more flexible in roost selection than females (Lacki and Schwierjohann 2001, Broders and Forbes 2004, Perry and Thill 2007). In the Ouachita Mountains of Arkansas, both sexes primarily roosted in snags, although females roosted in snags surrounded by fewer midstory trees than did males (Perry and Thill 2007). In New Brunswick, Canada, Broders and Forbes (2004) found that there was spatial segregation between male and female roosts, with female maternity colonies typically occupying more mature, shade-tolerant deciduous tree stands and males occupying more conifer-dominated stands. In northeastern Kentucky, males do not use colony roosting sites and are typically found occupying cavities in live hardwood trees, while females form colonies more often in both hardwood and softwood snags (Lacki and Schwierjohann 2001).

NLEB breeding occurs from late July in northern regions to early October in southern regions and commences when males begin to swarm hibernacula and initiate copulation activity (Whitaker and Hamilton 1998, Caceres and Barclay 2000, Amelon and Burhans 2006, Whitaker and Mumford 2008). Copulation occasionally occurs again in the spring (Racey 1982). Hibernating females store sperm until spring, exhibiting a delayed fertilization strategy (Racey 1979, Caceres and Pybus 1997). Ovulation takes place at the time of emergence from the hibernaculum, followed by fertilization of a single egg, resulting in a single embryo (Cope and Humphrey 1972, Caceres and Pybus 1997, Caceres and Barclay 2000). Gestation is approximately 50-60 days (Ollendorff 2002).

Maternity colonies, consisting of females and young, are generally small, numbering from about 30 (Whitaker and Mumford 2008) to 60 individuals (Caceres and Barclay 2000); however, one group of 100 adult females was observed in Vermilion County, Indiana (Whitaker and Mumford 2008). In West Virginia, maternity colonies in two studies had a range of 7–88 individuals (Owen *et al.* 2002) and 11–65 individuals, with a mean size of 31 (Menzel *et al.* 2002). Lacki and Schwierjohann (2001) found that the population size of colony roosts declined as the summer progressed with pregnant females using the largest colonies (mean=26) and postlactating females using the smallest colonies (mean=4), with the largest overall reported colony size of 65 bats. Other studies have also found that the number of individuals within a maternity colony typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Perry and Thill 2007, Garroway and Broders 2008, Johnson *et al.* 2012). Female roost site selection, in terms of canopy cover and tree height, changes depending on reproductive stage; relative to pre- and post-lactation periods, lactating NLEBs have been shown to roost higher in tall trees situated in areas of relatively less canopy cover and tree density (Garroway and Broders 2008).

Adult females give birth to a single pup (Barbour and Davis 1969). Birthing within the colony tends to be synchronous, with the majority of births occurring around the same time (Krochmal and Sparks 2007). Parturition likely occurs in late May or early June (Easterla 1968, Caire *et al.* 1979, Whitaker and Mumford 2008), but may occur as late as July (Whitaker and Mumford 2008). Broders *et al.* (2006) estimated a parturition date of July 20 in New Brunswick. Lactating and post-lactating females were observed in mid-June in Missouri (Caire *et al.* 1979), July in New Hampshire and Indiana (Sasse and Pekins 1996, Whitaker and Mumford 2008), and August in Nebraska (Benedict 2004). Juvenile volancy occurs by 21 days after parturition and as early as 18 days after parturition (Kunz 1971, Krochmal and Sparks 2007). Subadults were captured in late June in Missouri (Caire *et al.* 1979), early July in Iowa (Sasse and Pekins 1996), and early August in Ohio (Mills 1971).

Adult longevity is estimated to be up to 18.5 years (Hall 1957), with the greatest recorded age of 19 years (Kurta 1995). Most mortality for NLEBs and many other species of bats occurs during the juvenile stage (Caceres and Pybus 1997).

The NLEB has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Griffith and Gates 1985, Nagorsen and Brigham 1993, Brack and Whitaker 2001), with diet composition differing geographically and seasonally (Brack and Whitaker 2001). The most common insects found in the diets of NLEBs are lepidopterans (moths) and coleopterans (beetles), with arachnids (spiders) also being a common prey item (Brack and Whitaker 2001, Feldhamer *et al.* 2009).

Foraging techniques include hawking (catching insects in flight) and gleaning in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, Ratcliffe and Dawson 2003). Observations of NLEBs foraging on arachnids (Feldhamer *et al.*2009), presence of green plant material in their feces (Griffith and Gates 1985), and non-flying prey in their stomach contents (Brack and Whitaker 2001) suggest considerable gleaning behavior. NLEBs have the highest frequency call of any bat species in the Great Lakes area (Kurta 1995). Gleaning allows this species to gain a foraging advantage for preying upon moths because moths are less able to detect these high frequency echolocation calls (Faure *et al.* 1993). Emerging at dusk, most hunting occurs above the understory, 3-10 feet above the ground, but under the canopy (Nagorsen and Brigham 1993) on forested hillsides and ridges, rather than along riparian areas (LaVal *et al.* 1977, Brack and Whitaker 2001). This coincides with data indicating that mature forests are an important habitat type for foraging NLEBs (Caceres and Pybus 1997). Occasional foraging also takes place over forest clearings and water, and along roads (van Zyll de Jong 1985).

Female home range size may range from 47–425 acres (Lacki *et al.* 2009). Owen *et al.* (2003) estimated average maternal home range size to be 161 acres. Home range size of NLEBs in this study site was small relative to other bat species, but this may be due to the study's timing (during the maternity period) and the small body size of NLEBs (Owen *et al.* 2003). The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 2034 feet (Sasse and Pekins 1996).

C. Population dynamics

Although they are typically found in low numbers in inconspicuous roosts, most records of NLEBs are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species' range in the United States, although many hibernacula contain only a few (1-3) individuals (Whitaker and Hamilton 1998). Known hibernacula include: Arkansas (n=20), Connecticut (n=5), Georgia (n=1), Illinois (n=36), Indiana (n=25), Kentucky (n=90), Maine (n=3), Maryland (n=11), Massachusetts (n=7), Michigan (n=94), Minnesota (n=11), Missouri (n=>111), Nebraska (n=2), New Hampshire (n=9), New Jersey (n=8), New York (n=58), North Carolina (n=20), Oklahoma (n=4), Ohio (n=3), Pennsylvania (n=112), South Carolina (n=2), South Dakota (n=7), Tennessee (n=11), Vermont (n=13), Virginia (n=8), West Virginia (n=104), and Wisconsin (n=45). Other states within the species' range have no known hibernacula (due to no suitable hibernacula present or lack of survey effort).

Historically, the NLEB was most abundant in the eastern portion of its range (Caceres and Barclay 2000). NLEBs have been consistently caught during summer mist net surveys and detected during acoustic surveys in eastern populations. Large numbers of NLEBs have been found in larger hibernacula in Pennsylvania (*e.g.* an estimated 881 individuals in a mine in Bucks County in 2004). Fall swarm trapping conducted in September–October 1988–1989, 1990–1991, and 1999–2000 at two hibernacula with large historical numbers of NLEBs had total captures ranging from 6 to 30 bats per hour, which indicated that the species was abundant at these hibernacula (Pennsylvania Game Commission 2012).

The NLEB is commonly encountered in summer mist-net surveys throughout the majority of the Midwest and is considered fairly common throughout much of the region. However, the species is often found infrequently and in small numbers in hibernacula surveys throughout most of the Midwest. Historically, the NLEB was considered quite common throughout much of Indiana, and was the fourth or fifth most abundant bat species in the State in 2009 (Whitaker and Mumford 2008).

The NLEB is less common in the southern portion of its range than in the northern portion of the range (Amelon and Burhans 2006). In the South, it is considered more common in states such as Kentucky and Tennessee, and rarer in the southern extremes of the range (*e.g.* Alabama, Georgia, and South Carolina).

The NLEB is generally less common in the western portion of its range than in the northern portion of the range (Amelon and Burhans 2006). It is considered common in only small portions of the western part of its range (*e.g.* Black Hills of South Dakota) and uncommon or rare in the western extremes of the range (*e.g.* Wyoming, Kansas, Nebraska) (Caceres and Barclay 2000).

The NLEB occurs throughout the majority of the forested regions of Canada, although it is found in higher abundance in eastern Canada than in western Canada, similar to in the United States (Caceres Pybus 1997). However, the scarcity of records in the western parts of Canada may be due to more limited survey efforts. It has been estimated that approximately 40% of the NLEB's global range is in Canada (COSEWIC 2014).

D. Status and distribution

On October 2, 2013, the Service proposed to list the NLEB as an endangered species throughout its range under the ESA (USFWS 2013). The Service subsequently proposed listing the NLEB with a rule under Section 4(d) of the ESA on January 16, 2015 (USFWS 2015). No critical habitat has been proposed at this time.

The primary threat to and the reason for the proposed listing of the NLEB is white-nose syndrome (WNS), a disease caused by the fungus *Pseudogymnoascus destructans* (formerly known as *Geomyces destructans*) that is known to kill bats. The Service has found that no other threat is as severe and immediate to the species persistence as WNS. There is currently no known cure. The species would likely not be imperiled were it not for this disease (USFWS 2013).

White-nose syndrome is an emerging infectious disease responsible for unprecedented mortality in some hibernating insectivorous bats of the northeastern United States (Blehert *et al.* 2009) and poses a considerable threat to several hibernating bat species throughout North America (USFWS 2011). The first evidence of WNS was documented in Howes Cavern, 32 miles west of Albany, New York in February 2006 (Blehert *et al.* 2009). Since that first documented appearance, WNS has spread rapidly throughout the Northeast and is expanding through the Midwest. As of August 2014, WNS had been confirmed in 25 states (Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin) and 5 Canadian provinces (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec). The fungus that causes WNS has been confirmed in three additional states – Iowa, Minnesota, and Mississippi. WNS has killed more than 5.5 million bats in the northeast United States and Canada (USFWS 2014b).

The pattern of spread has generally followed predictable trajectories along recognized migratory pathways and overlapping summer ranges of hibernating bat species. Therefore, Kunz and Reichard (2010) assert that WNS is spread mainly through bat-to-bat contact. However, evidence suggests that fungal spores can be transmitted by humans (Sleeman 2011). Seven North American hibernating bat species are confirmed with WNS (USFWS 2014b).

White-nose syndrome is caused by the recently described psychrophilic (cold-loving) fungus, currently known as *Pseudogymnoascus destructans*. *P. destructans* may be nonnative to North America and only recently arrived on the continent (Puechmaille *et al.* 2011, Minnis and Lindner

2013). The fungus grows on and within exposed tissues of hibernating bats (Gargas *et al.* 2009, Lorch *et al.* 2011), and the diagnostic feature is the white fungal growth on muzzles, ears, or wing membranes of affected bats, along with epidermal erosions that are filled with fungal hyphae (Blehert *et al.* 2009, Meteyer 2009). *P. destructans* grows best at the cool temperatures at which many bats hibernate, with optimal fungal growth occurring at 54.5° to 60.4° F, and no growth above approximately 67° F (Verant *et al*. 2012). Temperatures in WNS-affected hibernacula seasonally range from 36° to 57° F, permitting year-round growth, and may act as a reservoir maintaining the fungus (Blehert *et al.* 2009). Langwig *et al*. (2014) documented that contact with *P. destructans* contaminated hibernacula in autumn initiated infection in bats, but transmission and infection intensity remained low until bats began to fully hibernate during the winter. In summer, despite high bat-to-bat contact rates, most bats cleared infections and prevalence dropped to zero, presumably due to the resumption of a body temperature higher than the upper growth limit of *P. destructans*.

In addition to the presence of the white fungus, observations show that bats affected by WNS are characterized by some or all of the following: (1) depleted fat reserves by mid-winter; (2) general unresponsiveness to human disturbance; (3) apparent lack of immune response during hibernation; (4) ulcerated, necrotic, and scarred wing membranes; and (5) aberrant behaviors, including shifts of large numbers of bats in hibernacula to roosts near the entrances or unusually cold areas, large numbers of bats dispersing during the day from hibernacula during midwinter, and large numbers of fatalities, either inside the hibernacula, near the entrance, or in the immediate vicinity of the entrance (WNS Science Strategy Group 2008, USFWS 2011).

Although the exact process by which WNS leads to death remains undetermined, it is likely that the immune function during torpor compromises the ability of hibernating bats to combat the infection (Bouma *et al.* 2010, Moore *et al.* 2011). A current hypothesis suggests that bats arrive at hibernacula unaffected and enter hibernation with sufficient fat stores, but then become affected and use fat stores too quickly as a result of disruption to hibernation physiology (WNS Science Strategy Group 2008). Recent observations suggest that bats are arriving at hibernacula with sufficient or only slightly lower fat stores (Courtin *et al.* 2010).

Boyles and Willis (2010) hypothesized that infection by *P. destructans* alters the normal arousal cycles of hibernating bats, particularly by increasing arousal frequency and/or duration. In fact, Reeder *et al.* (2012) and Warnecke *et al.* (2012) observed a progressive increase in arousal frequency in laboratory studies of hibernating bats infected with *P. destructans.* A disruption of this torpor-arousal cycle could easily cause bats to metabolize fat reserves too quickly, thereby leading to starvation. For example, skin irritation from the fungus might cause bats to remain out of torpor for longer than normal to groom, thereby exhausting their fat reserves prematurely (Boyles and Willis 2010). In the early stages of WNS infection, Verant *et al.* (2014) found that hibernating WNS-infected little brown bats utilized energy twice as fast as non-infected bats. However, this greater energy use by infected bats was not associated with an increased rate or duration of arousals from torpor during the early stages of infection. This implies that infected bats have an elevated metabolism prior to the onset of the increased arousal patterns characteristic of late-stage infections.

Cryan *et al.* (2010) suggested that mortality may be caused by catastrophic disruption of wing-dependent physiological functions. The wings of winter-collected WNS-affected bats often reveal signs of infection, whereby the degree of damage observed suggests functional impairment. Emaciation is a common finding in bats that have died from WNS. The authors hypothesized that wing damage caused by *P. destructans* infections could sufficiently disrupt water balance to trigger frequent thirst-associated arousals with excessive winter flight, and subsequent premature depletion of fat stores. In related research, Cryan *et al.* (2013) found that electrolytes (sodium and chloride) tended to decrease as wing damage increased in severity. Proper concentrations of electrolytes are necessary for maintaining physiologic homeostasis, and any imbalance could be life-threatening. Additionally, Verant *et al.* (2014) found that bats with early-stage WNS developed severe, chronic respiratory acidosis and hyperkalemia (high potassium concentrations in the blood). Although the exact mechanism by which WNS affects bats is still in question, the effect it has on many hibernating bat species is well documented, as well as the high levels of mortality it causes in some susceptible bat species.

The NLEB is known to be highly susceptible to WNS, and mortalities due to the disease have been confirmed. From 2007 to mid-2013, the USGS National Wildlife Health Center in Madison, Wisconsin tested 65 NLEB submissions. Twenty-eight of the 65 NLEBs tested were confirmed as positive for WNS by histopathology and another 10 were suspect (Ballmann 2013, personal communication cited in USFWS 2013). The New York Department of Environmental Conservation has confirmed at least 29 NLEBs submitted with signs of WNS since 2007 in New York but there were still bat carcasses not yet analyzed (Okonieski 2012, personal communication cited in USFWS 2013).

Due to WNS, the NLEB has experienced a sharp decline in the northeastern part of its range, as evidenced in hibernacula surveys. The northeastern United States is very close to saturation (i.e. WNS found in majority of hibernacula) for the disease, with the NLEB being one of the species most severely affected by the disease (Herzog and Reynolds 2013). Turner *et al.* (2011) compared the most recent pre-WNS count to the most recent post-WNS count for 6 cave bat species; they reported a 98% decline between pre- and post-WNS in the number of hibernating NLEBs at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia. In addition to the Turner *et al.* (2011) data, the Service conducted an additional analysis that included data from Connecticut (n=3), Massachusetts (n=4), and New Hampshire (n=4), and added one additional site to the previous Vermont data. Using a protocol similar to Turner *et al.* (2011), the Service found that the combined overall rate of decline seen in hibernacula count data for the 8 states was approximately 99% (USFWS 2013). Similarly, during 2013 hibernacula surveys at 34 sites where NLEBs were also observed prior to WNS in Pennsylvania, researchers found a 99% decline (from 637 to 5 bats) (Turner 2013).

Long-term (including pre- and post-WNS) summer data for the NLEB are somewhat limited; however, the available data parallel the population decline exhibited in hibernacula surveys. Summer surveys from 2005–2011 near Surry Mountain Lake in New Hampshire showed a 99% decline in capture success of NLEBs post-WNS, which is similar to the hibernacula data for the state (a 95% decline) (Brunkhurst 2012). In Vermont, the species was the second most common bat species in the state pre-WNS; however, it is now one of the least likely to be encountered, with the change in effort to capture one bat increasing by nearly 13 times, and approximately a 94% overall reduction in captures in mist-net surveys (Darling and Smith 2011). In eastern New York, captures of NLEBs have declined approximately 93% from pre-WNS (Herzog 2012). In West Virginia, NLEB mist-net captures comprised 41% of all captures pre-WNS and 24% post-WNS (Francl *et al.* 2012). Nagel and Gates (2012) reported a 78% decrease in NLEB passes during acoustic surveys between 2010 and 2012 in western Maryland. At two swarm trapping sites in Pennsylvania, researchers in 2010-2011 saw a decline in capture rates of 95% at one site and 97% at the second site post-WNS, which corroborates documented interior hibernacula declines (Turner *et al.* 2011, Turner 2013).

The area currently affected by WNS constitutes the core of the NLEB's range, where the species was most common prior to WNS. Furthermore, the rate at which WNS has spread has been rapid. Since its first documented occurrence in New York in February 2006, WNS had spread to 25 states and 5 Canadian provinces by August 2014 (USFWS 2014b). WNS has already had a substantial effect on NLEBs in the core of its range and is likely to spread throughout the species' entire range within a short time; thus the Service considers it to be the predominant threat to the species range-wide. This threat is ongoing and is expected to increase in the future as it continues to extirpate NLEB populations (USFWS 2013).

Other threats to the NLEB include wind-energy development, winter habitat modification (i.e. effects on hibernacula), summer habitat loss/modification (i.e. tree clearing from timber harvest, development, natural resource extraction, etc.), human disturbance of hibernating bats, predation, climate change, and contaminants (USFWS 2013). Although these threats (prior to WNS) have not individually or cumulatively had significant impacts at the species level, they may increase the overall impacts to the species when considered cumulatively with WNS.

E. Analysis of the species/critical habitat likely to be affected

The NLEB is presently in danger of extinction throughout its entire range due to the severity and immediacy of the threat posed by WNS. White-nose syndrome has currently spread to 25 of the 39 states where the NLEB is known to occur, but is expected to spread to the remaining states in the near future. Rates of decline at hibernacula have been as high as 99%. The proposed action, the implementation of the NCDOT activities in Divisions 1-8, is likely to adversely affect the NLEB.

Other species

This PCO only addresses the NLEB and should not, by itself, be necessarily construed as completing Section 7 consultation for any specific activity. Individually, each NCDOT activity may or may not have adverse effects on other federally threatened or endangered species. Therefore, independent of this programmatic conference, all NCDOT projects in Divisions 1-8 will be separately assessed for effects to other federally listed species.

III. ENVIRONMENTAL BASELINE

Under Section 7(a)(2) of the ESA, when considering the "effects of the action" on federally listed species, the Service is required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all federal, state, or private actions and other activities in the action area (50 CFR 402.02), including federal actions in the area that have already undergone Section 7 consultation, and the impacts of state or private actions which are contemporaneous with the consultation in process.

A. Status of the species within the action area

Eastern North Carolina is on the periphery of the NLEB's range, and data indicating the presence or absence of the species within the action area is sparse. However, the available data do suggest that NLEBs occur in low numbers within the action area and that the species is absent from much of the action area. Currently, negative data (data which does not support the presence of the species at a specific location) far exceeds positive data.

NLEB capture records in the action area

Camden County: Six NLEBs were captured in 2012, and one NLEB was captured in 2013 (Grider 2014).

Currituck County: During bat surveys conducted at a U.S. Naval facility that spans Chesapeake, Virginia and Currituck County, North Carolina, a total of 16 NLEBs were captured during the summers of 2013 and 2014 (Michael Wright, US Navy, personal communication, October 29, 2014).

Washington County: Six NLEBs were captured in June/July of 2007, including five juveniles, suggesting a resident maternity colony was present (Morris *et al*. 2009). In 2012, two NLEBs were captured (Grider 2014).

Other records indicating NLEB presence in the action area

Lee County: A rabies lab record from June 2001 is preserved in the University of North Carolina Wilmington Natural History Collection (David Webster, associate dean, University of North Carolina Wilmington, personal communication, January 21, 2014).

New Hanover County: A rabies lab record from 1996 is preserved in the University of North Carolina Wilmington Natural History Collection (David Webster, associate dean, University of North Carolina Wilmington, personal communication, January 21, 2014).

Wake County: Two specimens collected in Raleigh from 1947 and 1981 are preserved in the University of North Carolina at Wilmington Natural History Collection (David Webster, associate dean, University of North Carolina Wilmington, personal communication, January 21, 2014).

Negative data for NLEBs in the action area

Below is a summary of all known mist net bat survey work in eastern North Carolina which did not lead to any evidence of the presence of NLEB.

Fort Bragg/Camp Mackall (Cumberland, Harnett, Hoke, Richmond, and Scotland Counties) – (Janice Patten, wildlife biologist, Fort Bragg Endangered Species Branch, personal communication, July 1, 2014).

- Mist-netting was conducted from 2004-2009 at 38 locations across Fort Bragg and Camp Mackall. In addition, buildings were inspected for potential roosts. No NLEBs were captured or observed.
- In the winter of 2013-2014, several known roost locations where checked for bats. Bats were found at two sites, but no NLEBs were observed.

Uwharrie National Forest (Montgomery and Randolph Counties)

- Three nights of netting occurred during the 2004 Southeastern Bat Diversity Network bat blitz in Anson, Montgomery, and Randolph counties at over 30 sites. Seventy-seven bats (representing five species) were captured, but no NLEBs were captured (Cameron *et al*. 2004).
- NCDOT staff conducted netting in 2007 at four sites in Montgomery County. No NLEBs were captured.
- Fifty-eight nights of mist-netting occurred at 14 sites in the Uwharrie National Forest in the summer of 2014; 179 bats were captured, but there were no NLEB captures (King and Kalcounis-Rueppell 2014).

Croatan National Forest (Carteret, Jones, and Onslow Counties)

- Fourteen nights of mist-netting were conducted for the US 17 project on the west side of Croatan National Forest (CNF) in Jones and Onslow Counties, but no NLEBs were captured (Ecological Engineering 2014).
- Six nights of mist-netting were conducted in CNF along the proposed Havelock bypass corridor in 2005 (NCDOT). No NLEBs were captured.
- Five nights of mist-netting were conducted adjacent to CNF at the NCDOT Croatan Mitigation Bank from 2007-2010 (NCDOT). No NLEBs were captured.
- One night of mist-netting was conducted in Carteret County at the southern edge of CNF in 2009 (NCDOT). No NLEBs were captured.

North Carolina Division of Parks and Recreation surveys

North Carolina Museum of Natural Sciences staff surveyed 12 state parks and natural areas in eastern North Carolina between 1999 and 2004 via mist-netting and roost checks (Lambiase *et al*. 2000 and subsequent 2005 addendum). More than 160 bats were observed in approximately 40 days/nights of surveys, but no NLEBs were observed during any of these surveys. Survey locations included Eno River State Park (Orange and Durham Counties), Goose Creek State Park (Beaufort County), Lake Waccamaw State Park (Columbus County), Lumber River State Park (Columbus, Robeson, and Scotland Counties), Merchant's Millpond State Park (Gates County), Pettigrew State Park (Washington and Tyrell Counties), Raven Rock State Park (Harnett County), Weymouth Woods State Park (Moore County), Jones Lake State Park (Bladen County), Singletary Lake State Park (Bladen County), Theodore Roosevelt State Natural Area (Carteret County), and William B. Umstead State Park (Wake County).

Bladen and Lenoir County mist-netting

During the summer of 2012 (May 14 to August 5) Grider (2014) did not capture any NLEBs at sites in Bladen and Lenoir Counties, although 168 bats from seven other species were captured. During the spring of 2013 (March 11 to April 12), Grider (2014) did not capture any NLEBs at his field site in Bladen County, although five bats from one other species were captured.

Bridge surveys

Although there is evidence of NLEBs using bridges and other structures for roosting in other parts of the species range, bridge surveys in eastern North Carolina have failed to find any NLEBs. Felts and Webster (2003) found 219 bats (representing three species) during bridge and culvert surveys in southeastern North Carolina (Bladen, Brunswick, Columbus, Duplin, New Hanover, Onslow, and Pender Counties), but none were NLEB. McDonnell (2001) examined 990 bridges and culverts in 25 counties in the North Carolina Coastal Plain. Eighty-one (81) bats were found, but no NLEBs were identified.

Acoustic bat surveys in the action area

At this time, the Raleigh Field Office is not considering acoustic data as official records of presence or absence, given the software's difficulties in distinguishing the Myotis species and pending further refinement of acoustic software and standardization of methodologies and analysis. However, acoustic efforts are noted below as current best available information.

- From March 25 to May 15, 2014 the Service conducted passive acoustic surveys for NLEBs at 23 sites in 14 counties within the action area. NLEBs were identified by two software packages at 4 of the 23 sites in Bertie, Chatham, Craven, and Jones Counties (Kathy Matthews, USFWS Raleigh Field Office, personal communication, February 23, 2015).
- Multiple Sonobat acoustic transects were conducted across Fort Bragg and Camp Mackall from 2004-2014. Eight bat species were detected, but none were NLEBs (Janice Patten, wildlife biologist, Fort Bragg Endangered Species Branch, personal communication, July 1, 2014).

- Pittaway and Kalcounis-Rueppell (2014) analyzed acoustic transects along 18 routes that were run in 2009, 2010 and 2012 in the Uwharrie National Forest. No NLEB calls were recorded.
- Three nights of acoustic driving transects in 2010 conducted on CNF by USFS staff (Pittaway and Kalcounis-Rueppell 2014). No NLEB calls were recorded.

Winter bat activity in the action area

Grider (2014) determined that multiple species of bats remain active during the winter in eastern North Carolina, especially within the coastal plain. Seven species, including NLEB in Camden County, were identified by acoustic surveys during the winters of 2012/2013 and 2013/2014. Additionally, one NLEB was captured in a mist net in Camden County on March 11, 2013 (Kalcounis-Rueppell and Grider 2013). Several other bats from three other species were also captured December 20-21, 2013 at the same location (Grider 2014). In the rest of the NLEB's range, the species would normally be hibernating in caves or other suitable hibernacula during winter. See Section B below for more related discussion.

B. Factors affecting species environment within the action area

A number of ongoing anthropogenic and natural factors may affect the NLEB. Some of these effects have not been evaluated with respect to biological impacts on the species. In addition, some are interrelated and the effects of one cannot be separated from others. Known or suspected factors affecting the NLEB are discussed below.

White-nose syndrome

WNS is not known to occur within the action area (Heffernan 2015). This may be due to the near absence of caves or other suitable hibernacula within the action area. However, much of the action area does occur within the WNS buffer zone described in USFWS (2015).

Lack of known hibernacula

No NLEB hibernacula are currently known to exist within the action area. This is likely due to the near absence of suitable caves in eastern North Carolina. Although suitable or potentially suitable caves do exist outside the action area in south-central Virginia (Virginia Speleological Survey 2007) and in western North Carolina, these caves are >125 miles from known NLEB capture sites in northeastern North Carolina. This distance is beyond the 35-55 mile range at which NLEBs are typically known to migrate (Griffith 1945, Nagorsen and Brigham 1993). However, a small number of underground mines located primarily in the western portion of the action area could conceivably provide hibernacula for NLEBs. Overall, the absence of known hibernacula within or near the action area makes the area distinctly different than most of the rest of the range of the species.

Winter activity of NLEB in eastern North Carolina

From Grider (2014) it appears that the climate in eastern North Carolina, especially along the coast, is sufficient for year-round or near year-round activity for NLEBs, thus possibly precluding the need for traditional hibernacula. Whitaker *et al.* (1997) similarly found that eastern red bats (*Lasiurus borealis*) were able to forage during winter in coastal North Carolina. Due to relatively mild winter temperatures in coastal North Carolina, it is believed that sufficient insect activity occurs to sustain bat activity during much of the winter. Taylor (1963) found that some cold-tolerant insects can maintain flight at temperatures as low as 8°C. Grider (2014) found that his coastal plain North Carolina study sites averaged nightly temperatures of 8°C or higher on 34.1% of winter nights. However, he also found some minimal level of bat activity as low as -3.4°C.

Loss/modification of roosting and foraging habitat

The action area has experienced and continues to experience loss and modification of NLEB roosting and foraging habitat through tree removal. Tree removal occurs primarily as a result of development, timber harvest, and land clearing for agriculture. From 1990 to 2011, total forest land in the Coastal Plain and Piedmont Regions of North Carolina declined by approximately 4%, but the decline appears to have stabilized in recent years (Brown and New 2013).

Public conservation lands

The action area contains significant amounts of forested conservation lands in the form of national wildlife refuges, national forests, state forests, state parks, state game lands, and other protected properties. Public ownership confers some conservation benefit to listed species by removing some threats that might otherwise be present if the properties were owned by private landowners and subsequently developed. However, some management activities such as prescribed burning, timber stand improvement, and sustainable timber harvesting may have some level of adverse effects to the species.

Climate Change

Climate change in eastern North Carolina may result in additional sea level rise. Sea level rise would flood portions of coastal North Carolina, thus killing trees that NLEBs may use for foraging and roosting. Simultaneously, a warming climate could increase insect availability during winter and thus increase winter activity and perhaps alter behaviors.

IV. EFFECTS OF THE ACTION

Under Section 7(a)(2) of the ESA, “effects of the action” refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this PCO. Should the effects of the federal action result in a situation that would jeopardize the continued existence of the species, we may propose reasonable and prudent alternatives that the federal agency can take to avoid a violation of Section 7(a)(2). The discussion that follows is our evaluation of the anticipated direct and indirect effects of the proposed project. Indirect effects are those caused by the proposed action that occur later in time but are still reasonably certain to occur (50 CFR 402.02).

A. Factors to be considered

Proximity of the action: The proposed action will occur within suitable roosting and foraging habitat throughout the action area. No known hibernaculum occur within the action area.

Distribution: The expected disturbance from the proposed action may directly affect roosting and foraging NLEBs at multiple locations throughout the action area.

Timing: Project construction will occur throughout the year and through all phases of the NLEB's life cycle, although the winter behavior of NLEBs within the action area is not yet fully understood.

Nature of the effect: Adverse effects to the NLEB in the action area are expected to occur primarily in the form of nonlethal harassment of roosting bats as roost trees are felled during land clearing operations or when structures (e.g. bridges) are demolished. However, some minimal level of lethal effects is expected when bats are unable to escape roost trees which are being felled or when structures are demolished (e.g. when female bats with non-volant pups are present). Due to seemingly low numbers of NLEBs in the action area, the generalist roosting habitat selection of the species, and the abundance of forested lands within the action area, it is assumed that removal of roosting and foraging habitat is, in and of itself, not an adverse effect if no NLEBs are present.

Duration/disturbance frequency: This PCO analyzes the effects of the proposed action for a period of five years, beginning in April 2015. Covered activities will be ongoing throughout the 5-year timeframe, but the duration of each covered activity will vary from weeks to years.

Disturbance intensity and severity: The intensity and severity of disturbance will vary depending on the scope of each covered activity.

B. Analysis for effects of the action

Beneficial effects:

The greatest beneficial effect of the action is the previously described 5-year research project to be conducted by NCDOT (see Conservation Measures section above and Appendix B).

Information is severely lacking for the NLEB in eastern North Carolina. Of special interest is the need for information on the winter behavior of NLEBs in the action area. The data obtained from the research will be essential for long-term NLEB conservation in eastern North Carolina by helping to target management and protection efforts.

To comply with Section 404 of the Clean Water Act, NCDOT is required to mitigate for impacts to wetlands and streams. NCDOT typically offsets unavoidable impacts at a 2:1 ratio through a combination of restoration, enhancement, and preservation activities. Since most wetland impacts are to forested wetlands, NCDOT is responsible for replacing much of the forested wetland acreage that is lost due to project construction. Additionally, most stream mitigation requires forested riparian buffers to be planted or restored. From 2003 to 2013, NCDOT restored approximately 4,000 acres of forest, preserved approximately 18,000 acres of forest, and planted over one million trees within NCDOT Divisions 1-8 (LeiLani Paugh, NCDOT, personal communication, February 2, 2015). These restored and preserved acres of forested habitat provide substantial long-term benefits to the NLEB.

Direct effects:

The amount of information on the occurrence, distribution, and population size of the NLEB in the action area is minimal. Little information exists on locations of maternity roosts or preferred foraging areas. Therefore, quantifying the direct effects to the species is difficult. However, because the available data do suggest that NLEBs occur in low numbers within the action area and that the species is absent from much of the action area, it is presumed that most of NCDOT's activities within the action area, if viewed individually, would not adversely affect the species. However, when assessed at the programmatic level, it is certain that adverse effects will occur.

1. Mortality from tree clearing or structure removal

During tree clearing activities, if a NLEB is present in a tree at the time it is felled, it is possible the bat may be killed if it does not quickly exit the tree. Non-volant pups would be especially vulnerable. Given the seeming low occurrence of the NLEB in the action area, and given the large amount of forested acreage in the action area, the probability that any specific project would cause mortality of the species is likely low. However, collectively, all NCDOT activities within the action area together as a program will likely result in some relatively small amount of mortality, although the precise amount of mortality would not be predictable or measureable.

Although there is currently no evidence of NLEBs using bridges, culverts, or buildings as roost sites in the action area, there has been a minimal amount of NLEB use of bridges as roost sites in the mountains of western North Carolina. Therefore, it is possible that NLEBs may use bridges, large box culverts, or buildings as roost sites in eastern North Carolina. During the demolition of these structures, it is possible that NLEBs could be killed if they are unable to quickly exit the structure.

2. Overall habitat loss

Although the overall distribution of the NLEB is currently unknown for the action area, for the purposes of this programmatic conference, it is assumed that all forested land within the action area could serve as NLEB foraging and/or roosting habitat. NCDOT has determined that their activities from January 1, 2015 to December 31, 2019 will clear up to 10,223 acres of trees in Divisions 1-8. Based on U.S. Forest Service forest inventory data for North Carolina (New 2014), this amount of clearing represents 0.21% of the total forested acres in the action area. While there is no evidence to indicate that roosting or foraging habitat availability is a limiting factor for the NLEB in the action area, the acreage of tree clearing will serve as the surrogate to attempt to quantify the potential harm and/or harassment to the species from the removal of trees.

To put the potential amount of forested habitat loss into perspective, the following theoretical exercise is useful. Using an average maternal home range size of 161 acres from Owen *et al*. (2003), the theoretical maximum number of NLEB maternity colonies represented by 10,223 acres of trees to be cleared by NCDOT over five years is 63. However, this theoretical number of maternity colonies is a gross overestimate for multiple reasons. The 10,223 acres of tree clearing assumes that project ROWs are entirely cleared, which is generally not the case. Also, the available information regarding presence/absence of the species within the action area suggests that the occupancy rate of the forested acreage to be cleared is low. Only 3 of the 59 counties within the action area are conclusively known to currently support the NLEB. The proposed tree clearing within these three counties only represents a small fraction of the 10,223 acres that may be cleared within the action area over five years. Furthermore, there is only one STIP-level project planned within three miles of any known NLEB capture sight, and most of the trees within that project ROW have previously been cleared.

3. Harm or harassment from removing roost trees

Although there are few records of NLEB maternity or non-maternity roost areas from the action area, NCDOT activities at the programmatic level are likely to remove some unknown number of active roost trees. A NLEB present in a roost tree that is being felled will likely exit the tree and fly to another nearby tree. The NLEB's flight to another tree will cause extra energy expenditure and may expose the bat to increased predation pressures. Pregnant females and females with pups would be the most vulnerable due to the increased energy demands of pregnancy and the rearing of young. Likewise, NLEBs that exit their roost sites in bridges or buildings being demolished could experience similar effects.

4. Harm or harassment from removing foraging habitat

An individual NLEB whose foraging area overlaps with a specific project area or whose foraging area will be significantly fragmented will have to expend an increased amount of energy to establish a new foraging area or new travel corridors between roosting and foraging areas. This may subject the bat to increased inter- or intra-specific competition or to increased predation pressures. It is anticipated that in most cases an individual NLEB would have little difficulty in establishing new foraging areas and that any adverse effects would be minimal and temporary.

5. Harm or harassment due to noise, vibrations, and other disturbances

In addition to habitat destruction in a project footprint, a decrease in the quality of remaining habitat adjacent to a project footprint may occur. Increased disturbance may occur during clearing and construction from the use of equipment and from blasting, although blasting is rarely used by NCDOT. NLEBs may be exposed to noise levels and vibrations that they may not have experienced in the past, depending on the proximity of their roost sites or foraging areas to NCDOT activities. The majority of these effects will be temporary and generated solely during construction activities, although noise generated from new roads will be permanent. It is difficult to predict the degree to which NLEBs would be disturbed by the noise and vibrations associated with construction activities, but it is reasonable to assume that any effect resulting from noise and vibrations could result in bats selecting roost trees or foraging areas further from the disturbance. However, there would be limited exposure of foraging NLEBs to construction-related noise and vibration since most construction work occurs during the daytime, and the nighttime work that does occur generally occurs within congested urban areas which would be less likely to have NLEBs present. The burning of woody debris at construction sites may also disturb roosting or foraging bats with smoke or heat.

6. Decreased water quality

Although NCDOT implements various measures to avoid or minimize degrading water quality, some NCDOT activities may cause impacts in the form of temporary sedimentation or accidental spills of petrochemicals, uncured concrete, or herbicides. Degraded water quality could affect NLEB drinking water sources, and since some insects with an aquatic life-stage (e.g. caddisflies) make up a portion of the diet of the NLEB, the degraded water quality could affect the prey base for NLEBs. However, since NLEBs should have little difficulty finding alternative drinking water sources or alternative prey and foraging areas, the effect on the species would likely be insignificant and/or discountable.

7. Harassment from research project

During the five-year research project to be implemented by NCDOT, NLEBs could be adversely affected by mist-netting activities, such as becoming stressed or injured in the net. Roost surveys conducted during cold temperatures in winter could also arouse bats during periods of low insect activity, thus leading to the excess expenditure of energy reserves. Telemetry surveys could stress individual bats carrying transmitters. However, all of these potential effects are covered under ESA Section 10(a)(1)(A) permits for the researchers.

<u>Indirect effects</u>:

1. Mortality from vehicle traffic

Bats that fly across roads can be killed by vehicles (Lesinski 2007, Lesinski 2008, Russell *et al*. 2009, Gaisler *et al*. 2009). A study conducted in eastern North Carolina (in Tyrrell and Dare Counties) which analyzed wildlife road-kills documented bat mortality (Smith 2011). Since NLEBs typically forage 1 to 3 meters above the ground (Nagorsen and Brigham 1993), NLEBs could be struck and killed by vehicles on new roads constructed within the action area; however, such mortality would be expected to be minimal.

2. Habitat fragmentation from road traffic

Zurcher *et al*. (2010) found that roads can act as a barrier to bats, and the volume of traffic increases the barrier effect. Without specific data on the relationship between NLEB and current habitat connectivity levels in eastern North Carolina, only generalizations can be made about the effects of habitat fragmentation due to NCDOT activities. NCDOT projects may reduce NLEB habitat connectivity; therefore, NLEBs may need to expend extra energy to forage, find cover, or commute to roost sites as a result. No realistic estimate of the reduction in habitat connectivity can be made due to the limited NLEB data in the action area. It is assumed that the abundance of NLEB habitat will act to ameliorate the fragmentation effects of NCDOT activities.

3. Harm or harassment from removing maternity roost trees outside the maternity season

Activities that require the removal of primary maternity roost trees outside of the NLEB maternity season may result in adverse effects to maternity colony members and potential loss of a year’s recruitment. If pregnant females are required to search for new roosting habitat in the spring, this effort may place additional stress on pregnant females at a critical time when fat reserves are low and they are already stressed from the energy demands of pregnancy. Adult male and non-reproductive female NLEBs would be less affected since they are not subject to the physiological demands of pregnancy and rearing young.

4. Road avoidance due to traffic noise

Data regarding the effects of traffic noise on bats is mixed. For example, Schaub *et al*. (2008) suggested that foraging habitat for greater mouse-eared bats (*Myotis myotis*) in Germany near noisy roads is degraded, while Zurcher *et al.* (2010) found that noise from vehicles had no discernable effect on Indiana bats crossing roads in Indiana. Without data specific to NLEBs, it is unknown what effect traffic noise will have on the species.

5. Secondary development

There is potential for the NCDOT Program to induce additional development. While bridge replacements and maintenance activities do not increase development, new location and widening projects do have the potential to increase traffic capacity, which may induce secondary development, resulting in additional habitat loss. No quantitative analysis is practicable for the scope of the NCDOT Program.

Interrelated and interdependent effects:

Utility companies often locate utility lines (e.g. water, gas, electrical) along NCDOT roads within the ROW. In those situations, there would generally be no additional effects to the NLEB from tree clearing. However, occasionally, utility companies relocate utility lines outside the limits of the NCDOT ROW. In those situations, additional tree clearing may occur. Since that decision by the utility company generally does not occur until late in project planning or even after project construction has begun, and given the programmatic nature of this PCO, there is no accurate way to estimate the extent of additional tree clearing. However, based on the infrequent occurrence of this scenario, the additional adverse effect to NLEBs is expected to be minimal.

C. Species' response to proposed action

Numbers of individuals/populations in the action area affected: Comprehensive information regarding the population size of NLEBs in the action area is lacking. Total records of live captures within the action area comprise only about 20 individuals. These live captures are from only 3 of the 59 counties in the action area. A significant amount of negative data (i.e. surveys without evidence of NLEB) covering multiple counties suggests that the population of NLEB within the action area is low.

Sensitivity to change, resilience, and recovery rate: Due to the near absence of information on the population, distribution, and behavior of NLEBs in the action area, these factors are largely unknown.

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, local, or private actions that are reasonably certain to occur in the action area considered in this PCO. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Bridge maintenance

There will be NCDOT maintenance activities with no federal nexus such as bridge painting and repair work which could affect the NLEB. If NLEB are roosting in bridges in eastern North Carolina, maintenance activities could harass or kill individuals. However, current data suggest that bridge use by NLEB in North Carolina is very limited (McDonnell 2001, Felts and Webster 2003), so the overall effects of bridge maintenance on the species are expected to be minimal.

Tree trimming and hazard tree removal
Tree trimming and hazardous tree removal are activities that generally occur without a federal nexus. These activities occur along road ROWs to reduce safety hazards due to falling trees or limbs, or to improve line-of-sight issues. Potential effects to NLEB would be similar to the tree removal previously described in the direct effects section. Tree trimming and hazardous tree removal occurs on an as-needed basis, so quantifying the amount of habitat lost from this activity is not practicable.

Borrow areas
NCDOT contractors, independent of project planning and usually without a federal nexus, may select borrow areas to obtain material for earthwork and may require tree removal. Construction contractors are generally responsible for addressing federally threatened and endangered species issues for these sites per NCDOT standard specifications. However, most borrow areas are located in areas of previously disturbed habitat where tree removal is minimal.

Timber industry
Eastern North Carolina has a large timber industry, with approximately $551 million of timber being delivered to mills within the action area in 2012 alone (Jeuck and Bardon 2013). Much of this timber harvest is part of sustainable management, with the remainder occurring due to development and land clearing for other purposes. In addition to timber harvest, some unknown acreage of forested land is managed for optimal timber production and/or wildlife management. Both timber harvest and forest management involving tree clearing will continue to have adverse effects on the NLEB within the action area similar to the effects described above for the removal of roost trees and foraging habitat. However, these adverse effects would be very difficult to quantify.

Development
From 2010 to 2013, the U.S. Census Bureau estimated an annual 1.1% population growth rate in the action area (U.S. Census Bureau 2014). Most of this growth occured in urban areas, with the rural areas being nearly stable or declining in population. Increased population growth generally leads to increased land clearing. Tree clearing from development will continue to have adverse effects on the NLEB. However, given the size of the action area (59 counties) and the paucity of data on NLEBs within the action area, these effects would not be measureable.

VI. CONCLUSION

After reviewing the current status of the NLEB, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, it is the Service's conference opinion that NCDOT activities in eastern North Carolina (Divisions 1-8), as proposed, are not likely to jeopardize the continued existence of the NLEB. No critical habitat has been proposed or designated for the NLEB; therefore, none will be affected.

This non-jeopardy opinion is based on the following rationale:

1. Eastern North Carolina is on the periphery of the NLEB's range, and there are very few records of NLEBs in the action area.
2. Based on available data, NLEBs appear to occur in low numbers within the action area.
3. The NLEB appears to be absent from portions of the action area.
4. There are no known NLEB hibernacula and almost no caves in eastern North Carolina.
5. The loss of trees from NCDOT activities will not result in a shortage of available roosts or foraging opportunities for NLEB since forested habitat is abundant in eastern North Carolina and is not likely a factor limiting the numbers or reproduction of NLEB populations.
6. The likelihood of any individual NCDOT project having an adverse effect on the NLEB is likely low.
7. Most of the adverse effects that do occur will occur as non-lethal harassment. The probability of any individual project causing NLEB mortality is likely very low.
8. The greatest conservation need for NLEBs in eastern North Carolina is basic information on the distribution and behavior of the species. As part of the action, NCDOT has proposed to conduct an extensive and systematic research and data collection effort over five years. This information is needed to form conservation strategies for the species in the future.

INCIDENTAL TAKE STATEMENT

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

The prohibitions against taking the species found in Section 9 of the ESA do not apply until the NLEB is listed. However, the Service advises the action agencies to consider implementing the following reasonable and prudent measures. If this PCO is adopted as a Programmatic Biological Opinion following a listing, these measures, with their implementing terms and conditions, will be non-discretionary.

Amount or extent of take anticipated

The Service expects incidental take of NLEBs attributable to the proposed action will be difficult to detect and quantify for the following reasons: 1) most incidental take will occur as sub-lethal harassment, 2) sub-lethal effects are mostly undetectable, 3) dead bats are mostly undetectable, and 4) data on the presence, distribution, and behavior of NLEB in the action area is very limited. By far, the greatest amount of incidental take will be associated with tree clearing. Although other NCDOT activities have the potential to take NLEBs, these other activities are believed to be inconsequential when compared to tree clearing. Therefore, tree clearing acreage was determined to be the only meaningful surrogate to express the extent of incidental take. The NCDOT has determined that up to 10,223 acres of trees will be cleared by NCDOT activities within the action area over the next five years. This figure is conservatively estimated and is likely high since it assumes that all trees will be cleared within a project ROW, which is often not the case.

Effect of the take

In the accompanying PCO, the Service has determined that this level of anticipated take is not likely to result in jeopardy to the NLEB, or destruction or adverse modification of designated or proposed critical habitat.

Duration of the take

This level of incidental take is authorized from the effective date of a final listing determination through April 30, 2020.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate within NCDOT Divisions 1-8 to minimize take of the NLEB. These nondiscretionary measures include, but are not limited to, the terms and conditions outlined in this PCO.

1. Include visual bat surveys for structures and mines when developing environmental documentation during project planning.

2. Report annual tree clearing acreage to the Service.

3. Avoid disturbing any known NLEB maternity roosts during pupping season.

4. As research findings become available, coordinate with the Service to develop future conservation measures.

Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described previously. These terms and conditions are nondiscretionary.

1. Develop a policy to conduct bat presence surveys at bridges, within vacant buildings, and within suitable underground mines within project study areas when developing Natural Resource Technical Reports and National Environmental Policy Act documents during project planning. These bat presence surveys will be limited to visual surveys only. With regard to underground mines, there is no expectation that investigators will survey any mine with unsafe conditions. If NLEBs are observed, the information must be reported to the Raleigh Field Office. (RPM 1)

2. NCDOT must track and report annually to the Service the total tree clearing acreage for all activities covered by this programmatic conference/consultation (i.e. projects with a federal nexus only). A cumulative tree clearing acreage for the years 2015-2019 must be provided by April 2020. (RPM 2)

3. If NCDOT or other researchers identify NLEB maternity roosts, do not remove occupied maternity roost trees or clear-cut within 0.25 mile of an occupied maternity roost tree during the summer pupping season. The pupping season for NLEBs in eastern NC is not yet precisely known, but the dates of May 15 – August 15 will be used until more data are available. (RPM 3)

4. During the research related semi-annual meetings specified in the conservation measures, discuss and consider any future conservation measures which the research findings may suggest would benefit the NLEB. (RPM 4)

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The following conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or proposed critical habitat, to help implement recovery plans, or to develop information.

1. NCDOT and/or FHWA could contribute funding to purchase additional acoustic bat survey equipment and software for natural resource agencies.

2. NCDOT and/or FHWA could provide for bat acoustic survey techniques training for staff from the Service, WRC, and other natural resource agencies.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION/CLOSING STATEMENT

This concludes the conference for the action outlined in your January 13, 2015 request for formal conference. You may ask the Service to confirm the PCO as a Programmatic Biological Opinion issued through formal consultation if the NLEB is listed. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the PCO as the Programmatic Biological Opinion on the action and no further Section 7 consultation will be necessary.

After listing of the NLEB as endangered or threatened and any subsequent adoption of this PCO, the FHWA (NC Division) and USACE (Wilmington District) shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The Incidental Take Statement provided in this PCO does not become effective until the NLEB is listed and the PCO is adopted as the Programmatic Biological Opinion issued through formal consultation.

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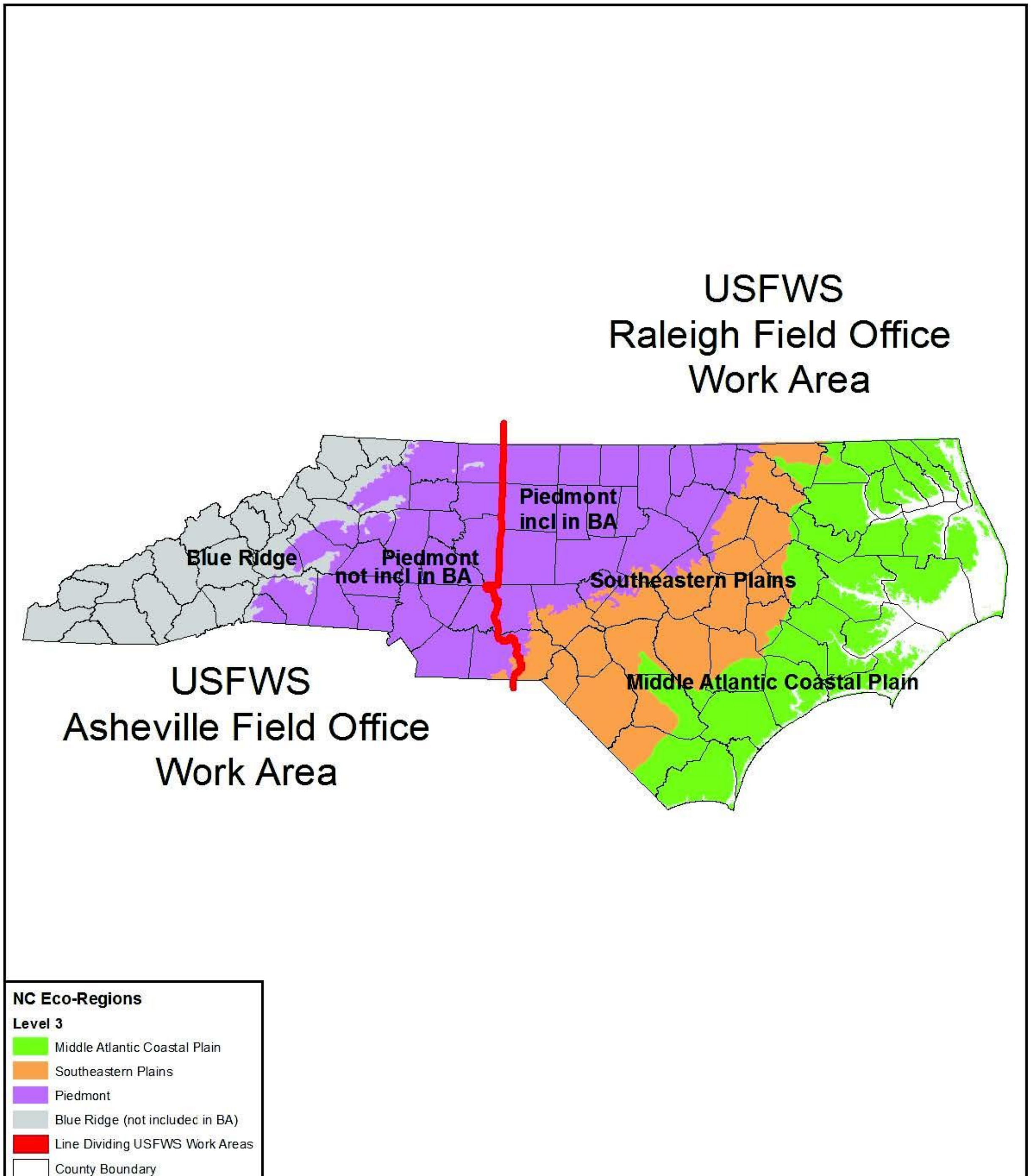
APPENDIX A

FIGURES



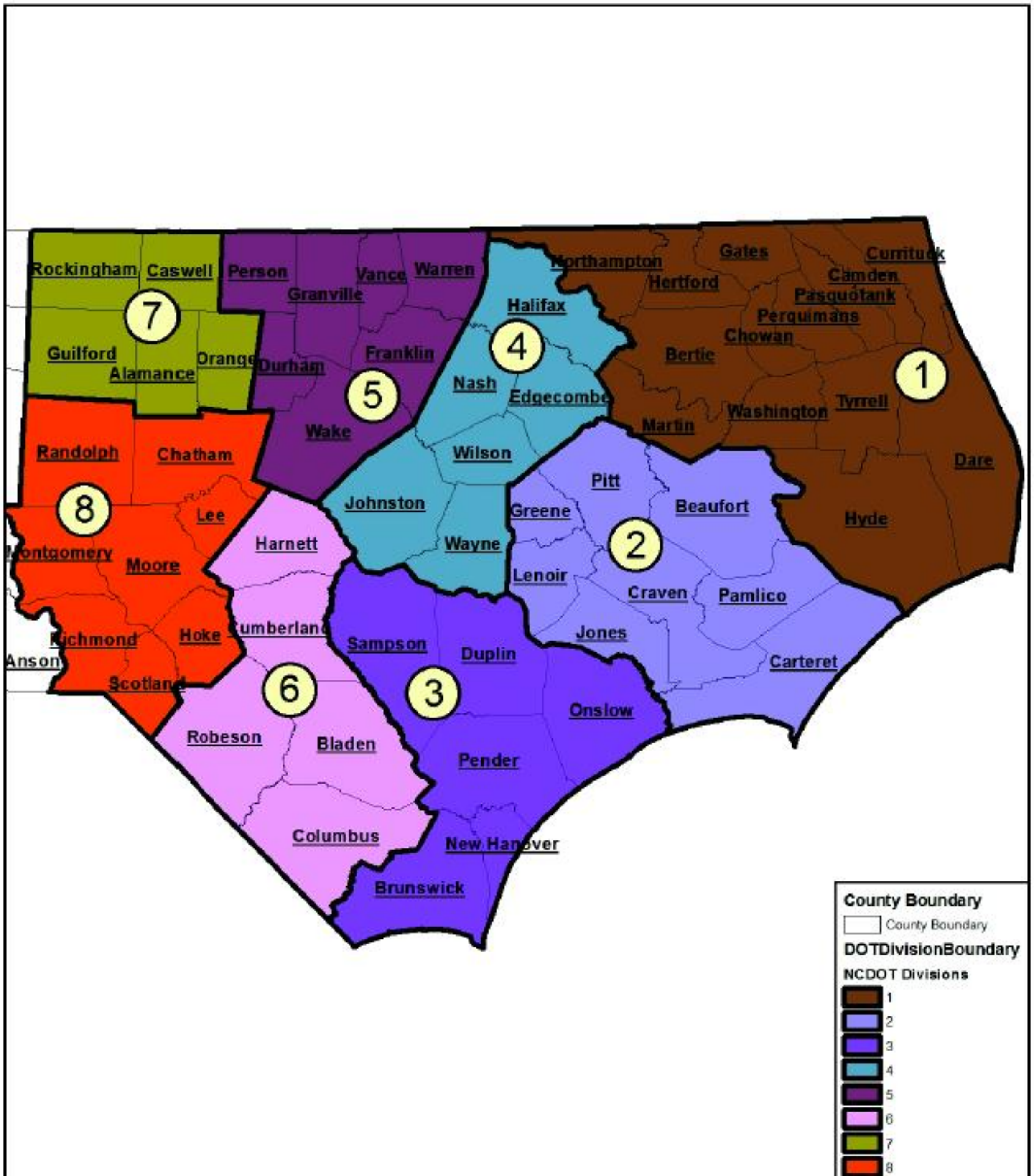
Prepared by NCDOT 12/1/14

Program Area and EPA Ecoregions

0 10 20 40 Miles

USFWS Work Area Eastern NC

FIG 1



Prepared by NCDOT 10/27/14

Action Area

Eastern NC Counties
& Eastern NCDOT Divisions

0 5 10 20 Miles

FIG
2

APPENDIX B

RESEARCH

NORTHERN LONG-EARED BAT RESEARCH STUDY
FOR EASTERN NORTH CAROLINA
NCDOT, 2015-2019

Objectives
1. Use acoustic monitoring to determine the distribution of Northern Long-eared Bat (NLEB) in eastern North Carolina, determine where presence is year-round and where it is limited to the maternity season, and develop basic understanding of northern long-eared bat habitat and temporal (year-round) activity patterns.
2. Use the results of the acoustic surveys to conduct mist-netting/telemetry on NLEBs to locate and characterize day roosts, especially winter roosts (if NLEB are present in eastern NC over the winter).
3. Swab bats in winter to determine presence/absence of *Pseudogymnoascus destructans*, the fungus that causes white nose syndrome (WNS).
4. Conduct structure, bridge and culvert checks to determine degree of use, seasons of use and type of structure preferences.

1. Acoustic Monitoring
For research in eastern NC, select 30 locations for conducting acoustic work, covering 10 locations/year for 3 years. At each location, sample 4 times/year (early and mid-summer, fall and winter) with 4 bat detectors for 3 nights/sampling period. This will result in 480 detector nights/year. Sampling for three years will result in a minimum of 1440 detector nights, which will be the minimum amount of acoustic work to be conducted through the 5-year research program. Additional work may be needed to fill information gaps; this will be determined as work progresses. If ten locations are sampled a year for five years, a maximum of 2400 detector nights will be the result. Using multiple bat detectors will allow four sites within a location to be sampled so that habitat preferences can be determined. Monitoring multiple times a year will ensure that the species' presence is detected if some areas are only inhabited on a seasonal basis. Sampling may be discontinued at locations with little or no bat activity, at which point a new location will be selected.

Thirty locations spaced out over eastern NC will provide information about the species' distribution. Counties with NLEB capture records, counties with reliable acoustic-only records (no captures), and counties near recent NLEB captures in Washington, Currituck and Camden counties will be prioritized for initial monitoring. Sampling locations will be coordinated with advisors from state and federal resource agencies and from academia to avoid duplicating efforts.

In addition to the methods listed below, all survey efforts will follow the NLEB Interim Conference and Planning Guidance (US Fish and Wildlife Service, 2014) to the extent practicable.

Methods:
- Use Anabat SD2 detectors or SM2 Songmeters encased in weather-proof housing. Ensure that the latest firmware is included. All detectors will have been tested within the last year for sensitivity.
- Use sensitivity setting of 7 (Anabat).
- Detectors will be placed in a variety of habitats and stand conditions.
- Bat echolocation passes will be identified using two automated systems such as EchoClass II and BCID (Bat Call ID) as well as supervised visual examination.
- Habitat will be scored as as pine/hardwood/mixed; the landscape setting as upland/bottomland; the timber as managed (thinned, burned, or pine plantation) or unmanaged, mature or cutover; and the condition as more open or more forested, following Ford et al. (2006). To score human disturbance, habitat will also be classed as natural, rural (scattered agricultural land or buildings visible), suburban (regular houses/buildings) or mixed (patches of natural and other land use).

- Natural communities will be typed according to Schafale (2012) to give an indication of which tree species are present.
- Assess forest basal area (m2/ha) using a 10- factor prism and canopy cover using a sighting tube at 10 random locations within a 0.05-ha circular plot around each survey site (Cook et al. 1995, Ford et al. 2006). This will give an indication of forest structure and how cluttered the surrounding habitat is.

Rationale for locations for acoustic work:

- Virginia lists records for NLEB in the Dismal Swamp in VA. The swamp lies in Gates, Pasquotank, and Camden Counties in NC. Navy biologists captured NLEB in Currituck County, NC and adjacent Chesapeake County, VA.
- Washington, Camden, Currituck and surrounding counties were selected to gather more information about presence/seasonal activity of NLEBs in the area.
- No NLEB records occur in the Piedmont or coastal plain of South Carolina; all records are from the mountains.
- There are records of NLEB in Wake County and the US Fish and Wildlife Service (USFWS) lists Lee County as a recent occurrence, so those counties and some of the surrounding counties will be targeted for work.
- New Hanover and Brunswick counties will be targeted due to a New Hanover record.
- UNC-Greensboro has identified one NLEB call in Bladen County, so it was selected.
- UNCG researchers felt that the swath of counties between New Hanover and Washington would be good to survey, so counties such as Duplin, Onslow, Pitt and Beaufort will be targeted.
- The following areas were avoided based on negative data: Uwharrie National Forest and Fort Bragg.

Proposed Acoustic Locations for 2015 (rational for selection is indicated below each county)

1. Bladen – Bladen Lakes State Forest
   One county acoustic record from UNCG
2. Currituck – North River Gameland
   Proximity to known NLEB capture sites
3. Gates (or Camden/Pasquotank) - Great Dismal Swamp National Wildlife Refuge
   Proximity to known NLEB capture sites
4. Hertford – Chowan Swamp Gameland (some of the gameland may fall in an NABat priority site)
   Proximity to known NLEB capture sites
5. Lee (or Chatham) – CP&L Gameland (selecting Chatham will hit part of an NABat priority site)
   NLEB capture record for Lee County
6. New Hanover – NCDOT Murrayville Mitigation Site
   NLEB rabies record for New Hanover County
7. Tyrell – Palmetto-Peartree Reserve (some of which falls in an NABat priority site)
   Proximity to known NLEB capture sites
8. Wake – Swift Creek Bluffs, Triangle Land Conservancy
   Historic NLEB record for Wake County
9. Washington - Pocosin Lakes National Wildlife Refuge
   Proximity to known NLEB capture site
10. Wayne – Waynesborough State Park (on Neuse River)
    Lack of data from this area of the state; proposed NCDOT Goldsboro bypass project

Locations will be further refined based on a variety of good habitat types. Locations at state parks, national wildlife refuges, and large NCDOT mitigation properties will be prioritized for sampling, as they should be amenable to repeated monitoring and, if NLEBs are determined to be present, can help provide species conservation measures. Locations will be selected to provide a wide array of vegetative communities and management/disturbance regimes. Because of logistical constraints associated with intensive mist-netting and day-roost research, these efforts will be concentrated initially in and around Camden, Washington and Currituck counties, where NLEB are known to occur.

The North American Bat Monitoring Program (NABat; https://www.fort.usgs.gov/science-tasks/2457) sampling design and protocols will be followed to the extent possible. The NABat sampling frame consists of a GIS-generated sampling grid across North America of 10x10 km grid cells. Two to four stationary sampling sites are established within each cell and are sampled two times/summer within the same week. Following repeatable protocols in a nationally standardized context will allow comparison within and between states and regions and can reveal trends across broad landscape scales. NABat will establish population baselines from which anticipated declines from white-nose syndrome and other threats can be documented and will provide information about bat populations within NC.

Acoustic monitoring results will be used to determine where mist-netting should be targeted. Acoustic data collected as a result of NCDOT research could be used to develop northern long-eared bat predictive habitat models. Modeling will not be conducted by NCDOT, but NCDOT will cooperate with other agencies wishing to use our data to develop models.

2. Mist-netting/telemetry
NLEBs will be netted over water, forest edges, and forested roads and outfitted with radio-transmitters. The bats will be radio-tracked to day-roosts to describe roost and site characteristics following the methods of Perry and Thill, (2007). Mist netting/telemetry in the northeastern part of the state (around Camden, Currituck and Washington counties) can begin concurrently with acoustic work in early 2015 and can expand to other areas of eastern NC over time, depending on the acoustic results. If mist-netting is not as productive as we anticipate (few NLEB captures), resources can be reallocated for more acoustic work. The initial assumption is that there will be positive acoustic results to justify mist-netting at least 15 locations in the eastern half of NC. This 15-location estimate is based on known occurrences and negative survey results, while anticipating that ideally, mist-netting should occur in enough locations to provide data from all regions of eastern NC. The target season for most netting will be in the fall, with the intent of tracking bats to their winter roosts. Some summer netting may be conducted as well if requested by USFWS, which would allow data to be collected on reproductive status and summer roosts.

Assume at least five locations will be surveyed with mist-nets each year for three years, with 8 nights of surveying per location, for a minimum of 120 survey nights. If 25 locations are netted eight nights each (67 nights of mist-netting a year over a three-year period), two hundred survey nights will be conducted. Mist-netting will be coordinated with UNCG researchers, who will be conducting NLEB work around Camden and Washington counties in 2015.

Telemetry will be used to collect information about roost types and locations. For telemetry, assume that up to 100 NLEBS will be captured and transmittered throughout the five year programmatic duration, for a minimum of 8400 hours of telemetry (100 bats x 4 hours a day x 21 days), assuming sufficient numbers of bats are captured.

Allowing for the possibility that up to 50 NLEB roost sites will be found, each roost will be inspected at least four times a year for two years to determine summer/winter usage. Emergence counts may be conducted instead of physically entering roosts. Collecting data on winter presence and roosting habitat will prioritized over collecting summer data (e.g. 2/3 effort on winter data, 1/3 effort on summer data). If 100 NLEB roosts are found, a total of 800 roost inspections/emergence counts will be conducted.

Methods:

- Nets will remain open at least five hours a night (pre-dawn netting can count towards the five hours).
- There will be a 46 degree cut-off for mist-netting, based on insect activity results from Taylor (1963).
- Each bat will be tracked for at least 4 hours a day for 3 weeks, (unless the transmitter falls off or stops working prior to that point).
- Each roost will be inspected (or an emergence count will be conducted) at least four time a year: twice in summer and twice in winter.
- The following data will be collected at each roost: tree species, diameter at breast height (dbh), roost height, cavity description, total tree height, tree condition (live vs snag), and tree location. If the roost is in a site other than a tree, the site will be described.
- The natural community surrounding each roost tree will be typed according to Schafale (2012).
- Habitat surrounding each roost will be characterized in a 17.8-m radius (0.1-ha) plot centered on the roost tree with a tally of all woody stems >1 m tall and <5 cm dbh. Woody stems (including snags) >1 m tall and >5 cm dbh will be recorded by dbh and species. Canopy cover will be measured at four locations along the outer edge of each plot using a spherical densitometer (Perry and Thill, 2007).
- To determine site characteristics that may have affected roost selection, data will also be collected at random sites and compared with roost plots.

It should be noted that in addition to the above mist-netting and acoustic work, NCDOT may also conduct NLEB surveys for one or two new location projects in eastern North Carolina in early 2015.

3. White-nose Syndrome Data Collection

Data collection to determine the presence/extent of WNS will be coordinated with the North Carolina Wildlife Resources Commission (NCWRC) so as not to duplicate efforts. If winter roosts are located and the bats can be accessed safely, they will be swabbed in winter for *Pseudogymnoascus destructans*. Some winter/early spring mist-netting may be conducted at the request of USFWS in order to collect data on WNS occurrence. In the unlikely event fungal growth is observed on bats during the summer, photographs and wing punches will be collected. The Reichard Wing Damage Index should be recorded for all bats regardless of season, and bats with score of 2 or 3 will be photographed per North Carolina's White-nose Syndrome Surveillance and Response Plan (2013). Swabs and wing punches will be sent to the Southeast Cooperative Wildlife Disease Study lab for analysis.

4. Bridge and Structure Surveys

Bridge and structure surveys will be conducted to determine if NLEB use them for roosting in eastern NC, and if so, how often, what types of structures are used, and for which seasons. These surveys will focus initially around Camden and Washington counties, expanding into other counties as acoustic surveys dictate. A variety of bridge types will be selected for surveying: concrete slab, cast-in-place, steel deck, concrete beam, wooden, etc. Large culverts will also be surveyed.

Data will be collected from 200 bridges/culverts throughout the 5 year duration. Some bridge data may be compiled from existing NCDOT records. Bridge surveys will be conducted primarily in summer, but some surveys may also be conducted in winter to look for potential winter roosts. If a bridge has evidence of significant bat use, that structure will be checked again to collect data on seasonal use. Buildings capable of housing bats (abandoned houses, barns, sheds, etc.) will be surveyed opportunistically.

5. Reporting and Decision-making Process

NCDOT will develop monitoring methods and locations with technical advice from advisors from state and federal resource agencies and from academia. Their recommendations will be considered by the research group. The group will consist of staff from the NCDOT Biological Surveys Group, and representatives from USFWS, NCWRC and FHWA. The US Army Corps of Engineers (USACE) will remain informed as the research progresses, but has chosen to be silent member of the group. NCDOT will provide quarterly reports to USFWS, FHWA, NCWRC and USACE throughout the duration of the five year research study, and meetings will be held at least twice a year to provide results, to plan for future efforts, and to maintain coordination between agencies. Work will begin in 2015 and will be completed by the end of 2019. Final reports will be due by April 2020.

Products

Levels of effort for the various objectives may vary somewhat as the work progresses, if the research group determines it is appropriate. For example, if mist-netting proves to be rather unproductive, less effort will be needed for telemetry, freeing up more resources for acoustic surveys.

Initial mist-netting and acoustic planning/installation
Year-round acoustic surveys
Acoustic data interpretation and analysis
Northern long-eared netting and tracking
Roost data collection
WNS swabbing results
Quarterly reports
Preparation and submittal of final acoustical activity report
Preparation and submittal of final tracking/roost report
Final report

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ATTACHMENT D

FHWA and USACE letter dated January 13, 2015
to the USFWS and the
NLEB Programmatic Biological Assessment

U.S. Department of Transportation
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, NC 27601

DEPARTMENT OF THE ARMY
WILMINGTION DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTION, NORTH CAROLINA 28403-1343

January 13, 2015

In Reply Refer To:
HDA-NC

Mr. Pete Benjamin
Field Supervisor
U.S. Fish and Wildlife Service
Raleigh Field Office
551F Pylon Drive
Raleigh, NC 27606

Dear Mr. Benjamin:

This letter serves as our request to initiate formal conference with the U.S. Fish and Wildlife Service (USFWS) in accordance with Section 7(a)(4) of the Endangered Species Act of 1973 (ESA), as amended, for potential effects to the northern long-eared bat (*Myotis septentrionalis*) (NLEB) that could result from implementation of North Carolina Department of Transportation (NCDOT) projects in Divisions 1-8.

The Federal Highway Administration (FHWA) and the U.S. Army Corps of Engineers (USACE), Wilmington District, anticipate that the NLEB will be formally listed under the ESA on or after April 2, 2015. A Programmatic Biological Assessment (PBA) has been prepared for NCDOT transportation projects in Divisions 1-8 and is attached to this letter.

The PBA includes:

- a description of the action being considered;
- a description of the area that may be affected by the action;
- a description of NLEB that may be affected by the action;
- a description of the manner in which the action may affect the listed species, and analyses of indirect, and cumulative effects; and
- conservation measures that incorporate avoidance, minimization, and measures to offset adverse effects on the species.

Both FHWA and USACE have individually reviewed the PBA and agree with the conclusions contained therein.

Our biological conclusion/determination for the northern long-eared bat is "May Affect, Likely to Adversely Affect" due to potential direct, indirect, and cumulative effects from NCDOT transportation projects in Divisions 1-8.

Please review the attached PBA and provide us with your Conference Opinion. If you have any questions, please contact Donnie Brew at (919) 747-7017, or donnie.brew@dot.gov; and/or Lori Beckwith at (828) 271-7980, ext. 223, or loretta.a.beckwith@usace.army.mil.

Sincerely,

John F. Sullivan, III, P.E.
Division Administrator
North Carolina Division

Sincerely,

Scott McLendon
Chief, Regulatory Division
Wilmington District

Attachment

Copy Furnished (w/o attachment):

Richard Hancock, NCDOT, PDEA
Neil Medlin, NCDOT, PDEA, Natural Environment Section

Programmatic Biological Assessment
Northern Long-Eared Bat
(*Myotis septentrionalis)*
In Eastern North Carolina

North Carolina Department of Transportation

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Federal Highway Administration & US Army Corps of Engineers

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January 9, 2015

Executive Summary

The Federal Highway Administration (FHWA) North Carolina Division, the US Army Corps of Engineers (USACE) Wilmington District, and the North Carolina Department of Transportation (NCDOT) have developed this programmatic biological assessment (PBA) for Endangered Species Act (ESA) compliance purposes associated with the anticipated listing of the Northern Long-eared Bat (NLEB). FHWA, USACE, and NCDOT consider the approach utilized (explained in detail within the body of this PBA) to be conservative from the species' perspective.

The Northern Long-eared Bat (NLEB, *Myotis septentrionalis*) was considered a stable species until its population was dramatically reduced by a disease called white-nose syndrome (WNS). Although other factors also affect the NLEB's long-term survival, WNS was the driving factor for the proposed listing of the NLEB as Endangered (78 Federal Register 61046-61080) under the Endangered Species Act (ESA) of 1973, as amended.

NLEB are considered a generalist species able to inhabit almost all wooded communities within their range. Eastern North Carolina is on the periphery of the species' range. Data is lacking on NLEB biology, behavior, habitat preference and distribution in eastern North Carolina. Despite an abundance of available habitat, less than 25 NLEB have been documented (from 1901 to 2014) in six noncontiguous eastern North Carolina counties.

FHWA, USACE, and NCDOT developed this Programmatic Biological Assessment to account for potential adverse effects to NLEB that may occur as a result of proposed transportation projects in NCDOT Divisions 1-8. The approach for the PBA was developed by a working group consisting of personnel from FHWA, USACE, US Fish and Wildlife Service-Raleigh Field Office (USFWS), and NCDOT. This working group began regular meetings to establish a methodology for ensuring NLEB ESA compliance that would result in no NCDOT transportation project delays and provide for NLEB species protection/uplift.

As explained in this PBA, the effects analysis for NLEB concludes that the NCDOT transportation program will result in take. Harassment will likely be the most common form of take. However, there is potential for mortality.

In terms of NLEB species protection/uplift, the working group determined that detailed information on NLEB distribution and behavior in eastern North Carolina would be the initial key to conservation of the species in this part of its range. Therefore, conservation measures in this PBA include a five year NLEB research study in eastern North Carolina. This research will be conducted in close association with USFWS and will be important to future avoidance, minimization, and conservation measures for NLEB.

It is expected that future NLEB consultation will utilize data from the five year NLEB research study to refine compliance methodology for improved future consultations and conservation opportunities for NLEB.

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Chapter 1. Programmatic Overview

1.1. Background

This Programmatic Biological Assessment (PBA) was prepared by the North Carolina Department of Transportation (NCDOT), in coordination with the Federal Highway Administration (FHWA) North Carolina Division and the US Army Corps of Engineers (USACE) Wilmington District, and addresses the proposed action in compliance with Section 7(a)(2) and 7(c) of the Endangered Species Act (ESA) of 1973, as amended. Section 7 requires that consultation (or conferencing for species proposed for listing) be conducted with the US Fish and Wildlife Service (USFWS) to ensure federal actions do not jeopardize the continued existence of any threatened, endangered, or proposed species or result in the destruction or adverse modification of critical habitat.

A USFWS proposal for listing the Northern long-eared bat (*Myotis septentrionalis*) as an endangered species was published in the Federal Register in October 2013. The listing may become effective as soon as April 2, 2015. Therefore, potential effects to this species as a result of NCDOT projects must be evaluated.

1.2 Action and Federal Nexus

This PBA evaluates the potential effects to NLEB from all proposed NCDOT Division-planned and central office-planned projects with a federal nexus in NCDOT Divisions 1-8 (i.e. the proposed action, hereafter referred to as "NCDOT Program") that are scheduled to be under construction during a five-year period beginning April 2, 2015. The NCDOT Program will be carried out by NCDOT and/or NCDOT contractors or partners.

The lead federal agency for the preparation of this PBA is the FHWA.

Projects implemented by NCDOT must comply with federal environmental laws and regulations when a federal action occurs. Two pertinent examples of potential federal actions for NCDOT projects are federal funding and federal permitting.

- Funding- Many NCDOT projects will be performed using FHWA federal-aid funds. FHWA reimbursement to NCDOT for funding of a project is a federal action requiring compliance with applicable federal laws and regulations.
- Clean Water Act Section 404 permitting-When NCDOT activities involve discharges to Waters of the United States a permit from the USACE is required. Such permitting is a federal action requiring compliance with federal laws and regulations.

In project specific situations, where both the FHWA and the USACE have a nexus, the FHWA will typically serve as the lead federal agency. Sometimes the FWHA study area and the USACE permit area are the same, and sometimes the USACE permit area is only a portion of the FHWA study area. However, some transportation projects have a USACE nexus, but no FHWA nexus.

When there is no FHWA funding, the USACE will typically serve as the lead federal agency for those projects that require authorization (i.e. a Department of the Army (DA) permit) under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899. In those situations, the USACE permit area may be the same as the NCDOT SEPA study area, or it may be different. For any specific transportation project, the Wilmington District, USACE may have an ESA action area that does not include the entire length of the project.

1.3 Action Area

In a typical lineal or corridor project, a DA permit simply authorizes crossings of jurisdictional waters of the U.S. by the placement of culverts, bridge abutments, stabilization, soil, and similar structures. Therefore, the USACE's action area does not necessarily include the entire length of the highway project. According to the Wilmington District, USACE, the action area for linear projects includes not only the footprint of the fill (the direct effect), but also those areas of the water upstream and downstream of the proposed fill that might reasonably be affected by the placement of that fill (the indirect effect), as well as those segments of the proposed road whose alignment is dictated by the proposed fill (the interrelated actions), and those segments of the road that would have no independent utility apart from the proposed fill (the interdependent actions). The action area determination is made by the USACE on a case-by-case analysis of the circumstances of each particular project.

As noted previously, on a project by project basis, the Wilmington District, USACE, may have a different ESA action area than the FHWA would have for the same transportation project. However, due to the large number of transportation projects in NCDOT Divisions 1-8 that are scheduled to be under construction during a five-year period beginning April 2, 2015, it would be impracticable to predict the respective ESA action areas and quantify the impacts of each individual project. Because of this, a large number of transportation projects will be collectively evaluated, rather than evaluated on an individual basis for the purposes of this PBA. As a result, USACE, FHWA, and NCDOT have established a programmatic action area rather than individual project action areas. Therefore, the programmatic action area for this PBA will be the 59 North Carolina counties that fall within NCDOT Divisions 1-8.

The Wilmington District, USACE, has determined that it is in their interest to enter into this PBA for the limited purpose of dealing with potential ESA issues related to one species, the NLEB. The FHWA and NCDOT have independently agreed to the USFWS programmatic conditions for this species. The expansion of the ESA action area for purpose of this PBA does not affect the Wilmington District's policy regarding the ESA action area with regard to other threatened or endangered species. Furthermore, the Wilmington District may have a more limited ESA action area for other threatened or endangered species in a transportation project that is also subject to this PBA.

1.4. NCDOT Program Description

North Carolina is one of a handful of states that no longer have county highway departments. NCDOT took over all county roads in the 1930s, in order to have greater leverage with vendors and suppliers of the materials necessary to more economically build and maintain highways.

Currently, with about 80,000 miles of state-owned and maintained highways, North Carolina has one of the two largest state-owned and maintained highway systems in the country. In North Carolina, municipalities maintain an additional 21,000 miles of city streets, and combining these two administrative systems with highways maintained by other agencies such as the National Park Service or the U.S. Forest Service, the state contains approximately 105,000 miles of roads and highways (NCPedia 2014, USDOT 2014, Hartegan *et al*. 2013).

NCDOT maintains and constructs a wide variety of transportation infrastructure across the state, ranging from aviation, bicycle, pedestrian, ferry, highway, public transportation and railroad projects across the state. NCDOT has divided the state into 14 transportation regions or NCDOT Divisions. Typically larger projects are planned as part of the Statewide Transportation Improvement Program (STIP), while smaller projects are planned within the local division. Most state transportation projects eventually become the responsibility of the local NCDOT Division offices to maintain. Project priorities and time schedules within the STIP and NCDOT Divisions can vary greatly depending on several factors including purpose and need, safety concerns and funding.

1.4.1. NCDOT STIP and Division Projects

NCDOT projects are tracked by planning name in either the STIP or by the NCDOT Division. NCDOT STIP and Division projects, including commonly used prefixes, are listed below (Table 1) with brief descriptions adapted from the NCDOT STIP (NCDOT 2014a).

TABLE 1. NCDOT STIP AND DIVISION PROJECT TYPES AND DESCRIPTIONS

Prefix	Project Type	Description
B	Bridge Replacement in STIP	Existing bridges are replaced. These projects are generally larger or more complicated (due to construction needs or affects to human or natural environment) projects than the next two categories.
BD	Bridge Replacement in Division	Existing bridges are replaced; generally these are two lane bridges.
BP	Bridge Preservation in Division	Existing bridges are preserved by supplementing or replacing compromising elements.
C	Congestion Mitigation	Addition of lanes, sidewalks, greenways, trails, intersections and/or associated crosswalks and signage for improved movement.
E	Enhancement	Installation of interactive signage, visitor’s exhibits and/ or gateway or interruptive markers intended for scenic beautification.
EE	Mitigation	Wetland and Stream mitigation in the form of enhancement, restoration or preservation is conducted to offset losses due to project construction.
EB, ER	Bike Route and	New or additional lanes for bike or pedestrian traffic.

Prefix	Project Type	Description
	Pedestrian Enhancement	
EL	Enhancements – Multi-use Path	Ramp, parking lot, or visitor center improvements preservation or maintenance.
F	Ferry	Dock, ramp, engine, ferry, parking lot, or visitor center improvements preservation or maintenance.
FS	Feasibility Study	Conducted to determine the degree to which the project is justified (economically, environmentally, socially, financially)
I	Interstate	Pavement preservation or maintenance, access improvement, widening, upgrading intersections, bridge preservation and/or adding lanes along interstates.
K	Rest Area	Existing or new rest area ramp, parking, sewer, fixtures and finishes installation, or preservation.
L	Landscape	Plantings or replantings along NCDOT projects.
P	Passenger Rail	Rail grade separations, track realignment, track improvement, track and station right of way acquisition, and track bypass installation.
R, A, M	Rural	Improvements to existing and new locations, road widening, intersection or interchange improvements, traffic circles, and weigh stations improvements.
S, SB	Scenic Byway	Waysides, overlooks, interpretive signs, land conservation to implement resource protection and heritage tourism development to enhance and preserve scenic vistas and tourism corridors.
SF, SI, W	Highway Safety and Hazard	Realign curves, install median barriers, install shoulders or turn lanes to improve safety.
SR	Safe Routes to School	Improve safety and/or reduce traffic, fuel consumption and air pollution in vicinity of schools. Also include education, training and other non-infrastructure needs.
U	Urban	Roadway improvements including new lanes, new location extensions, bridge replacements, grade separations, interchange and intersection conversion
X	Special Projects	New location and new structures
Y,Z	Railroad-Highway Crossings	Grade separation and crossing safety improvements

1.4.2. NCDOT Program Categories

A national effort to develop a NLEB (and Indiana bat, *Myotis sodalis*) range-wide informal programmatic agreement for transportation projects is currently occurring. A draft of the current effects spreadsheet was shared with NCDOT via federal agencies. In order to be more compatible with the federal range wide conferencing and to reduce duplication of effort: the categorization of projects and the effects of transportation activities to NLEB were adapted for use in this PBA.

NCDOT projects (STIP and Division) have been grouped and categorized as follows, and are discussed in greater detail in Chapter 5:

- New Construction
- Safety and Mobility
- Maintenance and Preservation
- Disaster Response, Bank Stabilization, and Sinkhole Repair
- Transportation Enhancements
- Conservation Measures

The NLEB range-wide effort used the above categories to consider all possible effects to NLEB. Each category is broken down into a list of all probable activities (as seen in Appendix D). The activities are the mechanisms through which project categories have potential to affect NLEB. The North Carolina working group has borrowed and adapted these categories and activities to consider all possible effects to NLEB in eastern North Carolina (NCDOT Divisions 1-8). The working group reviewed all activities and identified those with the potential to affect NLEB in eastern North Carolina. General descriptions of these categories and their likely associated activities can be found in Chapter 5.

1.5. Program Area and Setting

North Carolina is in the southeastern quadrant of the United States of America. The program area roughly covers the eastern half of North Carolina, including 59 counties that fall under the jurisdiction of the USFWS Raleigh Field Office (Figure 1). The area is a mosaic of federal, state, and private lands. Using Level 3 EPA Ecoregions (USEPA 2002), the program area can be divided into the Middle Atlantic Coastal Plain, Southeastern Plain and the Piedmont.

1.5.1. Middle Atlantic Coastal Plain (Ecoregion 63)

Ecoregion 63 is found primarily in the Carolinas and other states to the north. It consists of low elevation, flat plains, with many swamps, marshes, and estuaries. Forest cover in the region, once dominated by longleaf pine, is now mostly loblolly and some shortleaf pine, with patches of oak, gum, and cypress near major streams. Its low terraces, marshes, dunes, barrier islands, and beaches are underlain by unconsolidated sediments. Poorly drained soils are common, and the region has a mix of coarse and finer textured soils. Ecoregion 63 is typically lower, flatter, more poorly drained, and marshier than Ecoregion 65 (see below). Pine plantations for pulpwood and lumber are typical, with some areas of cropland (USEPA 2002).

1.5.2. Southeastern Plain (Ecoregion 65)

These irregular plains with broad interstream areas have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation was predominantly longleaf pine, with smaller areas of oak-hickory-pine. On some moist sites, southern mixed forest occurred with beech, sweetgum, southern magnolia, laurel and live oaks, and various pines. The Cretaceous or Tertiary-age sands, silts, and clays of the region contrast geologically with the older metamorphic and igneous rocks of the Piedmont (45, see description below). Streams in this area are relatively low-gradient and sandy-bottomed (USEPA 2002).

1.5.3. North Carolina Piedmont (Ecoregion 45)

Considered the non-mountainous portion of the old Appalachians Highland by physiographers, the northeast-southwest trending Piedmont ecoregion comprises a transitional area between the mostly mountainous ecoregions of the Appalachians to the northwest and the relatively flat coastal plain to the southeast. It is a complex mosaic of Precambrian and Paleozoic metamorphic and igneous rocks with moderately dissected irregular plains and some hills. Once largely cultivated, much of this region is in planted pine or has reverted to successional pine and hardwood woodlands. The historic oak-hickory-pine forest was dominated by white oak, southern red oak, post oak, and hickory, with shortleaf pine, loblolly pine, and to the north and west, Virginia pine. The soils tend to be finer-textured than in coastal plain regions (USEPA 2002).

1.6. Eastern North Carolina NLEB Conference History, Reasoning, Assumption and Methodology

1.6.1. Eastern North Carolina NLEB Conference History

On October 2, 2013 the USFWS proposed listing the NLEB as Endangered under the ESA. On June 30, 2014 a six month extension on final determination of the proposal to list the NLEB as Endangered and a reopening of comment period was issued. The NLEB is expected to become a federally protected species on or soon after April 2, 2015.

Communication between NCDOT and the USFWS Raleigh Field Office regarding the NLEB began immediately after the species was proposed for federal protection. Due to the size of NCDOT's transportation program (Section 1.4), and the potential magnitude of transportation project delays, NCDOT and FHWA opted not to wait for the result of the range-wide programmatic agreement (Section 1.4.2) to begin our NLEB compliance efforts.

A working group composed of representatives from NCDOT, FHWA, USACE, and USFWS was created to develop a strategy to address the potential effects that NCDOT projects may have on the NLEB. The goal of the working group is to "Advance (transportation) projects forward without schedule delay(s) and ensure (NLEB) species protection/uplift in the most efficient way". Ongoing meetings of this group began May 28th, 2014 and are listed in Table 2, below. Working group meetings will continue on a biannual basis for the life of the agreement.

TABLE 2. NLEB WORKING GROUP MEETINGS

Date	Action	Participants	Topic of Discussion
5/28/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Kick Off
6/3/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Develop Approach
6/11/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Develop Approach

Date	Action	Participants	Topic of Discussion
6/26/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Develop Approach
7/14/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Develop Approach
8/4/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Develop Approach
8/25/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Review Draft PBA
9/18/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Review Draft PBA
10/7/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Review Draft PBA
10/30/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Review Draft PBA
11/17/2014	Meeting	USFWS, USACE, FHWA, NCDOT	Review Draft PBA

1.6.2. Eastern North Carolina NLEB Conference Reasoning

The approach the working group developed to ensure ESA compliance is programmatic formal consultation covering the entire NCDOT Program in Divisions 1-8. At the onset, the working group collected, considered, and discussed the following data and concerns. For supporting information, see Chapter 4.

Biological Information:

1. Eastern North Carolina appears to be on the fringe of the NLEB range.
2. To date, there are very few records of NLEB in eastern North Carolina.
3. NLEB appear to occur in low numbers in eastern North Carolina.
4. There are no known NLEB hibernacula and very few caves known in eastern North Carolina. Although mines are present in some areas of eastern North Carolina, most are collapsed or filled with groundwater, or are surface/pit mines, which do not provide suitable winter roosting habitat for NLEB.
5. Roosting and foraging habitat in the form of forested communities do not appear to be a limiting factor in eastern North Carolina.
6. Indiana bats do not occur in eastern North Carolina.
7. Some limited mist-netting and acoustic data indicates that NLEB may be active almost year-round in eastern North Carolina. Given the milder winter temperatures in coastal counties, the presence of insects through much of the winter, and the documented activity of other bat species throughout the winter, it is reasonable to suspect that NLEB are active in winter and may forego traditionally understood hibernation in eastern North Carolina.

Practical Concerns:

1. There is currently very limited information for NLEB in eastern North Carolina regarding distribution and behavior. The range map for NLEB produced by the USFWS in the January 6, 2014 Interim and Planning Guidance is very generalized for North Carolina, and is insufficient for project planning/analysis.

2. Indiana bats do not occur in eastern North Carolina and thus “piggy-backing” NLEB onto an Indiana bat ESA compliance strategy is not possible and/or relevant.
3. Standard survey guidelines (USFWS 2014b) may not be sufficient to thoroughly evaluate the ecology of NLEB in eastern North Carolina, since the species may be present year round (see Section 4.2.2).
4. Conventional conservation measures similar to those used for Indiana bats, such as date restrictions on tree clearing, would not be applicable to NLEB in eastern North Carolina if the species is active in the winter. Therefore, there would be no effective way to avoid take of the species during much of the year.
5. Unlike most states, North Carolina does not have county highway departments. As a result, North Carolina has one of the two largest state-owned and maintained highway systems in the country with about 80,000 miles of state-owned and maintained highways. Comparatively, the Kentucky Transportation Cabinet and the Indiana Department of Transportation maintain approximately 28,000 miles and 11,000 miles, respectively (Section 1.4).
6. NCDOT has over 1,000 projects programmed for construction over the next 5 years that are likely to involve tree clearing activities.
7. Following a traditional approach and assessing individual transportation projects for the purpose of rendering project specific biological conclusions would be time consuming. In addition, the survey window for NLEB is restricted to some spring/summer months.
8. Utilizing currently available NLEB data for the purpose of rendering project specific biological conclusions would result in a large number of transportation projects requiring formal Section 7 consultation.
9. Even if some projects or project types could be categorized as “May affect, not likely to adversely affect,” it is doubtful that the NCDOT, the USACE, or the USFWS have the staff necessary to review the volume of projects that would have to be reviewed for informal consultations.
10. An overall consultation plan needed to be designed in a way to avoid any NCDOT project delays associated with NLEB ESA compliance, and for NCDOT to provide the conservation community with sufficient information on NLEB in eastern North Carolina to properly focus management efforts in the future.

1.6.3. Eastern North Carolina NLEB Conference Assumptions and Methodology

The working group conducted the effects analysis (See Chapter 6) utilizing the following premises and assumptions:

1. Suitable roosting and foraging habitat for NLEB is present throughout eastern North Carolina (Divisions 1-8). Therefore, we assume suitable habitat is not a limiting factor for NLEB in eastern North Carolina.

2. Available information indicates there are relatively few NLEB in eastern North Carolina (see Chapter 4), but from a conservative perspective, we are assuming NLEB are present throughout our action area.
3. We assume the abundance of suitable NLEB habitat throughout eastern NC will act to ameliorate the effects of NCDOT activity disturbances to habitat in terms of habitat removal and/or habitat connectivity
4. We assume that noise generated from traffic will increase over time
5. We assume that few NLEB roost along roadsides
6. We assume that cities are not preferred NLEB habitat
7. Due to the limited available data for NLEB in eastern North Carolina, we assume the current greatest conservation need for NLEB in eastern North Carolina is more comprehensive information on the species' distribution and behavior.
8. Some transportation project activities adversely affect NLEB habitat:
    - We assume tree clearing is likely to be the activity with the greatest potential to affect NLEB, as they primarily roost in trees.
    - Limited data suggests NLEB may make occasional use of bridges and other structures. Therefore, our assumption is that maintenance and/or removal of these structures have limited potential to affect NLEB.
    - We assume a wide variety of other NCDOT Program activities have potential to affect NLEB, by affecting water quality through contaminants or sedimentation, or by producing noise, light, vibration or other disturbances.
    - We assume that any effect resulting from noise and vibrations related to construction activities could result in bats selecting roost trees further from the disturbance
    - We assume the probability of incidental take of NLEB from any individual NCDOT project in eastern North Carolina to be very low due to its limited distribution (see Chapter 4), with the probability of take in the form of mortality to be even lower.
    - We assume that implementing a traditional project-by-project ESA evaluation for projects currently programmed for construction will result in substantial project delays due to the following:
        - The limited data currently available for NLEB in eastern North Carolina.
        - The large number of transportation projects scheduled for construction.
        - The limited survey window for NLEB.
    - It is our premise that with such a low probability of take, it is a more efficient use of resources to conduct a high-level programmatic formal consultation for the entire NCDOT Program in eastern North Carolina.

As concluded by the effects analyses presented in Chapter 6, the result of the NCDOT Program is take of NLEB. Due to the limited data available for NLEB presence and behavior in eastern NC, accurately quantifying take associated with the NCDOT Program is impracticable.

The USFWS has found that in many cases, the biology of a listed species or the nature of the proposed action makes it difficult to detect or monitor the precise take of individual animals. In these cases, evaluating impacts to a "surrogate" may be the most reasonable and meaningful measure of assessing and monitoring take of listed species. The use of surrogates is a practical way to express the amount or extent of anticipated take in cases where the nature of the take-related impacts and the biology of the affected listed species make it difficult and costly to detect and accurately monitor. http://www.fws.gov/endangered/improving_ESA/ITS.html

Based on the biological information and practical concerns presented in Section 1.6.2 in addition to the assumptions and premises listed above, the working group elected to identify a surrogate for estimating effects to NLEB in eastern NC by the NCDOT Program. The surrogate identified by the working group is tree clearing resulting from NCDOT Program activities.

In order to project tree clearing totals associated with the NCDOT Program for 5 years, the working group elected to use GIS tools. Tree clearing estimates were calculated for projects scheduled for construction for the next two years and the results were extrapolated out to 5 years. Because the presence of NLEB in eastern North Carolina is likely to be low, we acknowledge that the estimated level of take is likely to be overestimated by using tree clearing as a surrogate.

Although there will be many other NCDOT activities (aside from tree clearing) with potential to affect NLEB in eastern North Carolina (Appendix D), these effects were not analyzed in great detail in this PBA for the following reasons:

1. Actual NLEB take from all other activities combined is likely to be less than the estimated NLEB take level based on tree clearing due to the likely limited distribution of NLEB in eastern North Carolina (see Chapter 4).
2. All NCDOT project activities combined (minus tree clearing) are likely to have inconsequential effect to NLEB when compared to the effect from tree clearing activities (see Chapter 6).
3. The amount of take resulting from structure removal will be much lower than take from tree clearing, due to lack of evidence to suggest that NLEB regularly use structures for roosting. Any take resulting from structure removal will be accounted for by the overestimation of take associated with tree clearing activities.

We propose that this consultation remain effective beyond five years, but agree that it must either be updated or replaced no later than Dec 31, 2020. Likewise, consultation will be reinitiated if needed, particularly if the amount or extent of incidental take is anticipated to be exceeded or any new information reveals effects of the action that may affect the NLEB in a manner or to an extent not previously considered. In addition, if critical habitat is designated for the NLEB or if more significant information about the species' biology comes to light, consultation on this species will be reinitiated.

Chapter 2. Northern Long-Eared Bat

2.1. Species Description

The NLEB is a medium-sized bat species, with an average adult body weight of 5 to 8 grams, with females tending to be slightly larger than males (Caceres and Pybus 1997). Average body length ranges from 77 to 95 mm and wingspan between 228 and 258 mm (Barbour and Davis 1969, Caceres and Barclay 2000). Pelage (fur) colors include medium to dark brown on its back, dark brown ears and wing membranes, and tawny to pale-brown fur on the ventral side (Nagorsen and Brigham 1993, Whitaker and Mumford 2008). As indicated by its common name, the NLEB is distinguished from other *Myotis* species by its long ears (average 17 mm, Whitaker and Mumford 2008) that, when laid forward, extend beyond the nose but less than 5 mm beyond the muzzle (Caceres and Barclay 2000). The tragus (projection of skin in front of the external ear) is long (average 9 mm), pointed, and symmetrical (Nagorsen and Brigham 1993, Whitaker and Mumford 2008).

The NLEB was once considered a subspecies of Keen's long-eared Myotis (*Myotis keenii)* (Fitch and Schump 1979), but was recognized as a distinct species by van Zyll de Jong in 1979 (1979) based on geographic separation and difference in morphology (Nagorsen and Brigham 1993, Caceres and Pybus 1997, Whitaker and Hamilton 1998, Caceres and Barclay 2000, Simmons 2005, Whitaker and Mumford 2008). No subspecies have been described for this species (van Zyll de Jong 1985, Nagorsen and Brigham 1993, Whitaker and Mumford 2008).

The range of the NLEB includes much of the eastern and north-central United States, and portions of all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and eastern British Columbia. Within the United States, this area includes all or portions of the following 39 States: Alabama, Arkansas, Connecticut, Delaware, the District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hapshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming (USFWS 2014a). However, throughout the majority of the species' range it is patchily distributed and historically was less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

2.2. Life History

NLEB predominantly overwinter in hibernacula that include caves and abandoned mines. Hibernacula used by NLEB are typically large, with large passages and entrances (Raesly and Gates 1987), relatively constant and cooler temperatures (32 to 48 degrees F) (Raesly and Gates 1987, Caceres and Pybus 1997, Brack 2007), and with high humidity and no air currents (Fitch and Shump 1979, Van Zyll de Jong 1985, Raesly and Gates 1987, Caceres and Pybus 1997). NLEB are typically found roosting in small crevices or cracks in cave or mine walls or ceilings, often with only the nose and ears visible, thus are easily overlooked during surveys (Griffin 1940, Barbour and Davis 1969, Caire *et al.* 1979, Van Zyll de Jong 1985, Caceres and Pybus 1997, Whitaker and Mumford 2008). Caire *et al.* (1979) and Whitaker and Mumford (2008) commonly observed individuals exiting caves with mud and clay on their fur, also suggesting the bats were roosting in tighter recesses of hibernacula. They are also found hanging in the open, although not as frequently as in cracks and crevices (Barbour and Davis 1969, Whitaker and Mumford 2008).

To a lesser extent, NLEB have been found overwintering in other types of habitat that resemble cave or mine hibernacula, including abandoned railroad tunnels. In 1952 three NLEB were found hibernating near the entrance of a storm sewer in central Minnesota (Goehring 1954). Kurta and Teramino (1994) found NLEB hibernating in a hydro-electric dam facility in Michigan. In Massachusetts, NLEB have been found hibernating in the Sudbury Aqueduct (French 2012, unpublished data). Griffin (1945) found NLEB in December in Massachusetts in a dry well.

During the summer, NLEB typically roost singly or in colonies underneath bark or in cavities or crevices of both live trees and snags (Sasse and Perkins 1996, Foster and Kurta 1999, Owen *et al.* 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone *et al.* 2010). Males and non-reproductive females' summer roost sites may also include cooler locations, including caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006). NLEB have also been observed roosting in colonies in manmade structures such as buildings, barns, bridges, a park pavilion, sheds, cabins, under eaves of buildings, behind window shutters, and in bat houses (Mumford and Cope 1964; Barbour and Davis 1969; Cope and Humphrey 1972; Keeley and Tuttle 1999; Feldhamer *et al*. 2003; Amelon and Burhans 2006; Whitaker and Mumford 2008; Timpone *et al.* 2010; Joe Kath 2013, pers. comm. cited in USFWS 2013, O'Keefe pers. comm. Cited in USFWS 2014c).

The NLEB appears to be somewhat opportunistic in tree roost selection, selecting varying roost tree species and types of roosts throughout its range, including tree species such as black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*) (Mumford and Cope 1964, Clark *et al.* 1987, Sasse and Pekins 1996, Foster and Kurta 1999, Lacki and Schwierjohann 2001, Owen *et al.* 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone *et al*. 2010). NLEB most likely are not dependent on certain species of trees for roosts throughout their range; rather, certain tree species will form suitable cavities or retain bark and the bats will use them opportunistically (Foster and Kurta 1999). Carter and Felhamer (2005) speculated that structural complexity of habitat or available roosting resources are more important factors than the actual tree species.

Many studies have documented the NLEB's selection of live trees and snags, with a range of 10 to 53 percent selection of live roosts found (Sasse and Perkins 1996, Foster and Kurta 1999, Lacki and Schwierjohann 2001, Menzel *et al.* 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone *et al.* 2010). Foster and Kurta (1999) found 53 percent of roosts in Michigan were in living trees, whereas in New Hampshire, 34 percent of roosts were in snags (Sasse and Pekins 1996). The use of live trees versus snags may reflect the availability of such structures in study areas (Perry and Thill 2007) and the flexibility in roost selection when there is a sympatric bat species present (*e.g.*, Indiana bat, *Myotis sodalis*) (Timpone *et al.* 2010). In tree roosts, NLEB are typically found beneath loose bark or within cavities and have been found to use both exfoliating bark and crevices to a similar degree for summer roosting habitat (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Menzel *et al.* 2002, Owen *et al.* 2002, Perry and Thill 2007, Timpone *et al.* 2010).

Canopy coverage at NLEB roosts has ranged from 56 percent in Missouri (Timone *et al.* 2010), 66 percent in Arkansas (Perry and Thill 2007), greater than 75 percent in New Hampshire (Sasse and Pekins 1996), to greater than 84 percent in Kentucky (Lacki and Schwierjohann 2001). Studies in New Hampshire and British Columbia have found that canopy coverage around roosts is lower than in available stands (Sasse and Pekins 1996, Caceres 1998). Females tend to roost in more open areas than males, likely due to the increased solar radiation, which aids pup development (Perry and Thill 2007). Fewer trees surrounding maternity roosts may also benefit juvenile bats that are starting to learn to fly (Perry and Thill 2007). However, in southern Illinois, NLEB were observed roosting in areas with greater canopy cover than in random plots (Carter and Feldhamer 2005). Roosts are also largely selected below the canopy, which could be due to the species' ability to exploit roosts in cluttered environments; their gleaning behavior suggests an ability to easily maneuver around obstacles (Foster and Kurta 1999, Menzel *et al.* 2002).

Female NLEB typically roost in tall, large-diameter trees (Sasse and Pekins 1996). Studies have found that the diameter-at-breast height (dbh) of NLEB roost trees was greater than random trees (Lacki and Schwierjohann 2001), and others have found both dbh and height of selected roost trees to be greater than random trees (Sasse and Pekins 1996, Owen *et al.* 2002). However, other studies have found that roost tree mean dbh and height did not differ from random trees (Menzel *et al.* 2002, Carter and Feldhamer 2005). Lacki and Schwierjohann (2001) have also found that NLEB roost more often on upper and middle slopes than lower slopes, which suggests a preference for higher elevations due to increased solar heating.

NLEB hibernate during the winter months to conserve energy from increased thermoregulatory demands and reduced food resources. In general, NLEB arrive at hibernacula in August or September, enter hibernation in October and November, and leave the hibernacula in March or April (Caire *et al.* 1979, Whitaker and Hamilton 1998, Amelon and Burhans 2006). However, hibernation may begin as early as August (Whitaker and Rissler 1992a). In Copperhead Cave in west-central Indiana, the majority of bats enter hibernation during October, and spring emergence occurs mainly from about the second week of March to mid-April (Whitaker and Mumford 2008). In Indiana, NLEB become more active and start feeding outside the hibernaculum in mid-March, evidenced by stomach and intestine contents. In northern latitudes, such as in upper Michigan's copper-mining district, hibernation for NLEB may begin as early as late August and may last for 8 to 9 months (Stones and Fritz 1969, Fitch and Shump 1979). NLEB have shown a high degree of philopatry (using the same site multiple years) for a hibernaculum (Pearson 1962), although they may not return to the same hibernaculum in successive seasons (Caceres and Barclay 2000).

Typically, NLEB are not abundant and compose a small proportion of the total number of bats hibernating in a hibernaculum (Barbour and Davis 1969, Mills 1971, Caire *et al.* 1979, Caceres and Barclay 2000). Although usually found in small numbers, the species typically inhabits the same hibernacula with large numbers of other bat species, and occasionally are found in clusters with these other bat species. Other species that commonly occupy the same habitat include: little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibii*), tri-colored bat (*Perimyotis subflavus*), and Indiana bat (Swanson and Evans 1936, Griffin 1940, Hitchcock 1949, Stones and Fritz 1969, Fitch and Shump 1979). Whitaker and Mumford (2008), however, infrequently found NLEB hibernating beside little brown bats, Indiana bats, or tri-colored bats, since they found few hanging on side walls or ceilings of cave passages. Barbour and Davis (1969) found that the species is never abundant and rarely recorded in concentrations of over 100 in a single hibernaculum.

NLEB often move between hibernacula throughout the winter, which may further decrease population estimates (Griffin 1940, Whitaker and Rissler 1992b, Caceres and Barclay 2000). Whitaker and Mumford (2008) found that this species flies in and out of some of the mines and caves in southern Indiana throughout the winter. In particular, the bats were active at Copperhead Cave periodically all winter, with NLEB being more active than other species hibernating in the cave. Though NLEB fly outside of the hibernacula during the winter, they do not feed; hence the function of this behavior is not well understood (Whitaker and Hamilton 1998). However, it has been suggested that bat activity during winter could be due in part to disturbance by researchers (Whitaker and Mumford 2008).

NLEB exhibited significant weight loss during hibernation. In southern Illinois, weight loss during hibernation was found in male NLEB, with individuals weighing an average of 6.6 grams prior to January 10, and those collected after that date weighing an average of 5.3 grams (Pearson 1962). Whitaker and Hamilton (1998) reported a weight loss of 41–43 percent over the hibernation period for NLEB in Indiana. In eastern Missouri, male NLEB lost an average of 3.0 grams during the hibernation period (late October through March), and females lost an average of 2.7 grams (Caire *et al.* 1979).

While the NLEB is not considered a long-distance migratory species, short migratory movements between summer roost and winter hibernacula between 35 and 55 miles have been documented (Griffith 1945, Nagorsen and Brigham 1993). However, movements from hibernacula to summer colonies may range from 5 to 168 miles (Griffin 1945). Several studies show a strong homing ability of NLEB in terms of return rates to a specific hibernaculum, although bats may not return to the same hibernaculum in successive winters (Caceres and Barclay 2000). Individuals have been known to travel between 35 and 60 miles between caves during the spring (Griffin 1945, Caire *et al.* 1979).

NLEB switch roosts often (Sasse and Perkins 1996), typically every 2–3 days (Foster and Kurta 1999, Owen *et al.* 2002, Carter and Feldhamer 2005, Timpone *et al.* 2010). In Missouri, the longest time spent roosting in one tree was 3 nights; however, up to 11 nights spent roosting in a manmade structure has been documented (Timpone *et al.* 2010). Similarly, Carter and Feldhamer (2005) found that the longest a NLEB used the same tree was 3 days; in West Virginia, the average time spent at one roost was 5.3 days (Menzel *et al.* 2002). Bats switch roosts for a variety of reasons, including temperature, precipitation, predation, parasitism, and ephemeral roost sites (Carter and Feldhamer 2005). In Missouri, Timpone *et al.* (2010) radio-tracked 13 NLEB to 39 roosts and found the mean distance between the location where captured and roost tree was 1.1 miles (range 0.04–3.0 miles), and the mean distance traveled between roost trees was 0.42 mile (range 0.03–2.4 miles). In Michigan, the longest distance the same bat moved between roosts was 1.2 miles and the shortest was 20 feet (Foster and Kurta 1999). In New Hampshire, the mean distance between foraging areas and roost trees was 1975 feet (Sasse and Pekins 1996). In the Ouachita Mountains of Arkansas, Perry and Thill (2007) found that individuals moved among snags that were within less than 5 acres.

Some studies have found tree roost selection to differ slightly between male and female NLEB. Male NLEB have been found to more readily use smaller diameter trees for roosting than females, suggesting males are more flexible in roost selection than females (Lacki and Schwierjohann 2001, Broders and Forbes 2004, Perry and Thill 2007). In the Ouachita Mountains of Arkansas, both sexes primarily roosted in snags, although females roosted in snags surrounded by fewer midstory trees than did males (Perry and Thill 2007). In New Brunswick, Canada, Broders and Forbes (2004) found that there was spatial segregation between male and female roosts, with female maternity colonies typically occupying more mature, shade-tolerant deciduous tree stands and males occupying more conifer-dominated stands. In northeastern Kentucky, males do not use colony roosting sites and are typically found occupying cavities in live hardwood trees, while females form colonies more often in both hardwood and softwood snags (Lacki and Schwierjohann 2001).

NLEB breeding occurs from late July in northern regions to early October in southern regions and commences when males begin to swarm hibernacula and initiate copulation activity (Whitaker and Hamilton 1998, Caceres and Barclay 2000, Amelon and Burhans 2006, Whitaker and Mumford 2008). Copulation occasionally occurs again in the spring (Racey 1982). Hibernating females store sperm until spring, exhibiting a delayed fertilization strategy (Racey 1979, Caceres and Pybus 1997). Ovulation takes place at the time of emergence from the hibernaculum, followed by fertilization of a single egg, resulting in a single embryo (Cope and Humphrey 1972, Caceres and Pybus 1997, Caceres and Barclay 2000). Gestation is approximately 50-60 days (Ollendorff 2002).

Maternity colonies, consisting of females and young, are generally small, numbering from about 30 (Whitaker and Mumford 2008) to 60 individuals (Caceres and Barclay 2000); however, one group of 100 adult females was observed in Vermilion County, Indiana (Whitaker and Mumford 2008). In West Virginia, maternity colonies in two studies had a range of 7–88 individuals (Owen *et al.* 2002) and 11–65 individuals, with a mean size of 31 (Menzel *et al.* 2002). Lacki and Schwierjohann (2001) found that the population size of colony roosts declined as the summer progressed with pregnant females using the largest colonies (mean=26) and postlactating females using the smallest colonies (mean=4), with the largest overall reported colony size of 65 bats. Other studies have also found that the number of individuals within a maternity colony typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Perry and Thill 2007, Garroway and Broders 2008, Johnson *et al.* 2012). Female roost site selection, in terms of canopy cover and tree height, changes depending on reproductive stage; relative to pre- and post-lactation periods, lactating NLEB have been shown to roost higher in tall trees situated in areas of relatively less canopy cover and tree density (Garroway and Broders 2008).

Adult females give birth to a single pup (Barbour and Davis 1969). Birthing within the colony tends to be synchronous, with the majority of births occurring around the same time (Krochmal and Sparks 2007). Parturition likely occurs in late May or early June (Easterla 1968, Caire *et al.* 1979, Whitaker and Mumford 2008), but may occur as late as July (Whitaker and Mumford 2008). Broders *et al.* (2006) estimated a parturition date of July 20 in New Brunswick. Lactating and post-lactating females were observed in mid-June in Missouri (Caire *et al.* 1979), July in New Hampshire and Indiana (Sasse and Pekins 1996, Whitaker and Mumford 2008), and August in Nebraska (Benedict 2004). Juvenile volancy occurs by 21 days after parturition and as early as 18 days after parturition (Kunz 1971, Krochmal and Sparks 2007). Subadults were captured in late June in Missouri (Caire *et al.* 1979), early July in Iowa (Sasse and Pekins 1996), and early August in Ohio (Mills 1971).

Adult longevity is estimated to be up to 18.5 years (Hall 1957), with the greatest recorded age of 19 years (Kurta 1995). Most mortality for NLEB and many other species of bats occurs during the juvenile stage (Caceres and Pybus 1997).

The NLEB has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Griffith and Gates 1985, Nagorsen and Brigham 1993, Brack and Whitaker 2001), with diet composition differing geographically and seasonally (Brack and Whitaker 2001). The most common insects found in the diets of NLEB are lepidopterans (moths) and coleopterans (beetles), with arachnids (spiders) also being a common prey item (Brack and Whitaker 2001, Feldhamer *et al.* 2009).

Foraging techniques include hawking (catching insects in flight) and gleaning in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, Ratcliffe and Dawson 2003). Observations of NLEB foraging on arachnids (Feldhamer *et al.*2009), presence of green plant material in their feces (Griffith and Gates 1985), and non-flying prey in their stomach contents (Brack and Whitaker 2001) suggest considerable gleaning behavior. NLEB have the highest frequency call of any bat species in the Great Lakes area (Kurta 1995). Gleaning allows this species to gain a foraging advantage for preying upon moths because moths are less able to detect these high frequency echolocation calls (Faure *et al.* 1993). Emerging at dusk, most hunting occurs above the understory, 3 to 10 feet above the ground, but under the canopy (Nagorsen and Brigham 1993) on forested hillsides and ridges, rather than along riparian areas (LaVal *et al.* 1977, Brack and Whitaker 2001). This coincides with data indicating that mature forests are an important habitat type for foraging NLEB (Caceres and Pybus 1997). Occasional foraging also takes place over forest clearings and water, and along roads (Van Zyll de Jong 1985).

Female home range size may range from 47 to 425 acres (Lacki *et al.* 2009). Owen *et al.* (2003) estimated average maternal home range size to be 161 acres. Home range size of NLEB in this study site was small relative to other bat species, but this may be due to the study's timing (during the maternity period) and the small body size of NLEB (Owen *et al.* 2003). The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 2034 feet (Sasse and Pekins 1996).

2.3. Population Dynamics

Although they are typically found in low numbers in inconspicuous roosts, most records of NLEB are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species' range in the United States, although many hibernacula contain only a few (1-3) individuals (Whitaker and Hamilton 1998). Known hibernacula include: Arkansas (n=20), Connecticut (n=5), Georgia (n=1), Illinois (n=36), Indiana (n=25), Kentucky (n=90), Maine (n=3), Maryland (n=11), Massachusetts (n=7), Michigan (n=94), Minnesota (n=11), Missouri (n=>111), Nebraska (n=2), New Hampshire (n=9), New Jersey (n=8), New York (n=58), North Carolina (n=20), Oklahoma (n=4), Ohio (n=3), Pennsylvania (n=112), South Carolina (n=2), South Dakota (n=7), Tennessee (n=11), Vermont (n=13), Virginia (n=8), West Virginia (n=104), and Wisconsin (n=45). Other states within the species' range have no known hibernacula (due to no suitable hibernacula present or lack of survey effort).

Historically, the NLEB was most abundant in the eastern portion of its range (Caceres and Barclay 2000). NLEB have been consistently caught during summer mist net surveys and detected during acoustic surveys in eastern populations. For example, large numbers of NLEB have been found in larger hibernacula in Pennsylvania (*e.g.* an estimated 881 individuals in a mine in Bucks County in 2004). Fall swarm trapping conducted in September–October 1988–1989, 1990–1991, and 1999–2000 at two hibernacula with large historical numbers of NLEB had total captures ranging from 6 to 30 bats per hour, which indicated that the species was abundant at these hibernacula (Pennsylvania Game Commission 2012, unpublished data).

The NLEB is commonly encountered in summer mist-net surveys throughout the majority of the Midwest and is considered fairly common throughout much of the region. However, the species is often found infrequently and in small numbers in hibernacula surveys throughout most of the Midwest. Historically, the NLEB was considered quite common throughout much of Indiana, and was the fourth or fifth most abundant bat species in the state in 2009 (Whitaker and Mumford 2008).

The NLEB is less common in the southern portion of its range than in the northern portion of the range (Amelon and Burhans 2006). In the South, it is considered more common in states such as Kentucky and Tennessee, and rarer in the southern extremes of the range (*e.g.* Alabama, Georgia, and South Carolina).

The NLEB is generally less common in the western portion of its range than in the northern portion of the range (Amelon and Burhans 2006). It is considered common in only small portions of the western part of its range (*e.g.* Black Hills of South Dakota) and uncommon or rare in the western extremes of the range (*e.g.* Wyoming, Kansas, Nebraska) (Caceres and Barclay 2000).

The NLEB occurs throughout the majority of the forested regions of Canada, although it is found in higher abundance in eastern Canada than in western Canada, similar to in the United States (Caceres Pybus 1997). However, the scarcity of records in the western parts of Canada may be due to more limited survey efforts. It has been estimated that approximately 40 percent of the NLEB's global range is in Canada (COSEWIC 2014).

2.4. Status and Distribution

On October 2, 2013, the USFWS proposed to list the NLEB as an endangered species throughout its range under the ESA. No critical habitat has been proposed at this time (USFWS 2013).

The primary threat to and the reason for the proposed listing of the NLEB is white-nosed syndrome (WNS), a disease caused by the fungus *Pseudogymnoascus destructans* (formerly known as *Geomyces destructans*) that is known to kill bats. The USFWS has found that no other threat is as severe and immediate to the species persistence as WNS. There is currently no known cure. The species would likely not be imperiled were it not for this disease (USFWS 2013).

White-nose syndrome is an emerging infectious disease responsible for unprecedented mortality in some hibernating insectivorous bats of the northeastern United States (Blehert *et al.* 2009) and poses a considerable threat to several hibernating bat species throughout North America (USFWS 2011). The first evidence of WNS was documented in Howes Cavern, 32 miles west of Albany, New York, in February 2006 (Blehert *et al.* 2009). Since that first documented appearance, WNS has spread rapidly throughout the Northeast and is expanding through the Midwest. As of June 2014, WNS had been confirmed in 25 states (Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin) and 5 Canadian provinces (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec) (USFWS 2014d). Two additional states (Iowa and Minnesota) are considered suspect for WNS. USFWS biologists and partners estimate that at least 5.7 to 6.7 million bats of several species have now died from WNS (USFWS 2012).

The pattern of spread has generally followed predictable trajectories along recognized migratory pathways and overlapping summer ranges of hibernating bat species. Therefore, Kunz and Reichard (2010) assert that WNS is spread mainly through bat-to-bat contact. However, evidence suggests that fungal spores can be transmitted by humans (Sleeman 2011). Seven North American hibernating bat species are known to be affected by WNS, but the effects vary by species (USFWS 2014d).

White-nose syndrome is caused by the recently described psychrophilic (cold-loving) fungus, currently known as *Pseudogymnoascus destructans*. *P. destructans* may be nonnative to North America and only recently arrived on the continent (Puechmaille *et al.* 2011, Minnis and Lindner 2013). The fungus grows on and within exposed tissues of hibernating bats (Gargas *et al.* 2009, Lorch *et al.* 2011), and the diagnostic feature is the white fungal growth on muzzles, ears, or wing membranes of affected bats, along with epidermal erosions that are filled with fungal hyphae (Blehert *et al.* 2009, Meteyer 2009). *P. destructans* grows optimally at temperatures from 41 to 50 degrees F, the same temperatures at which bats typically hibernate. Temperatures in WNS-affected hibernacula seasonally range from 36 to 57 degrees F, permitting year-round growth, and may act as a reservoir maintaining the fungus (Blehert *et al.* 2009).

In addition to the presence of the white fungus, observations show that bats affected by WNS are characterized by some or all of the following: (1) depleted fat reserves by mid-winter; (2) general unresponsiveness to human disturbance; (3) apparent lack of immune response during hibernation; (4) ulcerated, necrotic, and scarred wing membranes; and (5) aberrant behaviors, including shifts of large numbers of bats in hibernacula to roosts near the entrances or unusually cold areas, large numbers of bats dispersing during the day from hibernacula during midwinter, and large numbers of fatalities, either inside the hibernacula, near the entrance, or in the immediate vicinity of the entrance (WNS Science Strategy Group 2008, USFWS 2011).

Although the exact process by which WNS leads to death remains undetermined, it is likely that the immune function during torpor compromises the ability of hibernating bats to combat the infection (Bouma *et al.* 2010, Moore *et al.* 2011). Early hypotheses suggested that WNS may affect bats before the hibernation season begins, causing bats to arrive at hibernacula with insufficient fat to survive the winter. Alternatively, a second hypothesis suggests that bats arrive at hibernacula unaffected and enter hibernation with sufficient fat stores, but then become affected and use fat stores too quickly as a result of disruption to hibernation physiology (WNS Science Strategy Group 2008). More recent observations, however, suggest that bats are arriving at hibernacula with sufficient or only slightly lower fat stores (Courtin *et al.* 2010).

Boyles and Willis (2010) hypothesized that infection by *P. destructans* alters the normal arousal cycles of hibernating bats, particularly by increasing arousal frequency and/or duration. In fact, Reeder *et al.* (2012) and Warnecke *et al.* (2012) observed an increase in arousal frequency in laboratory studies of hibernating bats infected with *P. destructans.* A disruption of this torpor-arousal cycle could easily cause bats to metabolize fat reserves too quickly, thereby leading to starvation. For example, skin irritation from the fungus might cause bats to remain out of torpor for longer than normal to groom, thereby exhausting their fat reserves prematurely (Boyles and Willis 2010).

Cryan *et al.* (2010) suggests that mortality may be caused by catastrophic disruption of wing-dependent physiological functions. The wings of winter-collected WNS-affected bats often reveal signs of infection, whereby the degree of damage observed suggests functional impairment. Emaciation is a common finding in bats that have died from WNS. The authors hypothesized that wing damage caused by *P. destructans* infections could sufficiently disrupt water balance to trigger frequent thirst-associated arousals with excessive winter flight, and subsequent premature depletion of fat stores. In related research, Cryan *et al.* (2013) found that electrolytes (sodium and chloride) tended to decrease as wing damage increased in severity. Proper concentrations of electrolytes are necessary for maintaining physiologic homeostasis, and any imbalance could be life-threatening. Although the exact mechanism by which WNS affects bats is still in question, the effect it has on many hibernating bat species is well documented, as well as the high levels of mortality it causes in some susceptible bat species.

The NLEB is known to be highly susceptible to WNS, and mortalities due to the disease have been confirmed. From 2007 to mid-2013, the USGS National Wildlife Health Center in Madison, Wisconsin tested 65 NLEB submissions. Twenty-eight of the 65 NLEB tested were confirmed as positive for WNS by histopathology and another 10 were suspect (Ballmann 2013, pers. comm.). The New York Department of Environmental Conservation has confirmed at least 29 NLEB submitted with signs of WNS since 2007 in New York but there were still bat carcasses not yet analyzed (Okonieski 2012, pers. comm. cited in USFWS 2013).

Due to WNS, the NLEB has experienced a sharp decline in the northeastern part of its range, as evidenced in hibernacula surveys. The northeastern United States is very close to saturation (i.e.

WNS found in majority of hibernacula) for the disease, with the NLEB being one of the species most severely affected (Herzog and Reynolds 2013). Turner *et al.* (2011) compared the most recent pre-WNS count to the most recent post-WNS count for 6 cave bat species; they reported a 98 percent decline between pre- and post-WNS in the number of hibernating NLEB at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia. In addition to the Turner *et al.* (2011) data, the Service conducted an additional analysis that included data from Connecticut (n=3), Massachusetts (n=4), and New Hampshire (n=4), and added one additional site to the previous Vermont data. Using a protocol similar to Turner *et al.* (2011), the Service found that the combined overall rate of decline seen in hibernacula count data for the 8 states was approximately 99 percent (USFWS 2013). Similarly, during 2013 hibernacula surveys at 34 sites where NLEB were also observed prior to WNS in Pennsylvania, researchers found a 99-percent decline (from 637 to 5 bats) (Turner 2013, unpublished data).

Long-term (including pre- and post-WNS) summer data for the NLEB are somewhat limited; however, the available data parallel the population decline exhibited in hibernacula surveys. Summer surveys from 2005–2011 near Surry Mountain Lake in New Hampshire showed a 99 percent decline in capture success of NLEB post-WNS, which is similar to the hibernacula data for the state (a 95 percent decline) (Brunkhurst 2012, unpublished data). In Vermont, the species was the second most common bat species in the state pre-WNS; however, it is now one of the least likely to be encountered, with the change in effort to capture one bat increasing by nearly 13 times, and approximately a 94 percent overall reduction in captures in mist-net surveys (Darling and Smith 2011, unpublished data). In eastern New York, captures of NLEB have declined approximately 93 percent from pre-WNS (Herzog 2012, unpublished data). In West Virginia, NLEB mist-net captures comprised 41 percent of all captures pre-WNS and 24 percent post-WNS (Francl *et al.* 2012). Nagel and Gates (2012) reported a 78-percent decrease in NLEB passes during acoustic surveys between 2010 and 2012 in western Maryland. At two swarm trapping sites in Pennsylvania, researchers in 2010-2011 saw a decline in capture rates of 95 percent at one site and 97 percent at the second site post-WNS levels, which corroborates documented interior hibernacula declines (Turner *et al.* 2011, Turner 2013 unpublished data).

The area currently affected by WNS constitutes the core of the NLEB's range, where the species was most common prior to WNS. Furthermore, the rate at which WNS has spread has been rapid. Since its first documented occurrence in New York in February 2006, WNS had spread to 25 states and 5 Canadian provinces by June 2014 (USFWS 2014d). WNS has already had a substantial effect on NLEB in the core of its range and is likely to spread throughout the species' entire range within a short time; thus the USFWS considers it to be the predominant threat to the species range-wide. This threat is ongoing and is expected to increase in the future as it continues to extirpate NLEB populations (USFWS 2013).

Other threats to the NLEB include wind-energy development, winter habitat modification (i.e. effects on hibernacula), summer habitat loss/modification (i.e. tree clearing from timber harvest, development, natural resource extraction, etc.), human disturbance of hibernating bats, predation, climate change, and contaminants (USFWS 2013). Although these threats (prior to WNS) have not individually or cumulatively had significant effects at the species level, they may increase the overall effects to the species when considered cumulatively with WNS.

Chapter 3. NCDOT Program Action Area

The action area for this Programmatic Biological Assessment is defined as all areas that could be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402).

NCDOT projects are organized first by NCDOT Division and then by county. NCDOT Divisions are numbered from east to west. There are a total of 14 NCDOT Divisions, including all 100 counties, and each Division contains 5 to 14 counties. The action area includes NCDOT Divisions 1-8 in eastern North Carolina, and includes all counties under the USFWS Raleigh Field Office's jurisdiction. The projects to be covered under this PBA will take place at existing roadways, bridges, some new locations, and other transportation-related infrastructure maintained within NCDOT Divisions 1-8.

The action area for this PBA is the 59 eastern most counties of North Carolina. North Carolina counties within the action area are listed by NCDOT Division in Table 3, and shown in Figure 2 (Appendix A).

TABLE 3. NCDOT DIVISIONS AND COUNTIES WITHIN ACTION AREA

Division One	Bertie, Camden, Chowan, Currituck, Dare, Gates, Hertford, Hyde, Martin, Northampton, Pasquotank, Perquimans, Tyrrell, Washington
Division Two	Beaufort, Carteret, Craven, Greene, Jones, Lenoir, Pamlico, Pitt
Division Three	Brunswick, Duplin, New Hanover, Onslow, Pender, Sampson
Division Four	Edgecombe, Halifax, Johnson, Nash, Wayne, Wilson
Division Five	Durham, Franklin, Granville, Person, Vance, Wake, Warren
Division Six	Bladen, Columbus, Cumberland, Harnett, Robeson
Division Seven	Alamance, Caswell, Guilford, Orange, Rockingham
Division Eight	Chatham, Hoke, Lee, Montgomery Moore, Randolph, Richmond, Scotland

Chapter 4. Environmental Baseline

4.1. Status of the Northern Long-Eared Bat in Eastern North Carolina

The North Carolina Heritage Program (NCNHP) is responsible for maintaining North Carolina state natural resource inventory data. NCWRC collects data (their own and data submitted from recognized experts) and shares with NCNHP. The following data is from NCNHP (NCNHP 2014), supplemented with data from the USFWS website on NLEB in North Carolina, as well as information collected from bat researchers and biologists who have conducted surveys in eastern North Carolina. Evidence of NLEB in eastern North Carolina is listed by county below, as well as survey efforts that resulted in presumed absence of the species. Results from acoustic surveys which indicated the presence of NLEB in areas where netting did not confirm presence were not considered viable "positive records", and therefore are not discussed as part of this analysis. Figure 3 visually depicts the information outlined in the following sections.

4.1.1. Northern Long-eared Bat Capture Records in Eastern North Carolina

Camden County: Six NLEB captures in 2012, including reproductive females (Kalcounis-Rueppell and Grider 2013).

Currituck County: During a bat survey conducted at a U.S. Naval facility that spans Chesapeake, Virginia and Currituck County, North Carolina, a total of 16 NLEB were captured during the summers of 2013 and 2014. Adult males and females and a juvenile female were captured. Adult females were fitted with radio-transmitters and tracked. Surveys will continue in 2015. A final report is pending (Michael Wright, US Navy, personal communication, October 29, 2014).

Washington County: Six NLEB captured in June of 2007, including one adult male and five juveniles, which suggested a resident maternity colony is present (Morris *et al*. 2009). In 2012, a male NLEB and a non-reproductive adult female NLEB were captured at two of four net sites (Kalcounis-Rueppell and Grider 2013).

4.1.2. Other Records Indicating Northern Long-Eared Bat Presence in Eastern North Carolina

Lee County: One female collected in June on 2001 is preserved in UNC Wilmington's Natural History Collection.

New Hanover County: A rabies lab record from approximately 2004. No information on location or time of year. Specimen was deposited at University of North Carolina Wilmington.

Wake County: Two historical records (1901 and 1902), according to NCNHP. Specimen from 1901 collected near a house in Raleigh. Second specimen (1902) had no locational data other than county. In addition, two specimens collected in Raleigh from 1947 and 1981 are preserved in UNC Wilmington's Natural History Collection.

4.1.3. Negative Records for Northern Long-Eared Bats in Eastern North Carolina

Below is a summary of all known acoustical and mist net bat survey work in eastern North Carolina. No NLEB were captured or recorded during these surveys.

Fort Bragg/Camp Mackall – (Janice Patten, Wildlife Biologist, Fort Bragg Endangered Species Branch, personal communication, July 1, 2014)

- Multiple Sonobat acoustic transects have been conducted across Fort Bragg and Camp Mackall from 2004-2014. Eight species have been detected, but none were NLEB.

- Mist-netting was conducted from 2004-2009 at 38 locations across Fort Bragg and Camp Mackall. This included checking buildings for potential roosts. Mist netting/building searches are being continued in 2014 and 2015. No NLEB were captured or observed.
- Late in the winter of 2013-2014, several known roost locations where checked for bats. Bats were found at two sites and several bats were swabbed for WNS. The results were all negative. No NLEB were observed.

Uwharrie National Forest Mist-netting

Over a period of ten years, the Uwharrie National Forest has been extensively surveyed for bats. No NLEB have been recorded or captured during these surveys.

- Three nights of netting occurred during the 2004 Southeastern Bat Diversity Network bat blitz in Montgomery, Anson, Randolph and Stanly counties at over 30 sites. Seventy-seven bats (five species) were captured, but no NLEB were captured or recorded (SBDN 2014)
- NCDOT staff conducted netting in 2007 at 4 sites in Montgomery County. No NLEB were captured.
- Pittaway and Kalcounis-Rueppell (2014) analyzed acoustic transects along 18 routes that were run in 2009, 2010 and 2012 in Uwharrie National Forest. No NLEB calls were recorded.
- Fifty-eight nights of mist-netting at fourteen sites in Uwharrie National Forest in the summer of 2014; 179 bats were captured, but there were no NLEB captures (King and Kalcounis-Rueppell, 2014).

Croatan National Forest

Fourteen (14) nights of mist-netting were conducted for the US 17 project on the west side of Croatan National Forest (CNF), but no NLEB were captured. In addition to the negative mist-netting results for US 17, the following negative survey results were also obtained in and adjacent to CNF:

- Six nights of mist-netting in CNF along the proposed Havelock bypass corridor in 2005 (NCDOT).
- Five nights of mist-netting adjacent to CNF at the NCDOT Croatan mitigation bank from 2007-2010 (NCDOT).
- One night of mist-netting in Carteret County at the southern edge of CNF in 2009 (NCDOT).
- Three nights of acoustic driving transects in 2010 conducted on CNF by USFS staff (Pittaway and Kalcounis-Rueppell 2014).

NCDPR Surveys

North Carolina Museum of Natural Sciences staff surveyed eight State Parks and Natural Areas in eastern North Carolina between 1999 and 2004 [Lambiase 2000 and subsequent addendum (unpublished)]. Mist-netting and roost checks were the primary means of survey. More than 160 bats were recorded in roughly 40 days/nights of surveys, but no NLEB were recorded during any of these surveys. Survey locations included Eno River State Park (Durham County), Goose Creek State Park (Beaufort County), Lake Waccamaw State Park (Columbus County), Lumber River State Park (Columbus, Robeson, and Scotland Counties), Merchant's Millpond State Park (Gates County), Pettigrew State Park (Tyrell County), Raven Rock State Park (Harnett County), Weymouth Woods State Park (Moore County), Jones Lake State Park (Bladen County), Singletary Lake State Park (Bladen County), and Theodore Roosevelt State Natural Area (Carteret County) (Lisa Gatens, Curator of Mammals, North Carolina Museum of Natural Sciences, November 18, 2014). Although surveys at each individual park were not numerous enough to conclude that NLEB are absent in those particular areas, the results do lend some evidence to that effect.

Bridge Surveys

There is evidence of NLEB using bridges and other structures for roosting (as mentioned in Section 2.2), but bridge surveys in eastern North Carolina have failed to find any NLEB. Two-hundred and nineteen (219) bats were found in bridge and culvert surveys in southeastern North Carolina by Felts and Webster (2003); three species of bats were found, but none were NLEB. The counties surveyed were Bladen, Brunswick, Columbus, Duplin, New Hanover, Onslow and Pender. McDonnell (2001) examined 990 bridges and culverts in 25 counties in the North Carolina Coastal Plain. Eighty-one (81) bats were found; there were no NLEB, but the species of three bats could not be determined.

4.2. Factors Affecting the Northern Long-Eared Bat

4.2.1. White Nose Syndrome in Eastern NC

According to White-Nose Syndrome.org, no suspected or documented cases of WNS have been reported from eastern North Carolina, although there are documented and confirmed cases of WNS in western NC and central South Carolina.

NCWRC and USFWS have cooperated to create North Carolina's White-nose Syndrome Surveillance and Response Plan released in December 2013. The plan lists North Carolina species affected by WNS (including NLEB) and details a survey plan to track the anticipated spread of WNS (including 11 locations in the North Carolina piedmont and coastal North Carolina). Protocols intended to reduce the spread of WNS in North Carolina are also included in the plan.

NLEB in eastern North Carolina may differ from the core NLEB population that resides in western North Carolina in that they may not use caves to hibernate or may not hibernate at all. If so, they may not be as vulnerable to WNS, and could help mitigate the effects of WNS in the core population. Ecological niche modeling predicting the potential extent of WNS based on future climate scenarios shows that, in theory, the coastal plain of North Carolina could be important future habitat for NLEB (Kalcounis-Rueppell *et al*. 2012).

NCWRC is leading an effort to determine the eastern extent of WNS in North Carolina. NCWRC employees began surveying potential winter roost locations in central North Carolina for the presence of bats, and swabbing the substrate of hibernacula walls (and any bats they encountered) for *Pseudogymnoascus destructans* spores in 2014. They will continue to do so in 2015 (personal communication July 17, 2014).

4.2.2. Overwintering of NLEB in Eastern North Carolina

NLEB are known to hibernate in caves throughout much of their range, and are believed not to travel great distances between winter hibernacula and summer forging habitat. Typical distances from summer to winter ranges are thought to be from 35 to 60 miles while distances have been documented from 5 to 168 miles (as discussed in Section 2.2). These details complicate understanding NLEB in eastern North Carolina. The occurrence of caves in the Piedmont and Coastal Plain of North Carolina is extremely rare. Rock features that include fissures or overhangs are less rare, but cannot be considered common (Phil Bradley, North Carolina Geological Survey, personal communication), and would be less likely to provide suitable habitat for NLEB hibernation. Only one cave in eastern North Carolina (Onslow County) is known to be suitable as a roosting site for bats. The site was visited during summer months in the late 1990's and contained several roosting bats. The bats were believed to be tricolored bats (*Perimyotis subflavus*) (Michael Shafale, NCNHP, personal communication, November 21, 2014).

NLEB occurring in eastern North Carolina could potentially hibernate in caves or mines in western North Carolina or western Virginia. However, the species is not currently thought to fly these great distances. According to Virginia Speleological Survey website (VSS 2014), the closest caves to NLEB capture sites in eastern North Carolina are located in Halifax County, Virginia which lies due North of Roxboro, North Carolina. This means that the recently documented NLEB in Camden County, North Carolina would have to fly more than 125 miles to reach the nearest cave, unless the Onslow County cave is suitable for winter roosting.

A hypothesis proposed by Griffin (1945) indicated that NLEB may regularly hibernate in "unsuspected retreats" in areas where caves and mines are not present and has not been discounted. NLEB have been documented hibernating in cave-like structures such as a storm sewer, a hydroelectric dam, an aqueduct, and a dry well (as discussed in Section 2.2). It is possible that NLEB in eastern North Carolina may hibernate in trees, like Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and southeastern myotis (*Myotis austroriparius*).

Finally, some biologists suspect NLEB may not need to hibernate in the more temperate climate of eastern North Carolina. There is some evidence of myotid bat activity during the winter in the coastal plain of North Carolina (personal communication, Lisa Gatens, Curator of Mammals, North Carolina Museum of Natural Science, 10/22/14). Furthermore, NLEB may utilize bridges for roosting throughout the year in eastern North Carolina (as discussed in Section 2.2).

Taylor (1963) found that moths in a laboratory situation were capable of sustained flight at temperatures as low as 8 degrees Celsius (46.4 degrees Fahrenheit). In another study, the stomach contents of red bats (*Lasiurus borealis*) captured during winter months from the Great Dismal Swamp in coastal North Carolina and Virginia was found to contain primarily moths and flies (Whitaker *et al*. 1997). As mentioned in Section 2.2, the NLEB diet is known to consist of moths and flies, among other prey items. Therefore, it is plausible that an appropriate food source would be available to NLEB in eastern North Carolina during the winter.

Research aimed at understanding if and/or where NLEB hibernate in eastern North Carolina will be greatly beneficial to understanding how NCDOT projects could affect NLEB.

4.2.3. Wind Energy Development

Wind turbines can kill bats, including northern long-eared bats. Wind-turbine blades cause mortality through direct effect or through the pressure differential caused by the motion of the spinning blades. This pressure differential causes a bat's lungs to fill with fluid as it flies near the spinning blades and this phenomenon (known as barotrauma) kills the bat instantly (Baerwald *et al* 2008). More research is underway to better understand bat wind-turbine vulnerabilities, but current studies suggest that bats face the greatest risk during migration from summer foraging sites to wintering grounds (tree bats) or hibernacula (cave bats) (Kunz *et al* 2007, Arnett *et al*. 2008). Only a small number of NLEB mortalities have been documented from wind energy facilities (American Wind Energy Association 2001, as cited in USFWS 2013). However, there are many wind projects currently within the bat's range, and more are planned. According to the USFWS Raleigh Ecological Services Field Office, there are currently no wind energy facilities in North Carolina, though there are several facilities in various stages of planning in the outer coastal plain.

4.2.4. NLEB Habitat Loss/Modification

Until better NLEB data allows a more refined approach, NCDOT is considering all wooded area to be potential NLEB habitat in eastern North Carolina. Brown and New (2013) have assigned forested acreage percentages to the eastern North Carolina Counties as shown in Table 4. This data indicates that the majority of eastern North Carolina is moderately to heavily forested. In fact, the report concluded that forest area in the state is stable or trending upward, and forests continue to cover about 60% of the State's land.

TABLE 4. PERCENT FORESTED AREA (ACRES), BY NORTH CAROLINA COUNTY

Percent Forested Area	County
0-25%	Carteret, Currituck, Dare, Hyde, New Hanover, Pasquotank
26-50%	Alamance, Camden, Chowan, Durham, Greene, Guilford, Johnston, Nash, Orange, Perquimans, Pamlico, Pitt, Sampson, Tyrell, Wake, Washington, Wayne, Wilson
51-75%	Beaufort, Bertie, Bladen, Brunswick, Caswell, Caswell, Chatham, Columbus, Cumberland, Craven, Duplin, Edgecombe, Franklin, Gates, Granville, Halifax, Harnett, Hertford, Hoke, Lee, Lenoir, Martin, Montgomery, Moore, Northampton, Onslow, Pender, Person, Randolph, Robeson, Rockingham, Scotland, Vance, Warren
76-100%	Jones, Richmond

Tree clearing could affect NLEB in several ways. First and most likely, removal of trees reduces and/or degrades NLEB foraging habitat. NLEB foraging habitat is not considered rare in eastern North Carolina. However, NLEB may have to expend extra energy to locate new foraging habitat due to tree clearing. Next, tree clearing could remove and/or degrade a NLEB roost site. Potential roost sites are not considered rare in eastern North Carolina, although this may require NLEB to expend extra energy to locate suitable roost locations. Finally, removal of trees could (if NLEB are present) harass, harm, or kill NLEB.

As discussed previously, details regarding the possibility of NLEB hibernating in eastern North Carolina are needed to understand if there is a seasonal effect of tree clearing on NLEB. However without this data the working group elected to weigh the effect of tree clearing considered without regard to season.

Due to the abundant amounts of suitable roosting and foraging habitat in the action area, combined with the low numbers of known NLEB in the action area, the working group concluded that roosting and foraging habitat is not a limiting factor for NLEB in eastern North Carolina.

4.2.5. Human Disturbance of Bats

Disturbance from recreational cavers and researchers entering hibernacula can cause bats to expend crucial fat reserves requiring bats to wake and forage in the winter when there is little avaialable food. If disturbance occurs too often, fat reserves can be depleted and starvation can occur (USFWS 2014d).

As discussed in Section 4.2.2, it is not known if NLEB hiberate in eastern North Carolina. In addition there is only one known cave in eastern North Carolina and no known bat monitoring occurring in that cave. It is therefore unlikely that humans are disturbing hibernating bats in eastern North Carolina.

4.2.6. Predation

Eastern North Carolina has many predatory species which hunt NLEB. These include predatory birds (primarily owls and hawks), snakes, raccoons, and cats. However there has been no evidence that predation was problematic for NLEB populations in eastern North Carolina in the past. There is no evidence that NCDOT projects will significantly alter species which prey on NLEB.

4.2.7. Climate Change

Climate change in eastern North Carolina could result in sea level rise (SLR). SLR could flood portions of the coastal NLEB habitat. SLR would represent a threat to wildlife conservation in eastern North Carolina, including NLEB.

Climate change has the potential to exert a cumulative effect on NLEB. "Temperate zone bats may be more sensitive to climate change than other groups of mammals because many aspects of their ecology are closely linked to temperature" (Loeb and Winters 2013). Bat species that are unable to mitigate the effects of high temperature with behavioral changes may shift their range to avoid higher temperatures.

4.2.8. Contamination

As a predatory species bats are negatively affected by contaminants indirectly as well as directly. The availability of insect prey can be dramatically affected by the use pesticides and presence of pesticides in prey can result bio-accumulation which can harm and kill bats. Pesticide-induced mortality of insectivorous bats has been documented (Garner and Gardner 1992, Mohr 1972, Geluso *et al*. 1976, Clark *et al*. 1983).

4.2.9. Bridge and Building Use by NLEB in Eastern North Carolina

NCDOT biologists have been checking bridges across North Carolina for bat use since 2005, primarily in western North Carolina. After checking more than 325 bridges statewide, individual NLEB has been found using only three bridges. No NLEB colonies were found. The three bridges were located in Madison and Swain counties (mountainous region in western North Carolina).

No NLEB have been found roosting in bridges in eastern North Carolina. Felts and Webster (2003) found three species of bats (*Myotis austroriparius*, *Perimyotis subflavus*, and *Corynorhinus rafinesquii*) using 15 of 423 bridges inspected in southeastern North Carolina in winter months. This suggests that this part of the state has a climate suitable for roosting during most of the year.

McDonnell (2001) found both solitary bats and maternity colonies of three species (*Myotis austroriparius*, *Perimyotis subflavus*, and *Corynorhinus rafinesquii)* in 135 bridges in 21 eastern North Carolina counties during investigations conducted between May and August, 1997 and 1998 (McDonald 2001). These were all day roosting sites.

These researchers collectively checked more than 1,400 structures; no NLEB were found. In general, the bats found in bridges seemed to prefer roosting in concrete more than timber or steel bridges.

No NLEB have been documented roosting in buildings in eastern North Carolina. NCDOT is not aware of any comprehensive studies of buildings as roost structures in eastern North Carolina, aside from those conducted on Camp Mackall and Fort Bragg (mentioned in Section 4.1.3).

Chapter 5. Program Details

In order to conduct a thorough effects analysis of the NCDOT Program on the NLEB (see Chapter 6 and Appendix D) the working group needed to deconstruct the proposed action. As explained in Section 1.4.2 the NCDOT Program has been categorized following the draft federal agency-initiated Programmatic Agreement for IBAT/NLEB (Indiana Bat/Northern Long-eared Bat). Descriptions of activities that occur within each category were adapted from the Washington State Department of Transportation (2007) and the USFWS (2005).

Each category was broken down into a list of potential activities (as seen in Appendix D). The activities are the mechanisms through which project categories have potential to affect NLEB. The North Carolina working group used these categories and activities to consider all possible effects to NLEB in eastern North Carolina (NCDOT Divisions 1-8).

Activities and sub-activities that occur as part of the NCDOT Program are described in this chapter in text and tabular format under the appropriate category. A complete list of activities is also given, along with effects determinations, in Appendix D. Activities and sub-activities classifications are included in the text below as an indication of where they can be found in Appendix D.

5.1. New Construction (category)

New construction includes activities for roadway and railway construction and improvements, bridge and culvert construction and replacement, and the development of construction staging areas. Vehicle and heavy equipment use are involved in all aspects of new construction. New construction projects typically reduce and modify habitat, increase impervious surface area, and increase disturbance. Many of these projects affect undeveloped or undisturbed property, require the acquisition of additional right-of-way (ROW), and involve impacts to native vegetation. Contractors may need to establish project equipment staging areas and parking areas. Often, existing road surfaces or parking areas can be utilized. However, if heavy equipment staging is necessary in vegetated areas, temporary impacts to sensitive habitats could occur. New construction projects that increase capacity may have indirect effects associated with growth and development of the surrounding areas.

The following categories of NCDOT projects are considered New Construction and we anticipate there to be 1,436 over the 5 year period covered in this PBA: B, BD, I, P, R, SS, U, W, X.

Staging Areas/Site Prep (activity)
Staging Areas/Project Site Prep covers preparations at the project site itself and staging areas. Staging areas are places where equipment, a temporary field office, and materials are temporarily stored or located in preparation for their use during construction. These areas are typically located within or closely adjacent to the construction site.

All these tasks are considered to be activities that occur during the initial phases of construction. Descriptions of subactivities are provided below.

Lighting (subactivity under Staging Areas/Site Prep)
The use of lighting to illuminate project work involves installing permanent highway illumination and traffic signal projects. Lighting may also be used temporarily in order to conduct construction activities, especially during the evening and nighttime hours.

Tree clearing and Grubbing (subactivities under Staging Areas/Site Prep)
Tree clearing and clearing of other vegetation will be performed to prepare the project area for construction activities. Clearing generally takes place within pre-marked areas in the project action area necessary for construction purposes. The initial access into work areas for clearing activities will be via existing public roads, but clearing for temporary access roads may also be needed. Clearing consists of cutting and removing above ground vegetation such as grasses, brush, and trees; removing downed timber and other vegetative debris; and salvaging marketable timber. Grubbing will follow clearing operations to remove any remaining surface vegetation and buried debris. Clearing typically requires less ground disturbance than grubbing.

Clearing and grubbing will be required prior to earthwork in order to remove vegetative and other debris from work areas so that design specifications (e.g., for compaction) can be met. Trees, stumps, and large roots will be removed from excavation areas to a depth sufficient to prevent such objectionable material from becoming mixed with the material being incorporated in the embankment. Areas to be excavated will require grubbing to remove small bushes, vegetation, and any rubbish. Within excavation and embankment limits, tree stumps, roots, and other vegetation will be removed. All extraneous matter will be removed and disposed of in designated waste areas on or off-site by chipping, burying, or other methods of proper disposal, including burning. Various methods and equipment will be used for this work.

Clearing and grubbing takes place within construction limits, but may also occur in temporary construction easements used to assemble and store the construction vehicles that are too large to travel on the highway in one piece (e.g., haul trucks, earthmovers, large dozers, large excavators, hoes, etc.). These areas are also used to store supplies (erosion control materials, steel rebar and mesh, small diameter culverts, traffic signs and posts, office trailers, etc.).

Earthwork (subactivities under Staging Areas/Site Prep)
Earthwork is all earth moving activities that will occur for road and interchange construction, access road construction/relocation, utility placement and relocation, construction of drainage structures, and preparation of staging, maintenance, waste, and borrow areas. Earthmoving activities will include excavating (cutting), filling, ditching, backfilling, grading, embankment construction, auguring, disking, ripping, grading, leveling, borrowing and wasting of materials and any other earth-moving work required in the construction of the project. Earthmoving equipment to be used includes haul trucks, dozers, excavators, scrapers, and backhoes.

Earthwork may be conducted as part of the preparation of staging areas, bridge approaches, alignments, embankments, fills, backfills, foundations, toe trenches, road grades, utility relocation, stormwater treatment, ditch construction, bank stabilization, landscaping, restoration, and mitigation.

Blasting (subactivity under Staging Areas/Site Prep)
Blasting may be required on a limited number of projects. Timing and duration of the blasting will vary on a project-by-project basis. Blasting consists of excavating in rock to achieve smooth, unfractured backslopes; it can also involve blasting to facilitate excavation. Bridgework may require blasting during the construction or removal of bridge abutments. Debris or rock disposal may be required after blasting.

Dust Control (subactivity under Staging Areas/Site Prep)
Performing earthwork activities may necessitate the use of dust control measures. This work consists of applying water for the alleviation or prevention of dust nuisance originating from earthwork construction operation from within the project construction limits.

Install Erosion and Sediment Control Best Management Practices (BMPs) (subactivity under Staging Areas/Site Prep)
This work includes the installation of silt fences, check dams, sediment basins, coir blankets and temporary seeding.

Structure Demolition (subactivity under Staging Areas/Site Prep)
Structures within the project right-of-way will be purchased and either demolished or moved o (intact) off-site prior to the commencement of construction work. Structures include commercial, residential and public buildings and facilities. After demolition, structure debris is hauled off-site for disposal.

Installation of Drainage Features (subactivity under Staging Areas/Site Prep)
This work may include work area isolation; stream diversion; dewatering; excavation for pipe trenches, ditch creation and stream relocation; culvert jacking or drilling; laying pipe and

covering them; constructing headwalls on the outlet side of flow diversion; installing armoring; and restoring flow.

Other Project Site Prep Activities/subactivities

- portable fence installation/removal
- temporary access road construction, which requires installation of geofabric and rock
- gravel workspace

Wetland Fill (subactivity under Staging Areas/Site Prep)

When it cannot be avoided, wetland fill requires a permit from the USACE. The tree clearing acreage presented in Chapter 6 includes acres of wooded wetlands to be filled under the NCDOT Program.

Utility Relocation (subactivity under Staging Areas/Site Prep)

Utility relocation or placement can involve both above and below-ground work, including tree clearing, mowing, trenching, and horizontal or directional bore. When water, sewer, electric, or gas lines need to be relocated, these impacts are typically accounted for during project planning and permitting. In the rare event that utility lines would need to be relocated outside a project right of way, the utility company will be responsible for obtaining their own permits. In this rare instance, tree clearing would not be accounted for by NCDOT.

Offsite Use Areas (activity)

Waste and borrow areas that are used to dispose of and obtain materials for earthwork, are also subject to clearing and grubbing, but the contractor is responsible for addressing federally listed threatened and endangered species issues per NCDOT standard specifications. Most borrow and waste areas are sited in areas of previously disturbed habitat where tree removal is minimal.

Road Surface Preparation and Construction (activity)

The activity of road surface preparation and construction also includes the construction of bicycle and pedestrian facilities. This activity may include the following sub-activities:

- construct stormwater facilities
- final grading and road/trail bed preparation
- construct barrier wall & retaining wall (mechanically stabilized earth, soil nail, sheet pile, soldier pile, etc.)
- application of course aggregate, concrete or asphalt
- striping, pavement markers and signage
- guard rail installation
- noise wall construction
- sidewalk installation

New Rail Track Construction (activity)
New rail track construction includes the subactivities subgrade installation (building up ballast/railbed) and laying track.

Bridge/Culvert Construction (activity)
Work included in this activity includes bridge construction and replacement, construction and replacement of culverts over three feet in diameter, and widening of existing bridges and culverts.

Many of NCDOT's traditional bridge replacement projects take as little as 9 months, and low-impact bridges can be completed in as little as 3 to 6 months. Culvert replacements are typically even shorter in duration. Installation of new bridges may require the installation of an on-site detour bridge. Occasionally, half of the new bridge is constructed adjacent to the old bridge and acts as the detour bridge while the original bridge is removed and replaced.

Geotechnical investigations (drilling) are necessary for any type of construction work that requires a level of underground stability; they are normally needed to determine appropriate designs for bridge foundations.

Foundations are required elements of every bridge construction and replacement project.

Bridge foundations consist of three general types: 1) drilled shafts; 2) columns on spread footings; and 3) driven piles and pile-supported caps or walls. Driven piles are normally used to support temporary structures such as detour bridges and work bridges. However, driven piles are also used to provide additional support to spread footings.

In-water work may take place during many activities associated with bridge construction, except for superstructure construction. Best Management Practices (BMPs) are used to protect water quality during in-water work (NCDOT 2003). Special BMPs apply in High Quality Waters, Outstanding Resource Waters, and in N.C. Carolina Coastal Area Management Act counties (NCDOT 2003).

Bridge and culvert construction include the following subactivities and sub-subactivities:

- barge use - anchor spud installation, mooring, operation
- temporary work trestle/platform/detour bridge/causeway construction and removal –
    - impact/vibratory pile driving
    - deck installation
    - remove piles (vibratory hammer, direct pull, etc.)
- bridge demolition (for replacement)
    - work area isolation (cofferdam installation, impact/vibratory pile driving, dewatering)

    - remove piles, footings, piers, bridge decking, railbed, etc. (vibratory pile driver, clamshell bucket, containment boom)
    - wire saw concrete cutting, crane use
    - hoe ram use, debris containment, excavation
- substructure construction (piers, shafts, shaft caps, footings, abutments, foundations)
    - work area isolation (cofferdam installation, impact/vibratory pile driving, dewatering)
    - drilled shaft construction (auger drills hole within casing) or impact pile driving
    - install casing, rebar
    - pour concrete
    - spread footing construction
    - riprap installation
- superstructure construction
    - pier tables, cantilevers, decking, pre-cast concrete or steel girders, crane use

Post-construction Activities

In addition to temporary BMPs used during construction, NCDOT implements a post-construction stormwater program in accordance with the Department's National Pollutant Discharge Elimination System (NPDES) permit. Post-construction structural BMPs are permanent controls that treat stormwater runoff from stabilized drainage areas to protect water quality, reduce pollutant loading, and minimize post-construction impacts to water quality (NCDOT 2014b, NCDOT 2014c). Because post-construction BMPs are permanent, they require a long-term maintenance commitment to function as designed.

Post-construction activities include the following subactivities:

- temporary bmp removal (silt fencing, check dams, sediment basin)
- fence installation (if required)
- landscaping/beautification/site stabilization

Billboards

NCDOT has entered into an agreement with the FHWA relating to the control of outdoor advertising in areas adjacent to any highway which is or becomes a part of the National Highway System. No person shall erect and/or maintain any outdoor advertising within 660 feet of the highway ROW without first obtaining a permit from NCDOT. Constructing or maintaining a billboard may involve tree removal along highways. Vegetation cutting, thinning, pruning, or removal by billboard owners cannot be conducted without a permit by NCDOT.

The current tree clearing limit along federal primary highways is 380 feet for rural roads and 340 feet for roads within city limits. Statewide, there are an estimated total 8,000 billboards; up to 750 permits may be issued annually for vegetation removal statewide (Coleman 2012). In addition to tree clearing, billboards may also involve long-term lighting.

5.2. Safety and Mobility Improvement (category)

Safety and mobility improvement projects include activities not covered under Section 5.1, New Construction. Tree clearing and grubbing may be required on some safety and mobility improvement projects. If so, this work is discussed in Section 5.1. Vehicle and heavy equipment use will be required for all projects; portable lighting may be used for some projects. Post-construction work that may also occur as part of safety and mobility improvement projects is also described in Section 5.1.

Safety projects are designed to improve the safety of the highway system and not to add capacity. These include signal and illumination improvements, sign installation, installation of sidewalks, tree removal from the clear zone, guard rail installation, railroad grade separation, and alignment modifications. Alignment modifications may include adding auxiliary lanes (e.g. truck climbing and acceleration lanes), channelization (turn lanes), or on and off ramp extensions, or realigning an intersection to improve the sight distance.

Mobility improvement projects are designed to improve traffic operations and/or capacity on existing roadways. Typical projects include construction of high occupancy vehicle (HOV) lanes in urban areas, reconstructing existing interchanges, construction of new interchanges, adding additional lanes, and sidewalk, curb and shoulder construction. Overpass, bridge and culvert replacement and widening may occur as part of a mobility improvement project. A description of this work is provided under Section 5.1.

Most mobility improvement projects generally occur in heavily developed urban areas. Many of these projects affect very little undeveloped or undisturbed property and many occur in the existing ROW in heavily urbanized areas. Projects that increase capacity may have indirect effects associated with growth and development of the surrounding areas.

The following categories of NCDOT projects are considered Safety & Mobility Improvement and we anticipate there to be 601 over the next 5 year period covered in this PBA: C, EB, EL, F, I, P, R, S, SF, SI, SR, SS, U, W, Y, Z

Safety and Mobility Improvement activities and subactivities include the following:

Intelligent Transportation Systems

Intelligent transportation systems are advanced applications that strive to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and smarter use of transport networks. This includes all modes of transport, and incorporates current and evolving computer and communication technologies with the goal of improving traffic conditions, minimizing delays and increasing safety for all commuters in the state. Within NCDOT, this primarily involves the following subactivities: sign and camera installations

Railroad Protective Device Installation
This activity involves the installation of signals and other safety features where railroads intersect at grade or where railroads intersect roads at grade.

Railroad Grade Separation
Railroad grade separation involves the alignment of two or more surfaces, associated with similar or dissimilar transport types, of differing elevations. This typically consists of the creation of an overpass or underpass to allow for continued flow of activity at the axis/intersection of the transport facilities. Subactivities include:

- staging areas
- project site prep
- install drainage features
- utility lines
- pre-watering of roads and exposed areas in construction site for dust control or grading

Road surface, Railroad Bed Preparation and Construction
The preparation of and construction of road surfaces and railroad beds involve a variety of subactivities, including:

- construct stormwater facilities
- final grading and road/rail bed preparation
- retaining wall construction
- course aggregate application, concrete or asphalt application
- striping, pavement markers and signage
- railroad crossing gate installation
- guard rail installation
- sidewalk, curb and shoulder construction

Signal System Improvements
Signal system improvements involve changes or upgrades to signaling system.

5.3. Maintenance and Preservation (category)

All activities under this category will require the use of vehicles. Many will require the use of heavy equipment and portable lighting. Minor tree clearing and grubbing may be required on some maintenance, preservation, and facilities preservation projects. These activities are discussed in detail in Section 5.1.

The following categories of NCDOT projects are considered Maintenance & Preservation and we anticipate there to be 392 over the next 5 year period covered in this PBA: BP, I, K, Y, P, B, F, R, U.

Bridge Painting (activity)
Steel bridges or bridges with steel sections require painting on an as-needed basis, approximately every 10 years. Bridge painting involves abrasive blasting to remove all corrosion, washing the bridge and then applying a number of coats of paint. Paint must be applied when temperatures are above 35 degrees Fahrenheit, and cannot be applied in rainy conditions. Bridge painting and rehabilitation both require human presences above and below bridges.

Bridge Painting Subactivities

- Construct Scaffolding
- Install Full Containment (includes vacuum system for capturing wash water)
- Pressure Wash Bridge (graffiti removal)
- Sandblast Bridge
- Prime/Paint Bridge
- Remove Containment and Scaffolding

Bridge Rehabilitation (activity)
Bridge deck repairs occur regularly while bridge deck replacement is infrequent. Bridge decks that are made of concrete are partially removed and replaced. Removal may involve jackhammers, concrete saws, and hydro milling (high-pressure water). Longer bridges have expansion joints that must be repaired and replaced as needed. Bridge repair, painting, and retrofit projects may involve hanging scaffolding and containment devices under and around the bridges.

Bridge repair and maintenance activities include washing, sandblasting, patching, bonding, and filling voids in concrete with epoxy. Similar washing, sandblasting, and patching may be implemented for maintenance of guardrails and other infrastructure. In addition, this action may include minor replacement and repair of bridge structural elements, such as individual trusses, stringers, and girders. Generally, this work requires the use of light equipment, primarily handheld power tools. However, replacement or repair of bridge structure elements, such as individual trusses, stringers, and girders, may require the use of heavy equipment. It is relatively rare that an individual truss, stringer, or girder would require replacement or repair.

In-water work may take place during many activities associated with bridge rehabilitation projects. Typical in-water work activities are listed in Section 5.1 under Bridge/Culvert Construction.

Bridge Rehabilitation Subactivities and Sub-subactivities:

- Install Scaffolding and Containment
- Replace Rivets, Degraded steel, Bridge railing, Joint Seals, bearing work
- Seal Cracks (shotcrete)

- Repair Concrete Spalling
- Repair Bridge Approaches
- Repair/Replace Electrical System
- Bridge Deck Replacement (e.g., concrete, timber)
- Bridge Demolition
    - Install scaffolding and containment
    - Mill, break up, or use hydrodemolition to remove existing deck
    - Use vacuum truck or sweeper to remove debris
    - Repair/replace finger joints
    - Pour new deck
    - Remove containment and scaffolding

Culvert Cleaning/Repair (subactivity)

This activity includes smaller-diameter culvert replacements (less than three feet in diameter). Cross culverts, which convey water from one side of the highway to the other, can be blocked or clogged by debris, sediment, beaver deposited materials, vegetation, or slide materials. Occasionally scour within the system can result in blocking the culvert with rock or gravel. Blocked culverts can result in flooding over the roadway, or in severe cases, the culvert and the roadway can blow out. Regular removal of debris, vegetation, and sediment will help eliminate the problem.

Culvert Cleaning/Repair Sub-subactivities:

- Divert Flow, Dewater as previously described
- Clean Culvert
- Install Culvert Liner (Complete or Invert)
- Patch Repair (Metal or Concrete, Coat and Seal)
- Headwall or Outfall Repair (Concrete Work or Riprap Installation)
- Repair Joints (Band Installation, Inject Grout)
- Line with Shotcrete or Gunnite
- Sandblast/Repaint/Recoat

Drainage Improvements (activity)

Slope and ditch repair involves regrading ditches and slopes to the appropriate contour and filling in or repairing sides of the ditches where necessary. Each construction project has an associated staging area which contains the construction company job site headquarters, parking, equipment, and materials storage, refueling tanks, etc. Activities in this category include all work necessary to maintain roadside ditches and channels, cross culverts, catch basins and inlets, and detention/retention basins. This type of work frequently requires a Nationwide permit from the USACE which establishes a Federal nexus when Federal funding is not utilized. Roadside ditches are affected by the accumulation of sediments, debris, vehicles that leave the roadway, and slides. Regular maintenance is required to remove built up sediments, debris or blockages, re-slope the sides, and maintain capacity. Removal of newly constructed beaver dams is often necessary when the dams affect the effectiveness of storm drainage facilities.

Catch basins and inlets and retention facilities are part of the storm drain system of the highway. These are designed to trap sediments and liquids, and require regular cleaning. Material is removed by manual clearing methods or by using a vacuum truck. Solids are stored on NCDOT property, tested, and then disposed of at an approved disposal facility or recycled as fill material if suitable. Regular cleaning improves water quality and minimizes sediments that enter the natural stream systems.

Drainage Improvement Subactivities:

- Clean and Reshape Ditches (remove vegetation, sediment, debris)
- Culvert Repair Work (as previously described
- Clean Catch Basins/Inlets (manually or vacuum truck)
- Remove Beaver Dams from Culvert Ends
- Remove Sediment from Retention/Detention Facilities
- Dispose of Debris and Vegetation

Guardrail Replacement Subactivities:

- Remove Damaged Guardrail
- Install Posts w/Post Driver
- Install Steel Beam

Pavement Rehab & Resurfacing (activity)

These projects involve patching, repairing, and replacing of roadway surfaces and pavements. Each section of highway paved with asphalt or concrete must be repaved every 10 to 14 years. Asphalt paving is sensitive to temperature and weather. If the pavement is in good shape, it may be overlaid with a new layer of asphalt, but badly deteriorated pavement requires the replacement of the foundation material. Typically, the existing asphalt pavement is ground off and replaced or simply overlaid with new asphalt. Ground off pavement is normally recycled and used to make new asphalt pavement.

Since paving may result in a slightly higher road surface, manholes, drainage inlets, valves, guardrails and survey monuments may require raising. Ditches and slopes may be repaired, and culverts may be cleaned. Culverts may also require extension as part of the pavement preservation projects; culvert extensions are addressed under Section 5.1. Many paving projects are combined with safety improvement projects.

Overlay (activity):

- Apply Tack Coat and New Pavement Layer

Pavement Rehab (activity):

- Seal Cracks w/Liquid Asphalt
- Blanket Application of Liquid Asphalt
- Apply Aggregate
- Finish w/Power Roller

Resurfacing (activity):

- Grind (mill) Existing Pavement
- Collect and Dispose of Pavement Grindings/Slurry
- Dowel Bar Placement (if concrete)
- Apply New Pavement

Herbicidal Spraying within ROW (activity)
This activity involves treating roadside vegetation using chemical control treatment methods that are applied by hand or by vehicle-mounted sprayers. Herbicide is used to control vegetation where manual or mechanical means would be cost-prohibitive or result in excessive soil disturbance or other resource damage. All herbicides will be used according to manufacturer's label direction for rates, concentrations, exposure times, and application methods. Only formulations approved for aquatic-use will be applied in or adjacent to wetlands, lakes, and streams, in accordance with label direction. The use of spot herbicide applications is periodically used to control tree limb growth. Over the past several years, NCDOT has utilized dormant stem treatments during the winter months in some areas. This has allows for an expanded the window of opportunity to control brush, without causing "brown out" to the treated vegetation.

Mowing (activity)
Mowing occurs regularly along roadside shoulders during the growing season, and extends less frequently to the back of roadside ditches.

Mechanical Branch Removal along ROW (activity)
This is regular maintenance targeted at woody vegetation; it occurs along the edges of existing transportation corridors. NCDOT bases its brush and tree management program primarily on the roadside safety of the traveling public along its controlled access highways. The Department has for years allowed for a safety recovery zone, based on FHWA guidelines, of 40 feet from the edge of the travel to allow errant vehicles to recover. Following are the methods that the Department has as options to manage the woods line edge.

The use of A-boom mowers has been the routine method of limb removal along the tree line. NCDOT also contracts the use of machinery equipped with a series of high speed rotary saws on a heavy-duty skidder apparatus which cuts the limbs smoothly as it moves along the right-of-way. Currently there is no set schedule for addressing limb removal due to budget cuts; trimming limbs may wait until there is a complaint or problem.

NCDOT periodically contracts for the removal of a swath of roadside trees to set the woods line back to the original desired safety recovery distance when it has become overgrown over the course of several years. This requires the removal of 10 to possibly 20 feet of wooded buffer area. This allows the trees to again develop a natural woods line edge, which would not have to be interfered with for some time.

Hazard Tree Removal (activity)
This occurs along the edges of existing transportation corridors; it involves the removal of trees with potential to fall or drop branches in areas that may cause safety issues.

Repair ROW fence (activity)

Facility Rehabilitation (activity)
Activities in this category deal with the preservation, maintenance and construction of new weigh stations, rest areas, rail stations, and maintenance facilities**.** Rehabilitation of historic buildings and other historic structures may also occur. Subactivities at these facilities may include paving, expansion of buildings and parking areas, septic upgrades, and minor vegetation alteration and removal (including trees).

Facility Rehabilitation includes the following subactivities:

- Installation of Erosion and Sediment Control
- Minor Vegetation Removal
- Overlay, Paving
- Excavation
- Septic Upgrades
- Herbicide Application
- Painting/Striping/Signing
- Rehab historic rail buildings & other non-bridge structures

Reconstruct Existing Rail (activity):

- Install new rail, concrete ties, and resurface stone ballast
- Pavement resurfacing at crossings and approaches
- Upgrade signals and warning systems

Snow Removal/Deicers (activity)
Snow removal and deicing is conducted sporadically in eastern North Carolina. Stormwater pollution prevention plans are developed for NCDOT maintenance facilities where deicers and stored and loaded, and where equipment repair is conducted.

Bridge Inspections (activity)
Bridge inspections involve a detailed review of each bridge's superstructure, deck, supports, railing and pavement to check the functionality and safety of each bridge. This activity can cause the presence of humans in close proximity to where bats may be roosting. Each bridge is inspected every 24 months on average. A few older structures may be inspected every 12 months.

5.4. Disaster Response, Bank Stabilization and Sinkhole Repair (category)

There is no way accurately to predict all the activities that may be involved with disaster response, as that is entirely dependent on the extent and type of damage and level of repair that will be needed. Minor tree clearing and grubbing may be required on some disaster response, bank stabilization, and flood and sinkhole repair projects in order to provide access for equipment. Vehicles, heavy equipment and portable lighting may be used. These activities are discussed in detail in Section 5.1.

There is no accurate way to predict or account for upcoming disaster response, rock stabilization, and sinkhole repair projects, so an estimated number of projects cannot be given as part of this document, however, disasters do not occur frequently. Most NCDOT divisions report dealing with disaster situations once every 3-10 years.

Disaster Response (activity)
Disasters are usually weather-driven events from flooding, ice-storms or hurricanes. Disaster response activities involve emergency work to repair and stabilize eroding banks or shoulders on sections of rivers, streams, and the ocean adjacent to existing highways. Emergency repairs to bridges and roadbeds may also be necessary; temporary bridges may be constructed; these activities are discussed under Section 5.1**.** High water flows during floods or spring runoff in a system can cause erosion of the bank to the point that the adjoining highway is undermined. Other flood damage can include clogged culverts and deposition of debris along transportation corridors. Immediate repairs normally involve protection or reconstruction of the highway and associated infrastructure such as bridges, culverts and utilities. Flood debris removed from roads requires disposal at NCDOT designated disposal sites.

Reimbursements by FEMA and FHWA for emergency repairs require that environmental field evaluations be conducted at each repair site. When replacement of a structure is needed due to an emergency event, expansion of the pre-existing footprint (particularly an increase in length, diameter or location) or upgrading of the crossing structure requires notification and coordination with the appropriate agencies if wetland or streams will be impacted (NCDOT, 2010).

NCDOT environmental guidelines for emergency work include methods for minimizing impacts to wetlands, streams and water quality, as well as minimizing the project footprint. All repairs should follow the latest version of the Best Management Practices for Construction and Maintenance Activities (NCDOT, 2003).

Disaster Response Subactivities:

- Debris Removal
- Construct Temporary Access Road
- Vegetation Removal
- Vegetation Disposal
- Grading
- Install/Remove Temporary Erosion Control
- Barge Use
- Riprap Installation
- Road Reconstruction (rebuild roadbed, add drainage structures, repave, paint)
- Fill newly created breaches
- Sandbag installation/replacement
- Water removal (pumping water from flooded areas)
- Culvert Cleaning/Repair

Bank Stabilization/Flood Damage/Scour Repair (non-emergency) (activity)
Bank stabilization repair is the result of natural changes in river or stream morphology over time. These activities normally involve protection of the highway and associated infrastructure such as culverts and utilities. Clogged culverts often require cleaning or may need upgraded to a larger size to prevent further flow restrictions. Other repairs involve river training techniques to redirect the thalweg away from the road. These techniques include placing riprap, barbs, drop structures, groins or large woody debris in the waterway.

Bank Stabilization Subactivities:

- Debris Removal
- Construct Temporary Access Road
- Vegetation Removal -See above
- Vegetation Disposal - See above
- Grading - See above
- Barge Use
- Riprap Installation
- Willow Staking

- In-stream Structure Installation (weirs, barbs, logjams, etc.)
- Road Reconstruction - rebuild roadbed, add drainage structures, repave, paint; typically doesn't raise the road profile
- Retaining Wall Construction
- Landscaping/Site Stabilization
- Install/remove Temporary Erosion Control

Sinkhole Repair (activity)
Sinkhole repair will involve some level of earthwork and may include tree clearing and grubbing depending on the extent of damage. However, this would be very rare.

Sinkhole Repair Subactivities:

- Excavate and/or flush loose material
- Place non-concrete fill material
- Place concrete fill
- Compact fill
- Restore roadway

5.5. Transportation Enhancements (category)

Transportation enhancements can include bicycle and pedestrian facility construction and historic bridge rehabilitation, which were addressed above in other categories. These activities all may require staging areas, similar to new construction, but that breakdown is not repeated here to reduce redundancy. Other activities include the construction of turnouts, overlooks, historic markers, and viewpoints. Such activities could be consistent with new roadway construction. However, these are much smaller in scale typically, with less vegetation removal, disturbance, etc. Minor tree clearing, grubbing, and earthwork may be required on some transportation enhancement projects. These activities are discussed in detail in Section 5.1. Portable lights, vehicles and heavy equipment may also be used.

The following categories of NCDOT projects are considered Transportation Enhancements and we anticipate there to be 154 over the next 5 year period covered in this PBA: C, EB, EL, F, R, and U

Subactivities for the Activity Construct Turnouts, Overlooks, Historic Markers, and Viewpoints:

- Permanent Lighting Installed
- Portable Fence
- Prepare Project Site
- Install Drainage Features
- Utility Lines

- Pre-watering of Roads and Exposed Areas in Construction Site for Dust Control or Grading
- Road and Parking Lot Surface Preparation and Construction
- Construct Stormwater Facilities
- Final Grading and Road/Parking Lot Bed Preparation
- Construct Retaining Wall (mechanically stabilized earth, soil nail, sheet pile, soldier pile, etc.)
- Course Aggregate Application, Concrete or Asphalt Application
- Striping, Pavement Markers and Signage
- Guard Rail Installation
- Sidewalk Installation
- Information Kiosk Construction
- Post-construction work

5.6. Conservation Measures (category)

Conservation measures are actions which promote the recovery of listed species and are included as an integral part of the proposed action. These actions serve to minimize or compensate for project effects on the species under review (USFWS 1998).

NLEB Research and Data Collection Project (activity)

NCDOT has agreed to conduct a five year NLEB research study with four objectives. First, acoustic surveys will be conducted to determine the distribution of NLEB in eastern North Carolina. Second, results from acoustical surveys will be used to guide mist-netting surveys. Captured NLEB will be equipped with radio transmitters and tracked to aid in the characterization of summer and winter roosting habitat and activity. Third, NLEB will be checked for presence and severity of White Nose Syndrome. Finally, structures (bridges, culverts and buildings) will be assessed to determine frequency and seasonality of NLEB use.

The proposed survey work includes human activity in and around bat roosts, handling of bats, attachment of transmitters, and use of vehicles. The effects of bat survey work are covered under ESA Section 10(a)(1)(A) permits.

Stream and Wetland Mitigation (activity)

Stream and wetland mitigation are construction activities that include restoration of the hydrology, soils, and vegetation to wetland systems; bank stabilization and in-channel habitat restoration of streams; and reforestation of riparian buffers. These combined mitigation actions include habitat enhancement, preservation and replacement.

Stormwater Treatment (activity)

The NCDOT NPDES stormwater permit requires a BMP Retrofit Program to install stormwater treatment facilities where no construction has occurred recently. These BMPs may be structural (detention basin) or nonstructural (a pollution prevention plan), depending on what technique will be the most effective and practical method of controlling stormwater pollution in a specific area. The Retrofit Program applies or installs BMPs into the existing highway facility. Seventy stormwater retrofits will be constructed throughout North Carolina during the current five-year NPDES permit. An additional six are built every year in the Falls Lake watershed. Because post-construction BMPs are permanent, they require a long-term maintenance commitment to function as designed. (NCDOT 2014c)

Construct Wildlife Passage Facilities (activity)
The construction of wildlife crossings, which include culverts, underpasses and overpasses, will involve some level of vegetation alteration and earth work.

Wildlife Passage Subactivities:

- Prepare Project Site
- Install Drainage Features
- Construct Wildlife Overpass, Underpass - similar to bridge
    - Construct Retaining Wall
    - Final grading wildlife trail bed preparation
- Post-construction work

Endangered Plant Conservation (activity)
NCDOT periodically conserves habitat to offset effects to federally protected plants through conservation easement or purchase of property. This activity also includes habitat protection and restoration work such as thinning, burning, and non-native invasive species control. Herbicides may be used on non-natives, but only on a very limited basis. All herbicides are applied by hand.

Chapter 6. Effects Analysis

Utilizing the premises and assumptions explained in Chapter 1, the working group analyzed each activity and/or sub-activity described in Chapter 5 in order to assess potential NCDOT Program effects to NLEB. Appendix D shows the results of this exercise.

Our effects analysis for NLEB is based on the best available scientific and commercial data. As discussed previously there are wide gaps in useful information regarding NLEB is eastern North Carolina. Many effects can be considered under multiple categories (i.e. an effect could be considered a direct effect, an indirect effect and/or a cumulative effect, depending on interpretation). In the interest of clarity, the group used best professional judgment to identify effects in the most appropriate category. Care was taken to ensure species conservation would be fully considered in effect type assignment.

As can be seen in Appendix D there are a multitude of activities associated with the NCDOT Program that have the potential to affect NLEB in eastern North Carolina. The results of our effects analysis are summarized below.

6.1. Beneficial Effects

Beneficial effects are defined as contemporaneous positive effects without any adverse effects to the species (USFWS and NMFS 1998). NCDOT anticipates that certain aspects of the NCDOT Program will result in beneficial effects to NLEB.

6.1.1. Conservation Measure for NCDOT Program

As a mutually agreed upon conservation measure with USFWS, FHWA, and USACE, the NCDOT will fund and conduct five years of extensive research and data collection to fill in knowledge gaps for NLEB in eastern North Carolina (Appendix C). At the end of five years, the information acquired through the NCDOT research and data collection efforts will be utilized to reinitiate Section 7 consultation. At that time, based upon the data collected, additional appropriate conservation measures can be developed. Data from this five year research study is very likely to be beneficial to long-term NLEB conservation in eastern North Carolina by helping to target management and protection efforts.

6.1.2. Wetland and Stream Mitigation

NCDOT is required to mitigate for impacts to wetlands and streams as per Section 404 of the Clean Water Act. Typically, NCDOT offsets unavoidable impacts at a 2:1 ratio through a combination of restoration, enhancement, and preservation activities.

The primary beneficial effects of mitigation activities for NLEB are generated by the restoration of wetland and stream ecology as well as by the long term stewardship and protection of the land acquired to perform these efforts. Mitigation activities include restoration of the hydrology, soils, and vegetation to wetland systems; bank stabilization and in-channel habitat restoration of streams; and reforestation of riparian buffers. These large areas of mitigation are protected in perpetuity through conservation easements or fee simple acquisitions. Restrictions on the land prohibit tree removal, development, and disturbance of the natural community. These mitigation activities provide beneficial effects of habitat enhancement, preservation, and replacement for the NLEB.

In addition to physical habitat protection, these mitigation activities have the beneficial effect of pollutant removal from storm water, dissipation of surface flows, and increased groundwater storage, all of which contribute to improved water quality. Water quality improvements can increase the productivity of aquatic insect prey and suitable drinking sources for the NLEB.

Conservation measures for other protected resources could also benefit NLEB habitat. Forested areas that are preserved, enhanced, and restored for federally or state protected plants and animals may also serve as habitat for NLEB in eastern North Carolina.

While it is hard to quantify the beneficial effects of future stream, wetland, and conservation efforts by the Department, it is worth noting that per mitigation and conservation requirements, NCDOT has provided for the protection of over 50,000 acres of land across North Carolina over the past 10 years. Preservation accounts for approximately 37,000 acres of intact forest land protected in perpetuity. The reforestation associated with over 13,000 acres of restoration and enhancement activities equates to at least 8 million trees being planted. This trend will continue into the future and will contribute to habitat enhancement, preservation and replacement for the NLEB.

6.1.3. NCDOT Stormwater Program

NCDOT implements a stormwater program in accordance with the Department's National Pollutant Discharge Elimination System (NPDES) permit. Best Management Practices (BMPs) are installed to prevent degradation of the state's surface waters through the location, construction, and operation of the highway system. The primary objective is to regulate stormwater from new NCDOT development and re-development by requiring structural and non-structural practices to protect water quality, reduce pollutant loading, and minimize post-construction impacts to water quality (NCDOT 2014b, NCDOT 2014c). Retrofitting is also done by NCDOT in some areas where no other NCDOT projects are occurring; this is discussed more in Section 5.5. Retrofitting will result in improved water quality which could lead to the positive results discussed in Section 6.1.2.

6.1.4. Wildlife Passage Facilities

Bats have been documented making successful use of underpasses to cross roads (Bach *et al*. 2004, Kerth and Melber 2009). In addition to bridges and box culverts constructed for water conveyance which may allow wildlife passage, the NCDOT Program has dedicated wildlife crossing structures in eastern North Carolina. Different species have been documented to prefer different size structures (Boonman 2011); however, no studies of NLEB use of underpasses have been conducted. In general, larger underpasses allow more types of species to cross under roads. There are currently three large wildlife crossing structures (bridges) in eastern North Carolina. NCDOT has at least 15 additional large wildlife crossing structures in various stages of planning for eastern North Carolina.

6.1.5. Endangered Plant Conservation

NCDOT protects naturally occurring populations of threatened and endangered plant species as a conservation measure on a project by project basis. These conservation sites are protected through conservation easement or purchase. While the primary purpose of this activity is to protect the rare plants on site, another beneficial outcome is the protection of forested areas as well. Maintenance activities, such as controlled burns or non-native plant removal using mechanical measures or herbicides, which are conducted infrequently, may cause temporary effects/disturbance to NLEB, but are ultimately beneficial by controlling invasive vines and shrubs that can degrade roosting habitat. Trees girdled to create canopy gaps may provide roosting habitat after they die.

6.2. Direct Effects

Direct effects of a project on a species or its habitat, occurs during action implementation under ESA guidelines. As described previously there is insufficient data in eastern North Carolina to determine where and when NLEB are likely to be present and if they hibernate. To err on the side of species conservation, NCDOT will initially assume NLEB could be present throughout eastern North Carolina regardless of season.

6.2.1. Habitat Loss

NCDOT activities could result in habitat loss and/or degradation for NLEB in eastern North Carolina. There is insufficient data to draw a distinction between foraging and roosting habitat for NLEB in eastern North Carolina, although it is likely there is a great deal of overlap between the two types of habitat. Due to a lack of data on NLEB presence in winter, no distinction is made between summer roosting and winter habitat in eastern North Carolina.

A system for estimating tree clearing acreage was derived using a GIS-based desktop method. Determining woodlots to measure followed the NLEB Interim Conference and Planning Guidance (USFWS 2014b). Several data layers were inspected to make these estimations in ArcGIS 10.1. These layers included the 2010 Digital Statewide Orthoimagery and the most recent roadway design files which were comprised of such information as ROW boundaries, slope stakes, detour routes, etc. In general, the footprints of new locations projects were calculated from outside old ROW to outside new ROW (or slope stake [SS] to slope stake) to ensure clearing for utilities is included in calculations. STIP and Division project types and associated calculation methods are shown in Table 5. Once an appropriate woodlot was spotted on the aerial image that had potential to provide habitat for NLEB, the “area measurement” tool was used to calculate the acreage of all woodlots within the project footprint. These acreages were added to produce a total sum for each roadway project. Each roadway project sum was further combined to provide one comprehensive tree clearing tally per county. Individual roadway project tree clearing estimates can be provided upon request.

TABLE 5. TREE CLEARING ESTIMATE METHOD USED PER PROJECT TYPE

STIP/Division Project Prefix	Method Used to Estimate Tree Clearing
I	ROW to ROW
R, A, M, X	
U	
C	
E, EB, EL, ER, L, S	
EE	
K, L	
SR	
W, SF, SI	
F, FS, P, Y, Z	
B	SS to SS
BD	
BP	

To obtain a tree clearing estimate for NCDOT activities for a five year period, beginning in January 2015, the estimated acreage of tree clearing from January 2013 through December 2015 was determined based on final design electronic files. An estimate of anticipated tree clearing was developed for this time period. However, the design process was not far enough along to determine tree clearing acreages for the remainder of the five year period. Over a four year period beginning January 2016 and continuing through December 2019 estimates for tree clearing were extrapolated based on hard data analyzed for the January 2013 through December 2015 time period.

Based on our calculations, NCDOT activities anticipated to occur between January 1, 2015 and December 31, 2019 will result in an estimated loss of 10,223 acres of trees in eastern North Carolina. Based on the most recent county-level United States Forest Service Forest Inventory and Analysis data for North Carolina (New 2014) an estimated loss of 10,223 acres of trees represents 0.21% of total wooded acres in the action area. This estimate includes NCDOT projects which were begun before the presumed NLEB listing date of April 2, 2015 but will still be under construction as of that date. All activities which include tree clearing will be assumed to incur incidental take. Actual project tree clearing will be tracked and reported annually to USFWS, FHWA, and USACE for the duration of this programmatic agreement to ensure that actual tree clearing does not exceed the overall estimate.

Roosting

Tree cutting activity typically occurs during the daytime when NLEB bats would be roosting in trees. Anecdotal evidence from another *Myotis* species (Indiana bats) suggests that some bats may remain in their roost trees until after trees are felled; those that survive the impact of the fall will then attempt to crawl or fly out of the tree and seek cover elsewhere (Belwood 2002). Bats on the underside of the trees will likely be injured or killed when the trees fall to the ground. In some instances trees may be processed immediately after cutting, leaving NLEB little time to reorient and escape prior to the onset of additional effects.

Additional tree felling and the operation of heavy equipment (log skidders) in the vicinity of felled trees may further reduce the survival of bats; those that survive the fall of their roost tree have the potential to be killed or injured while attempting to escape and seek cover elsewhere. Bats that move to a nearby tree for cover (*i.e.*, a tree located within the area to be cleared) will again be exposed within a short period of time to risk of death or injury as that tree is also felled, limbed, and skidded out of the forest.

During tree clearing operations, NLEB roosting outside the activity footprint are not likely to be killed or injured as trees are felled. However, these bats may be exposed to noise and vibrations cause by tree clearing activities and equipment. Based on available information, the response to these disturbances may range from no perceivable response to avoidance of the area.

Direct effects to the NLEB from tree cutting are expected to range from death or injury of bats roosting within the project footprint to harassment or no adverse effect to bats roosting in the vicinity of the activity. Seasonal tree clearing restrictions are unlikely reduce or eliminate affects to NLEB because it is not known where or if NLEB hibernate or spend their winters in eastern North Carolina, and trees may be used year round.

The loss of trees from NCDOT activities should not result in a shortage of available roosts for NLEB as forested habitat is not limited in eastern North Carolina (see Section 4.2.4).

However, if any caves or mines are capable of providing suitable roosting habitat for NLEB in eastern North Carolina, activities that involve filling or excavation of soil or debris could adversely affect the roost site and any bats inside. Altered hydrology from filling, excavating or activities such as temporary stream diversions could cause flooding, affecting the roost site and potentially drowning bats. NCDOT considers these effects unlikely to occur, since there are no known NLEB hibernacula and few caves or subterranean mines in eastern North Carolina.

There is evidence that NLEB roost in structures such as bridges and buildings (see Section 2.2), although there is limited evidence of structure use in North Carolina to date, and no evidence of NLEB using structures in eastern North Carolina (see Section 4.2.9). Since NCDOT projects include the demolition of bridges and buildings for bridge replacements, road widening projects, and new location projects, there is potential for death or injury of bats similar to that described above for tree roosts. Since use of structures for roosting is apparently less common than the use of trees, the potential for take from structure demolition is considered to be minimal.

Foraging

In addition to the direct effects associated with the loss of roost trees when bats are present, the loss of foraging habitat may also directly affect NLEB. Effects to the bats whose foraging areas lie entirely or mostly outside the activity area are anticipated to be minimal. Individuals whose foraging areas occur entirely or mostly in the project area or whose foraging areas will be significantly fragmented will have to expend an increased amount of energy to establish new foraging areas or new travel corridors between roosting and foraging areas. Additionally, they may be subject to an increase in inter- and intra-specific competition. Bats that remain loyal to certain foraging areas may continue to cross through newly cleared areas in the activity footprint and may have an increased risk of mortality from predation although this risk is not detectable or measurable. Take of bats from the loss or fragmentation of foraging habitat is anticipated to be short term in the form of harassment. It is anticipated that in most instances NLEB in the action area will have little difficulty in establishing new foraging areas due to the availability of remaining suitable foraging habitat in the surrounding landscape.

6.2.2. Direct Effects of Decreased Water Quality

NCDOT activities are likely to affect water quality in eastern North Carolina. Potential effects include:

- temporary sedimentation from land-clearing and earth-moving activities such as site preparation, installation of drainage features, utility installation, culvert installation/extension, grading activities,
- potential water quality impacts during construction from accidental spills of petrochemicals, uncured concrete, herbicides, etc.

Insects (including caddisflies) associated with aquatic habitats make up a portion of the diet of NLEB (USFWS 2014c, Nagorsen and Brigham 1993, Brack and Whitaker 2001, Griffith and Gates 1985). Many species of caddisflies can be negatively affected by a decrease in water quality (Hilsenhoff 1982, Lenat 1993, Barbor *et al*. 1999). Therefore, a change in water quality can affect a portion of the prey base of the species. Decreases in water quality through contamination and the destruction of wetlands and stream habitats where NLEB are present may reduce the availability of certain aquatic insects and reduce the availability or quality of suitable drinking sources. A typical NCDOT project includes a number of measures to avoid, minimize and offset the impacts to water quality during all phases of the project (Section 6.1.2 and 6.1.3).

Although water quality impacts may cause a reduction in specific portions of the prey base and drinking sources for NLEB, adverse effects are likely to be undetectable due to the availability of alternative prey and drinking sources in the surrounding landscape. Bats may seek alternative areas for drinking and may turn to other types of prey. Therefore, potential direct adverse effects to the NLEB from a reduction in water quality are anticipated to be insignificant and/or discountable.

6.2.3. Direct Effects of Light, Noise, Vibrations, and Other Disturbance

In addition to habitat destruction in the project footprint, a decrease in the quality of remaining habitat adjacent to project footprints may occur. Increased disturbance is anticipated during clearing and construction from the use of equipment and, to a lesser extent, from blasting. Blasting is not utilized for projects in the Coastal Plain or Southeastern Plains. However, blasting may be utilized, on very rare occasions, in the Piedmont. As a result, NLEB will be exposed to noise levels, or intensity of noise and vibrations that they may not have experienced in the past, depending on the proximity of their roost sites to NCDOT activities. The majority of these effects will be temporary and generated solely during construction activities. However, some effects will become permanent.

In general, the increased noise and vibrations could affect NLEB unaccustomed to such disturbance while roosting, thereby reducing the suitability of habitat adjacent to the activity footprint. If NLEB hibernate in eastern North Carolina, disturbance during hibernation could cause bats to wake and expend extra energy during the winter. It is difficult to predict the degree to which NLEB would be disturbed by the noise and vibrations associated with construction activities.

Some studies suggest that Indiana bats may be able to tolerate disturbance from noise (no information was available for NLEB). Noise from vehicles had no discernable effect on Indiana bats crossing a road (Zurcher *et al*., 2010). Indiana bats roosted near the I-70/Indianapolis Airport area, including a primary maternity roost 1970 feet south of I-70. This roost was not abandoned despite constant noise from the Interstate and airport runways; their proximity to the Interstate could also have been due to lack of a more suitable roosting area (USFWS 2002).

It is reasonable to assume that any effect resulting from noise and vibrations related to construction activities could result in bats selecting roost trees further from the disturbance (USFWS 2005).

If any caves or mines are capable of providing suitable roosting habitat for NLEB in eastern North Carolina, vibrations from blasting or pile driving could cause the roost to collapse. This effect is unlikely to occur due to the limited numbers of caves and the fact that many old mines in eastern North Carolina collapsed or filled with groundwater long ago.

There are no data specific to the NLEB for the use or avoidance of lighted areas that may occur along roadways. Research by Rydell and Baagoe (1996) indicates that bats in the genuses *Eptesicus* (big brown bats, *Eptesicus fuscus*) and *Lasiurus* (red and hoary bats, *Lasiurus borealis* and *L. cinereus*, respectively) are the species typically noted foraging around artificial lights. In contrast, they noted that bats in the genus *Myotis* seem to avoid open spaces, preferring to feed in woodlands or low over water. Other researchers have stated that *Myotis* foraging strategies may be more suited to foraging in forested areas than out in open areas (Humphrey et. al. 1977; LaVal et. al. 1976; Brack 1983; Garner and Gardner 1992; Gardner et. al. 1996; Murray 1999), which may reduce NLEB exposure to lit areas along transportation corridors and construction sites. It is possible that lighting may cause avoidance behavior in NLEB.

Burning woody debris to dispose of it may disturb roosting bats with smoke or heat.

6.2.4. Direct Effects of Herbicide Use

Direct effects to soil and water resources may include some limited drift from fine mists during application. Once in the soils, herbicides can migrate via gravity, leaching, and surface runoff to other soils, groundwater, or surface water. However, many of the herbicide treatments would be applied directly to targeted species and relatively little herbicide would make contact with the soil. Due to the limited acreage and dispersed extent of the areas, and the short half-lives of the chemicals proposed for use, the effects would be temporary and minor. It is unlikely there will be any direct effects to bats since they are highly mobile. They would most likely leave or avoid the treatment area for the short-term while the applicators are applying herbicides. If an animal returns to a treated site, the herbicide should have dried on the vegetation, reducing the likelihood of dermal exposure when brushing by vegetation or during grooming activities. It is possible that individual bats may ingest herbicide contaminated insects resulting in a negative indirect effect. The possibility of contaminating insects would be minimal and short term.

6.2.5. Research and Management

During the five-year research study proposed by NCDOT, NLEB could be negatively affected by mist-netting activities, such as becoming overly stressed or injured in a net. Hibernacula/winter roost surveys can cause hibernating bats to arouse and burn energy reserves too fast and cause starvation although this is unlikely to occur in eastern North Carolina due to milder winters. Telemetry surveys could stress individual bats carrying transmitters. However, all of these potential effects are covered under ESA Section 10(a)(1)(A) permits.

6.3. Indirect Effects

Indirect effects are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur.

Indirect effects may include:

- Increased traffic and noise that result from increased road capacity,
- Increased disturbance and mortality from increased traffic speed,
- Maintenance activities (such as periodic vegetation removal and culvert cleaning) that could affect roosting bats or habitat conditions,
- Potential establishment or spread of noxious weeds that could degrade potential habitat,
- A decrease in water quality resulting from an increase in impervious surfaces, and
- A decrease in water quality due to the use of and potential spills from petro-chemicals, herbicides, and other contaminants associated with operations and maintenance.

6.3.1. Habitat Connectivity

Habitat connectivity (or habitat permeability) is the ability of wildlife to travel from one area of habitat to another. Connectivity is high when species face few barriers and low when barriers prevent or degrade movement. Barrier effects can be natural (i.e., a river or mountain) but are more often considered to be from artificial structures (i.e. highway or building). When habitat connectivity is low, habitat is said to be fragmented. Connectivity and barrier effects are species-dependent. While highly mobile and adaptable species like deer may easily cross a four lane highway, low mobility species like turtles can have their habitat fragmented by a two lane highway. Projects which degrade habitat and/or increase pavement width generally cause a drop in habitat connectivity. Although bats are volant (capable of flight), NLEB traveling height may put NLEB at traffic level. One study documented Little Brown Bats (*Myotis lucifugus*) traveling within two meters of the surface, which leaves them at traffic height, hence the presence of bats in roadkill studies, Russell *et al*. (2009). NLEB foraging occurs 3.3 to 9.8 feet above the ground, under or within the canopy (Nagorsen and Brigham 1993, cited in USFWS 2014b).

Zurcher *et al*. (2010) found that roads can act as a barrier to bats and traffic increases the barrier effect of roads. Kerth & Melber (2009) found that roadways may have a stronger barrier effect on bats that forage close to surfaces than on bats that forage in open space. Berthinussen and Altringham (2011) detected a decrease in bat activity and diversity in proximity to the road

Without specific data on the relationship between NLEB and current habitat connectivity levels in eastern North Carolina, only generalizations can be made about the effects of habitat fragmentation due to NCDOT activities. NCDOT projects will reduce NLEB habitat connectivity; therefore, NLEB may need to expend extra energy to forage, find cover or commute to roost sites as a result. No reasonable estimate of the reduction in habitat connectivity can be made due to the limited NLEB data in eastern NC. It is assumed that the abundance of NLEB habitat will act to ameliorate the effects of NCDOT activities.

6.3.2. Indirect Effects of Decreased Water Quality

Potential indirect effects to the NLEB from a reduction in water quality due construction, operation, and maintenance of transportation activities are anticipated to be similar to direct effects. Water quality is expected to decrease in the action area due to increased impervious surfaces, an increase in the number of structures in waterways (e.g., culverts) and increased vehicle use. Potential indirect adverse effects to the NLEB from a reduction in water quality are anticipated to be insignificant.

6.3.3. Indirect Effects of Disturbance

In addition to direct effects from habitat removal, the proposed project may also indirectly decrease the quality of habitat surrounding activity areas. NLEB remaining in the action area during the operation of the highway will be subject to disturbance from traffic noise, headlights, and in some areas, highway lighting. As a result, NLEB in the action area will be exposed to lights, noise levels, or intensity of noise and vibrations that they may not have experienced in the past, depending on the proximity of their roost sites to transportation activities.

The current ambient noise in eastern North Carolina varies greatly depending upon land use and human population density. It is assumed that noise generated from traffic will increase over time. No reasonable estimate of increased disurbance can be made, but it is assumed that the availability of suitable habitat in the surrounding landscape is likely to minimize the affect of NCDOT project-caused disturbance.

6.3.4. Indirect Effects of Vehicle Traffic

NCDOT activities may cause more NLEB to be vulnerable to vehicle strikes. Roads with higher vehicle use can be a barrier to bats (Zurcher *et al* 2009); however, bats have been documented crossing roads while commuting between roosting and foraging areas and/or while foraging on insects attracted to road lighting (Brack 1983, Menzel et. al. 2001, Butchkoski 2003).

The home ranges for some NLEB may be partially or even entirely divided by NCDOT facilities. Bats that continue to cross roadways after they become operational to access roosting or foraging areas will be subject to being struck by vehicles.

As noted previously, foraging strategies utilized by *Myotis* bats may be more suited to forested areas than out in the open (Humphrey et. al. 1977; LaVal et. al. 1976; Brack 1983; Garner and Gardner 1992; Gardner et. al. 1996; Murray 1999), which may reduce the vulnerability of NLEB to vehicle strikes.

Some NLEB may run the risk of colliding with vehicles during operation of NCDOT facilities; any bat that is struck by a vehicle is likely to be killed or fatally injured. However, it is difficult to meaningfully quantify the risk of bat/vehicle collisions. Furthermore, any such strikes would likely go either unnoticed or unreported.

6.3.5. Roost Alteration

If any caves or mines are capable of providing suitable roosting habitat for NLEB in eastern North Carolina, activities that involve filling, excavation or alteration of hydrology could indirectly affect the roost site by altering airflow or other roost characteristics. Vibrations from equipment use could cause structural weakness leading to collapse of a cave/mine at a later date. NCDOT considers these effects unlikely to occur since there are no known NLEB hibernacula and few caves or mines in eastern North Carolina.

6.3.6. Long-Term Habitat Alteration

Loss and fragmentation of NLEB habitat could occur in eastern North Carolina. Implementation of the NCDOT Program from January 1, 2015 and December 31, 2019 is projected to result in a loss or degradation of 10,223 forested acres in eastern North Carolina.

6.4. Cumulative Effects

Cumulative effects considered in this PBA include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area [50 CFR §402.02]. Future Federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to section 7 of the ESA.

The PBA action area covers more than half the state. The working group concluded that due to the availability of suitable NLEB habitat, the effect from the NCDOT Program will not likely significantly affect NLEB survival in eastern North Carolina. Negative NLEB capture data in eastern North Carolina may suggest the NLEB population in much of eastern North Carolina may be low, further reducing the likelihood of effects to NLEB (Section 4.1.3, Figure 3).

The cumulative effects from the NCDOT Program are minimal and would contribute little incremental effect when combined with impacts of other past, present, or reasonably foreseeable future activities. Consequently, they are not expected to contribute to any measurable increase in cumulative effects.

6.4.1. Bridge Maintenance

There will be NCDOT maintenance activities with no federal nexus like bridge painting and maintenance which could affect NLEB. If NLEB are roosting in bridges in eastern North Carolina, bridge painting and maintenance could harass, harm, or even kill individuals, especially if the activity occurs during early summer when young bats are nonvolant. Current data suggest that bridge use by NLEB in North Carolina is very limited (see Section 4.2.9), so the effects of bridge maintenance are expected to be minimal.

6.4.2. Tree Trimming and Hazard Tree Removal

Tree trimming and hazardous tree removal are activities that may occur without a federal nexus. These activities occur along roadside ROWs to reduce safety hazards due to falling trees or limbs, or to improve line-of-sight issues. Potential effects to NLEB from this activity are described in Section 6.2.1. Hazardous tree-removal occurs on an as-needed basis, so quantifying the amount of habitat lost from this activity is not practicable. Since NLEB are a forest interior species, it is assumed that few NLEB would be roosting along roadsides, so the effects from these activities should be minimal.

6.4.3. Climate Change

Climate change has the potential to exert a cumulative effect on NLEB. Temperate zone bats may be more sensitive to climate change than other groups of mammals because many aspects of their ecology are closely linked to temperature (Loeb and Winters 2013). Bat species that are unable to mitigate the effects of high temperature with behavioral changes may shift their range to avoid higher temperatures.

6.4.4. Herbicide Use

The impacts from the proposed herbicide treatment activities are negligible (see 6.2.4) and would contribute little or no incremental effect when combined with impacts of other past, present, or reasonably foreseeable future activities. Consequently, they are not expected to contribute to any measurable increase in cumulative effects. In the unlikely event of an herbicide spill, water quality could be affected, but the effects would be localized.

6.4.5. Human Population

Totaling 2010 US Census Bureau county data for the 59 counties in the action area, gives a population of 5,454,579. The US Census Bureau estimated an average growth rate of 3.5% by 2013 within the action area. However, it is interesting to note that most counties are either in decline or barely growing while the cities are rapidly growing, which accounts for the overall growth. In general, increasing human population would likely have a negative effect on NLEB. Although there is insufficient data to accurately discuss NLEB habitat in eastern North Carolina, it is likely that cities are not preferred habitat. If this assumption is true it is possible that the current human growth pattern is not likely to have significant effect on NELB in eastern North Carolina.

There is potential for the NCDOT Program to induce additional human population growth. It is likely that bridge replacements and maintenance activities will not increase population growth, but new location and widening projects do have potential to increase traffic capacity, which may induce local human population growth resulting in additional habitat loss. No quantitative analysis is practicable for the scope of the NCDOT Program.

6.4.6. Waste and Borrow

Waste and borrow areas that are used to dispose of and obtain materials for earthwork, are also subject to clearing and grubbing, but construction contractors are responsible for addressing federally listed threatened and endangered species issues per NCDOT standard specifications. Most borrow and waste areas are sited in areas of previously disturbed habitat where tree removal is minimal.

6.5. Incidental Take

We can conclude from the results of our effects analysis that incidental take to NLEB is likely to occur from NCDOT Program activities. It is probable that most NLEB take will be in the form of harassment (disturbance from tree clearing, construction noise, vibration, and light), since most NCDOT Program activities are likely to occur adjacent to existing transportation corridors, and based on studies in North Carolina, NLEB are more active in forest interiors than at forest edges (O'Keefe 2009, Morris et al. 2009, Morris et al. 2010). It is assumed that harassment will be the most common type of take. However, the potential for harm or mortality from NCDOT Program activities does exist.

As explained in Chapter 1 the working group elected to identify a surrogate for estimating effects to NLEB by the NCDOT Program in eastern North Carolina. This was in part due to the limited amount of accurate NLEB distribution and behavior data in eastern North Carolina. The surrogate chosen by the working group is tree clearing, and our calculations project up to 10,223 acres of trees to be cleared by the NCDOT Program over the duration of this PBA.

We anticipate that estimated tree clearing will exceed actual tree clearing amounts; therefore, we acknowledge that we may be overestimating the actual amount of NLEB take that will occur.

6.6. Avoidance and Minimization Measures

NCDOT is funding a five year research study to survey and study NLEB in eastern North Carolina. Data from this research can be used to in future consultations to determine the most effective means to avoid and minimize effects on NLEB in eastern North Carolina. Other measures include sediment and erosion control BMPs, dust control at construction sites, construction of stormwater facilities, noise wall construction, wildlife passage construction, wetland and stream mitigation, and the use of BMP measures when conducting in-water work.

6.7. Summary of Effects

We can conclude from our effects analysis that NLEB are likely to incur both direct, indirect and cumulative effects from NCDOT Program activities. Although the intensity of effects may vary by activity, season, and condition and home range of individual bats, there is insufficient data to make that distinction. Direct effects to NLEB are anticipated during construction and maintenance activities from the removal of habitat and disturbance from noise and vibrations. Take may be in the form of injury or mortality during clearing activities, harm due to the loss of roosting and foraging areas, and disturbance from clearing and construction noise. If NLEB are hibernating in the action area, they would be subject to disturbance during construction activities from vibrations from vehicle use, pile driving and blasting activities.

Indirect effects on NLEB are anticipated from NCDOT Program activities due to the fragmentation of habitat, disturbance from traffic noise, and an increased risk of bat-vehicle collisions. Take due to indirect effects is anticipated to range from death of some individuals over time to effects which may be insignificant or discountable for other individuals whose home ranges are mostly or entirely outside the PBA action area.

Potential cumulative effects include habitat loss from locally induced growth, waste and borrow pits, and hazardous tree removal. Other effects include bridge maintenance activities, the use of herbicides and potential water quality degradation from operations and maintenance activities.

Chapter 7. Effect Determinations for Northern Long-Eared Bat

7.1. Effect Determination

One of the assumptions the working group used as a premise for the effects analysis (see Chapter 6 & Appendix D) is that NLEB are present throughout the PBA action area (see Chapter 1). The result of the effects analysis is that the NCDOT Program will have an adverse effect on NLEB. As such, NCDOT has committed to track the acreage of trees cleared during project construction for the life of this agreement, and embark on a research study designed to provide critical information regarding the ecology of NLEB in eastern North Carolina. As shown in Appendix D, the activities associated with the NCDOT Program will have varying types of effects effect on the species.

7.1.1. No Effect Determinations

When the action agency determines its proposed action will not affect a listed species or designated critical habitat, the project is considered to have "no effect" on the species (USFWS 1998). Projects with activities that do not remove or modify potential NLEB habitat, and activities in locations where NLEB are not expected to be present will have no effect on NLEB and are listed in the table located in Appendix D. This could include urban projects and/or projects without tree or structure modification.

7.1.2. May Affect, Not Likely to Adversely Affect Determinations (MA-NLAA)

When it is determined that an activity may affect, but is not likely to adversely affect a federally protected species, the effects on that species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (USFWS 1998).

The working team anticipates that the majority of the effects from the NCDOT Program in eastern North Carolina will result in insignificant or discountable effects to NLEB. Activities that may result in a MA-NLTAA determination are listed in the table located in Appendix D.

7.1.3. May Affect, Likely to Adversely Affect Determinations (MA-LAA)

When the effect to a listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial, the activity is likely to adversely affect the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made, and requires the initiation of formal section 7 consultation (USFWS 1998).

While we believe that most NCDOT Program activities will result in insignificant or discountable effects to NLEB, some NCDOT Program activities will likely result in adverse effects to NLEB. As a result of the effects analysis conducted, we can conclude that NCDOT Program activities where NLEB foraging and/or roosting trees or structures are removed have the greatest potential to result in take to the species. Activities that may result in a MA-LTAA determination are listed in the table located in Appendix D.

7.2. Making Overall Effect Determinations

As a result of the effects analysis, the working group determined that tree clearing (a common component associated with NCDOT Program activities across the action area) represents the activity with the greatest potential to affect NLEB in eastern North Carolina. Although the likelihood of affecting NLEB is low, due to an assumed small population size in the PBA action area (refer to Section 4.1), the potential for NLEB to be affected by NCDOT Program activities is anticipated. Without a more complete understanding of the distribution, behavior, and abundance of NLEB in Eastern North Carolina, it is not practicable to accurately quantify the effect of the NCDOT Program on NLEB.

Over a five year period beginning in January 2015 and continuing until the end of 2019, an estimated maximum of 10,223 acres of trees will be removed as a result of NCDOT Program activities across the action area. Incidental takes from the NCDOT Program in eastern North Carolina could occur in the forms of harassment, harm and/or mortality. NCDOT/FHWA believe the greatest potential for incidental take of NLEB will occur in the form of harassment.

NCDOT will support five field seasons of specialized NLEB research in an effort to provide valuable data on distribution, habitat preference, and behavior of NLEB in eastern North Carolina.

Although we believe the NLEB research study will be greatly beneficial to NLEB conservation in eastern North Carolina, there is potential for adverse effects due primarily to tree and/or structure removal from NCDOT Program activities. Therefore, the biological conclusion for this PBA is May Affect, Likely to Adverse Effect.

7.3. Potential Flaws in Making Effect Determinations

The best available scientific and commercial data has been used to determine the effect of NCDOT Program activities on NLEB. However, due to several factors explained throughout this PBA, such as the limited data available for NLEB distribution and behavior in eastern NC, there is a potential that the assumptions detailed in this document have a degree of inaccuracy. As a result, accurately quantifying potential effects to NLEB from implementation of the NCDOT Program is impracticable at this time.

This PBA has equated acres of cleared trees to incidental take due to lack of any other suitable method to measure take across eastern North Carolina. Each year, the actual acres of trees removed as a result of NCDOT Program activities will be reported to the work group(FWHA, USFWS, and USACE) to ensure NCDOT projects are in compliance with the guidelines established by this PBA. If clearing amounts exceeds the estimated maximum loss, NCDOT/FHWA and the USACE will reinitiate consultation with USFWS.

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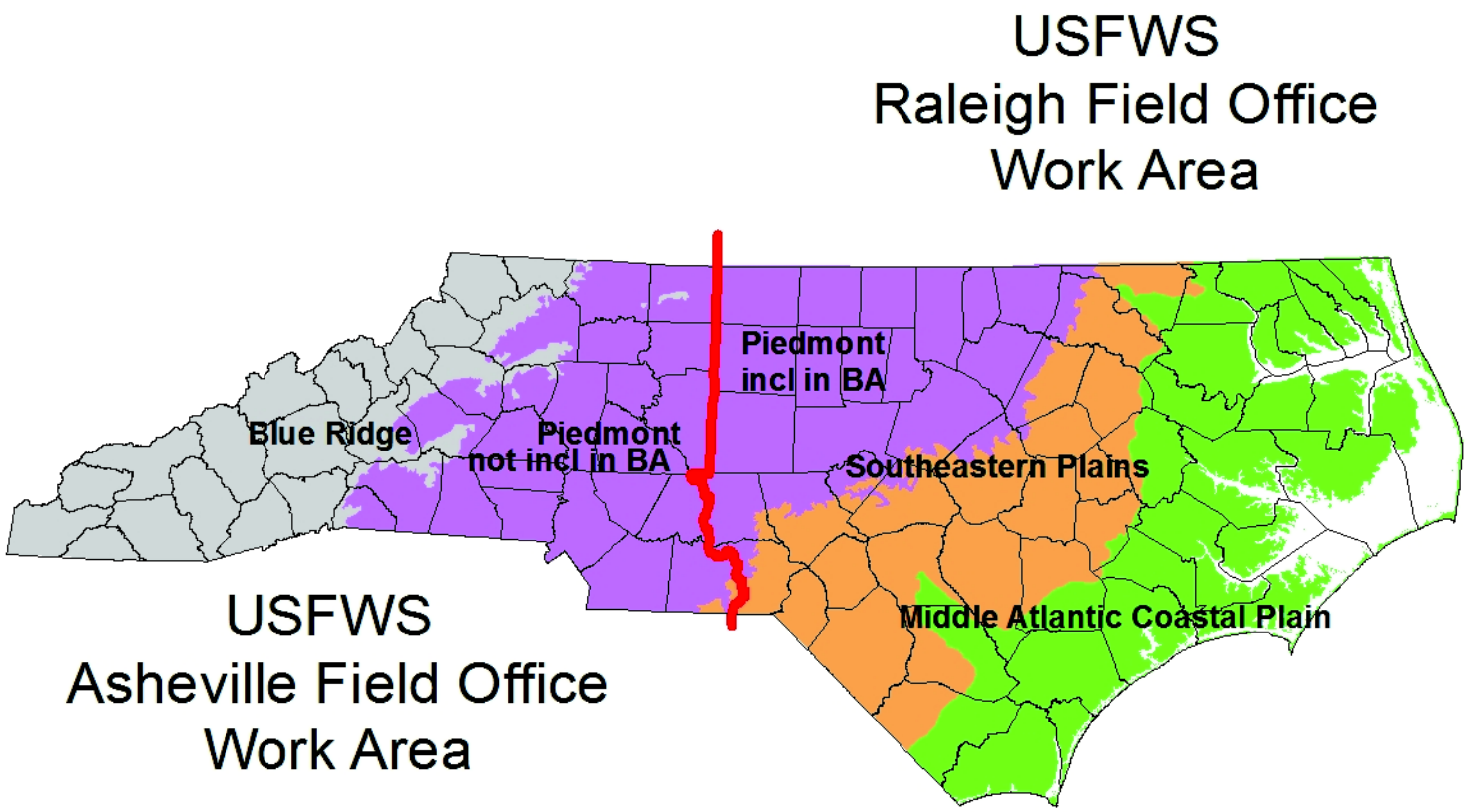
APPENDIX A

FIGURES



NC Eco-Regions

Level 3

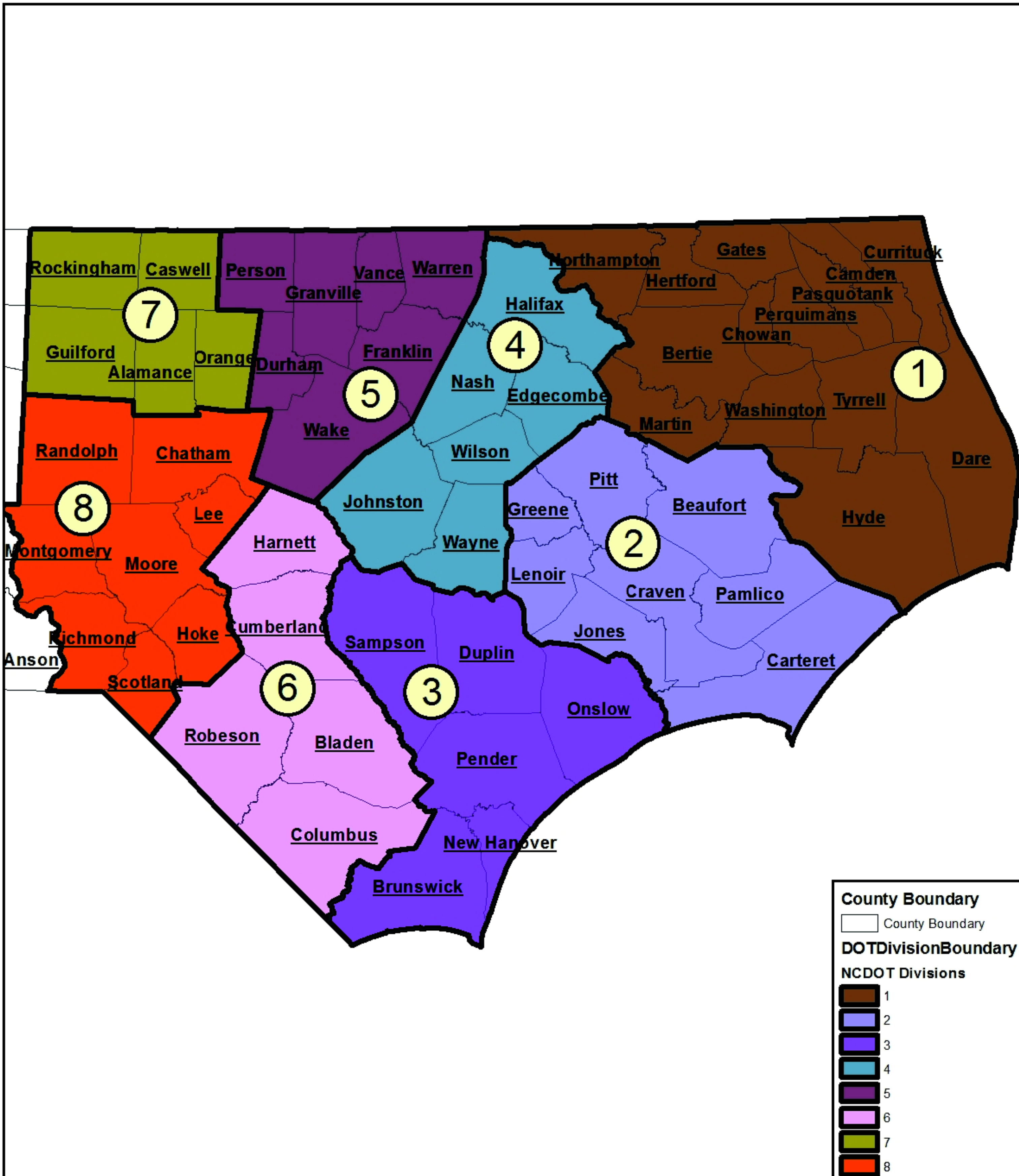
- Middle Atlantic Coastal Plain
- Southeastern Plains
- Piedmont
- Blue Ridge (not included in BA)
- Line Dividing USFWS Work Areas
- County Boundary

Prepared by NCDOT 12/1/14

Program Area and EPA Ecoregions

0 10 20 40 Miles

FIG 1



Prepared by NCDOT 10/27/14

Action Area

Eastern NC Counties
& Eastern NCDOT Divisions

0 5 10 20 Miles

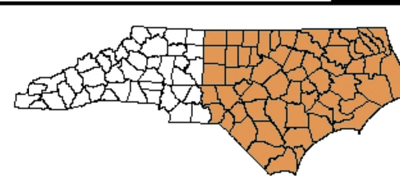
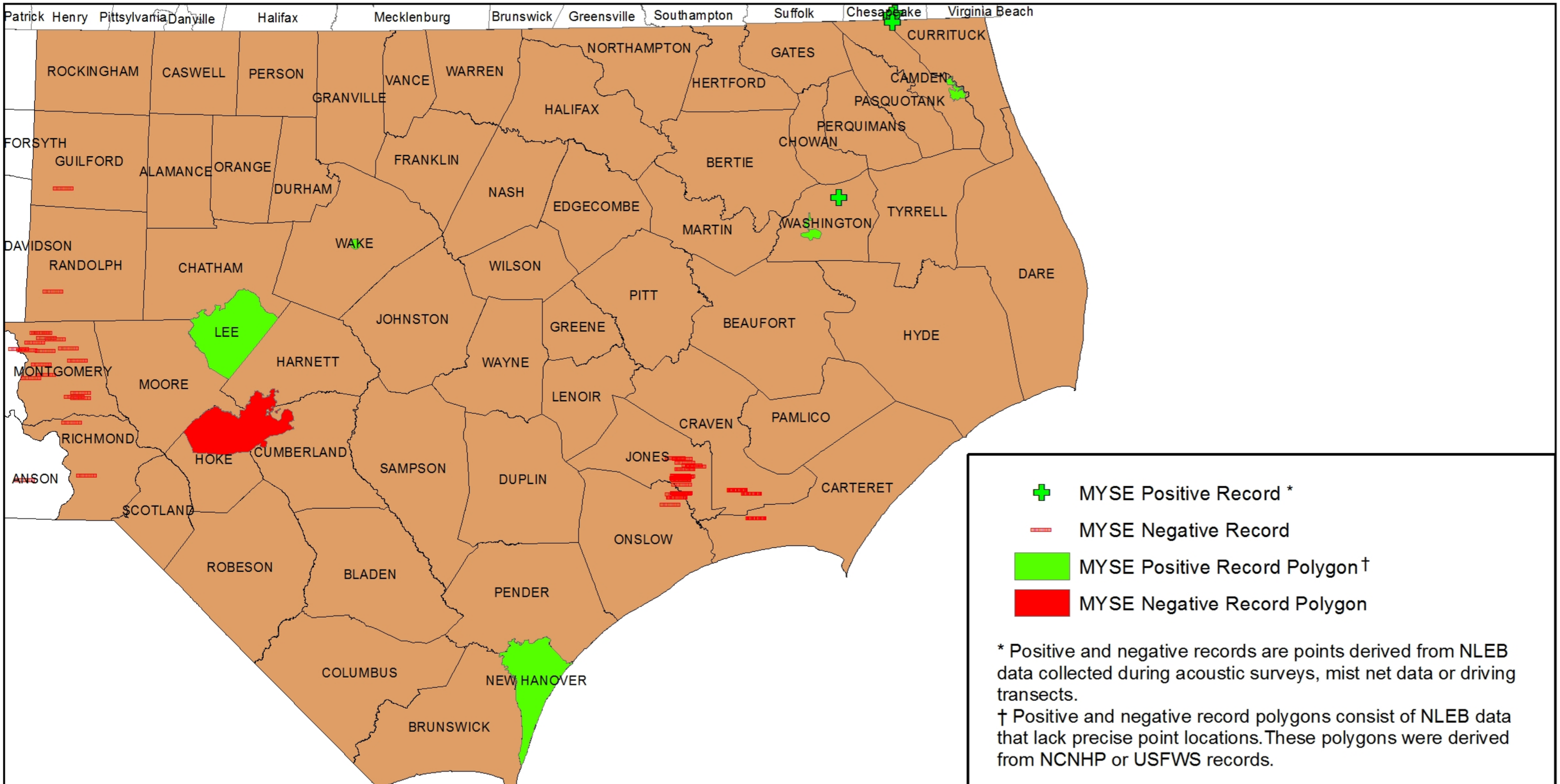


FIG
2



Prepared by NCDOT 12/22/14

Northern Long-eared bat Positive (+) Negative (-) Known Site Data

0 10 20 40 Miles

USFWS Raleigh Field Office Work Area (Eastern NC)

Fig 3

APPENDIX B

GLOSSARY OF TERMS

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

activity (and subactivity) - a construction process used to complete a project. i.e. tree removal, utility relocation, etc.

categories – construction project groups; i.e. new construction, transportation enhancement, etc.

critical habitat - (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of the ESA, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the ESA, upon a determination by the Secretary that such areas are essential for the conservation of the species (defined in Section 3 of the ESA).

division – unit of measurement dividing NCDOT counties into groups. There are 14 NCDOT Divisions within NC.

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

exfoliating bark - tree bark that peels away from a trunk or a branch of a tree; when a tree dies, plates of bark spring away from the bole of the tree. Some living trees, such as shagbark hickory and white oak, have bark that peels back from the living cambium.

hibernaculum (plural **hibernacula)** - a site, usually a cave or mine, where bats hibernate during the winter (see suitable habitat).

maternity colony - a group of reproductively active female bats and their young that occupy the same summer habitat. Males may also occur in maternity colonies.

maternity roost - a summer roost, usually a tree, used by reproductively active female bats and their young (males may also roost there).

may affect - the appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat.

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

not likely to adversely affect - the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. **Beneficial effects** are contemporaneous positive effects without any adverse effects to the species. **Insignificant**

effects relate to the size of the impact and should never reach the scale where take occurs. **Discountable effects** are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

population - a group of bats occupying a specific geographic area.

program - all NCDOT projects; lso referred to as the STIP, or State Transportation Program.

projects – group of construction activities (i.e. bridge replacements, road widening, intersection work etc.) organized and conducted within the NCDOT Divisions or within the State Transportation Improvement Program.

roost tree - any tree in which bats roost (see suitable roost tree).

snag - a standing dead (or mostly dead) tree, generally with <10% living canopy.

State Transportation Improvement Program (STIP) – a multi-year schedule for all NCDOT transportation projects. Once projects have been adopted by the Division of Bicycle and Pedestrian Transportation and the NC Board of Transportation, they are incorporated into the STIP.

structure- bridge, culvert, or building

suitable habitat - Summer and/or winter habitat that is appropriate for use by NLEB (may be known or unknown in terms of documented use). See most recent summer survey guidance)

- **winter** (hibernacula) is restricted to underground caves and cave-like structures (e.g. abandoned mines, railroad tunnels). These hibernacula typically have large passages with significant cracks and crevices for roosting; relatively constant, cooler temperatures (0-9 degrees C) and with high humidity and minimal air currents.
- **summer** for NLEB consists of the variety of forested/wooded habitats where they roost, forage, and travel. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow. May also include structures for roosting (e.g., barn, bridges).
- **spring staging/fall swarming** for NLEBs consists of the variety of forested/wooded habitats where they roost, forage, and travel within 5 miles of a hibernaculum. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat

when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow.

suitable roost tree - During summer NLEBs roost singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and snags, typically ≥3 inches dbh.

survey - a method of sampling, such as mist netting, that provides data concerning the presence/absence of bats at a site; also, the act of enumerating the bats hibernating in a cave or mine. NLEB summer survey guidance can be found at http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/NLEBinterimGuidance6Jan2014.pdf

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

take – Take is defined in Section 3 of the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

volant – capable of flight.

APPENDIX C

FIVE YEAR NLEB RESEARCH PROJECT

NORTHERN LONG-EARED BAT RESEARCH STUDY FOR EASTERN NORTH CAROLINA NCDOT, 2015-2019

Objectives
1. Use acoustic monitoring to determine the distribution of Northern Long-eared Bat (NLEB) in eastern North Carolina, determine where presence is year-round and where it is limited to the maternity season, and develop basic understanding of northern long-eared bat habitat and temporal (year-round) activity patterns.
2. Use the results of the acoustic surveys to conduct mist-netting/telemetry on NLEBs to locate and characterize day roosts, especially winter roosts (if NLEB are present in eastern NC over the winter).
3. Swab bats in winter to determine presence/absence of *Pseudogymnoascus destructans*, the fungus that causes white nose syndrome (WNS).
4. Conduct structure, bridge and culvert checks to determine degree of use, seasons of use and type of structure preferences.

1. Acoustic Monitoring
For research in eastern NC, select 30 locations for conducting acoustic work, covering 10 locations/year for 3 years. At each location, sample 4 times/year (early and mid-summer, fall and winter) with 4 bat detectors for 3 nights/sampling period. This will result in 480 detector nights/year. Sampling for three years will result in a minimum of 1440 detector nights, which will be the minimum amount of acoustic work to be conducted through the 5-year research program. Additional work may be needed to fill information gaps; this will be determined as work progresses. If ten locations are sampled a year for five years, a maximum of 2400 detector nights will be the result. Using multiple bat detectors will allow four sites within a location to be sampled so that habitat preferences can be determined. Monitoring multiple times a year will ensure that the species' presence is detected if some areas are only inhabited on a seasonal basis. Sampling may be discontinued at locations with little or no bat activity, at which point a new location will be selected.

Thirty locations spaced out over eastern NC will provide information about the species' distribution. Counties with NLEB capture records, counties with reliable acoustic-only records (no captures), and counties near recent NLEB captures in Washington, Currituck and Camden counties will be prioritized for initial monitoring. Sampling locations will be coordinated with advisors from state and federal resource agencies and from academia to avoid duplicating efforts.

In addition to the methods listed below, all survey efforts will follow the NLEB Interim Conference and Planning Guidance (US Fish and Wildlife Service, 2014) to the extent practicable.

Methods:
- Use Anabat SD2 detectors or SM2 Songmeters encased in weather-proof housing. Ensure that the latest firmware is included. All detectors will have been tested within the last year for sensitivity.
- Use sensitivity setting of 7 (Anabat).
- Detectors will be placed in a variety of habitats and stand conditions.
- Bat echolocation passes will be identified using two automated systems such as EchoClass II and BCID (Bat Call ID) as well as supervised visual examination.
- Habitat will be scored as as pine/hardwood/mixed; the landscape setting as upland/bottomland; the timber as managed (thinned, burned, or pine plantation) or unmanaged, mature or cutover; and the condition as more open or more forested, following Ford et al. (2006). To score human disturbance, habitat will also be classed as natural, rural (scattered agricultural land or buildings visible), suburban (regular houses/buildings) or mixed (patches of natural and other land use).

- Natural communities will be typed according to Schafale (2012) to give an indication of which tree species are present.
- Assess forest basal area (m2/ha) using a 10- factor prism and canopy cover using a sighting tube at 10 random locations within a 0.05-ha circular plot around each survey site (Cook et al. 1995, Ford et al. 2006). This will give an indication of forest structure and how cluttered the surrounding habitat is.

Rationale for locations for acoustic work:

- Virginia lists records for NLEB in the Dismal Swamp in VA. The swamp lies in Gates, Pasquotank, and Camden Counties in NC. Navy biologists captured NLEB in Currituck County, NC and adjacent Chesapeake County, VA.
- Washington, Camden, Currituck and surrounding counties were selected to gather more information about presence/seasonal activity of NLEBs in the area.
- No NLEB records occur in the Piedmont or coastal plain of South Carolina; all records are from the mountains.
- There are records of NLEB in Wake County and the US Fish and Wildlife Service (USFWS) lists Lee County as a recent occurrence, so those counties and some of the surrounding counties will be targeted for work.
- New Hanover and Brunswick counties will be targeted due to a New Hanover record.
- UNC-Greensboro has identified one NLEB call in Bladen County, so it was selected.
- UNCG researchers felt that the swath of counties between New Hanover and Washington would be good to survey, so counties such as Duplin, Onslow, Pitt and Beaufort will be targeted.
- The following areas were avoided based on negative data: Uwharrie National Forest and Fort Bragg.

Proposed Acoustic Locations for 2015 (rational for selection is indicated below each county)

1. Bladen – Bladen Lakes State Forest
   One county acoustic record from UNCG
2. Currituck – North River Gameland
   Proximity to known NLEB capture sites
3. Gates (or Camden/Pasquotank) - Great Dismal Swamp National Wildlife Refuge
   Proximity to known NLEB capture sites
4. Hertford – Chowan Swamp Gameland (some of the gameland may fall in an NABat priority site)
   Proximity to known NLEB capture sites
5. Lee (or Chatham) – CP&L Gameland (selecting Chatham will hit part of an NABat priority site)
   NLEB capture record for Lee County
6. New Hanover – NCDOT Murrayville Mitigation Site
   NLEB rabies record for New Hanover County
7. Tyrell – Palmetto-Peartree Reserve (some of which falls in an NABat priority site)
   Proximity to known NLEB capture sites
8. Wake – Swift Creek Bluffs, Triangle Land Conservancy
   Historic NLEB record for Wake County
9. Washington - Pocosin Lakes National Wildlife Refuge
   Proximity to known NLEB capture site
10. Wayne – Waynesborough State Park (on Neuse River)
    Lack of data from this area of the state; proposed NCDOT Goldsboro bypass project

Locations will be further refined based on a variety of good habitat types. Locations at state parks, national wildlife refuges, and large NCDOT mitigation properties will be prioritized for sampling, as they should be amenable to repeated monitoring and, if NLEBs are determined to be present, can help provide species conservation measures. Locations will be selected to provide a wide array of vegetative communities and management/disturbance regimes. Because of logistical constraints associated with intensive mist-netting and day-roost research, these efforts will be concentrated initially in and around Camden, Washington and Currituck counties, where NLEB are known to occur.

The North American Bat Monitoring Program (NABat; https://www.fort.usgs.gov/science-tasks/2457) sampling design and protocols will be followed to the extent possible. The NABat sampling frame consists of a GIS-generated sampling grid across North America of 10x10 km grid cells. Two to four stationary sampling sites are established within each cell and are sampled two times/summer within the same week. Following repeatable protocols in a nationally standardized context will allow comparison within and between states and regions and can reveal trends across broad landscape scales. NABat will establish population baselines from which anticipated declines from white-nose syndrome and other threats can be documented and will provide information about bat populations within NC.

Acoustic monitoring results will be used to determine where mist-netting should be targeted. Acoustic data collected as a result of NCDOT research could be used to develop northern long-eared bat predictive habitat models. Modeling will not be conducted by NCDOT, but NCDOT will cooperate with other agencies wishing to use our data to develop models.

2. Mist-netting/telemetry

NLEBs will be netted over water, forest edges, and forested roads and outfitted with radio-transmitters. The bats will be radio-tracked to day-roosts to describe roost and site characteristics following the methods of Perry and Thill, (2007). Mist netting/telemetry in the northeastern part of the state (around Camden, Currituck and Washington counties) can begin concurrently with acoustic work in early 2015 and can expand to other areas of eastern NC over time, depending on the acoustic results. If mist-netting is not as productive as we anticipate (few NLEB captures), resources can be reallocated for more acoustic work. The initial assumption is that there will be positive acoustic results to justify mist-netting at least 15 locations in the eastern half of NC. This 15-location estimate is based on known occurrences and negative survey results, while anticipating that ideally, mist-netting should occur in enough locations to provide data from all regions of eastern NC. The target season for most netting will be in the fall, with the intent of tracking bats to their winter roosts. Some summer netting may be conducted as well if requested by USFWS, which would allow data to be collected on reproductive status and summer roosts.

Assume at least five locations will be surveyed with mist-nets each year for three years, with 8 nights of surveying per location, for a minimum of 120 survey nights. If 25 locations are netted eight nights each (67 nights of mist-netting a year over a three-year period), two hundred survey nights will be conducted. Mist-netting will be coordinated with UNCG researchers, who will be conducting NLEB work around Camden and Washington counties in 2015.

Telemetry will be used to collect information about roost types and locations. For telemetry, assume that up to 100 NLEBS will be captured and transmittered throughout the five year programmatic duration, for a minimum of 8400 hours of telemetry (100 bats x 4 hours a day x 21 days), assuming sufficient numbers of bats are captured.

Allowing for the possibility that up to 50 NLEB roost sites will be found, each roost will be inspected at least four times a year for two years to determine summer/winter usage. Emergence counts may be conducted instead of physically entering roosts. Collecting data on winter presence and roosting habitat will prioritized over collecting summer data (e.g. 2/3 effort on winter data, 1/3 effort on summer data). If 100 NLEB roosts are found, a total of 800 roost inspections/emergence counts will be conducted.

Methods:

- Nets will remain open at least five hours a night (pre-dawn netting can count towards the five hours).
- There will be a 46 degree cut-off for mist-netting, based on insect activity results from Taylor (1963).
- Each bat will be tracked for at least 4 hours a day for 3 weeks, (unless the transmitter falls off or stops working prior to that point).
- Each roost will be inspected (or an emergence count will be conducted) at least four time a year: twice in summer and twice in winter.
- The following data will be collected at each roost: tree species, diameter at breast height (dbh), roost height, cavity description, total tree height, tree condition (live vs snag), and tree location. If the roost is in a site other than a tree, the site will be described.
- The natural community surrounding each roost tree will be typed according to Schafale (2012).
- Habitat surrounding each roost will be characterized in a 17.8-m radius (0.1-ha) plot centered on the roost tree with a tally of all woody stems >1 m tall and <5 cm dbh. Woody stems (including snags) >1 m tall and >5 cm dbh will be recorded by dbh and species. Canopy cover will be measured at four locations along the outer edge of each plot using a spherical densitometer (Perry and Thill, 2007).
- To determine site characteristics that may have affected roost selection, data will also be collected at random sites and compared with roost plots.

It should be noted that in addition to the above mist-netting and acoustic work, NCDOT may also conduct NLEB surveys for one or two new location projects in eastern North Carolina in early 2015.

3. White-nose Syndrome Data Collection

Data collection to determine the presence/extent of WNS will be coordinated with the North Carolina Wildlife Resources Commission (NCWRC) so as not to duplicate efforts. If winter roosts are located and the bats can be accessed safely, they will be swabbed in winter for *Pseudogymnoascus destructans*. Some winter/early spring mist-netting may be conducted at the request of USFWS in order to collect data on WNS occurrence. In the unlikely event fungal growth is observed on bats during the summer, photographs and wing punches will be collected. The Reichard Wing Damage Index should be recorded for all bats regardless of season, and bats with score of 2 or 3 will be photographed per North Carolina's White-nose Syndrome Surveillance and Response Plan (2013). Swabs and wing punches will be sent to the Southeast Cooperative Wildlife Disease Study lab for analysis.

4. Bridge and Structure Surveys

Bridge and structure surveys will be conducted to determine if NLEB use them for roosting in eastern NC, and if so, how often, what types of structures are used, and for which seasons. These surveys will focus initially around Camden and Washington counties, expanding into other counties as acoustic surveys dictate. A variety of bridge types will be selected for surveying: concrete slab, cast-in-place, steel deck, concrete beam, wooden, etc. Large culverts will also be surveyed.

Data will be collected from 200 bridges/culverts throughout the 5 year duration. Some bridge data may be compiled from existing NCDOT records. Bridge surveys will be conducted primarily in summer, but some surveys may also be conducted in winter to look for potential winter roosts. If a bridge has evidence of significant bat use, that structure will be checked again to collect data on seasonal use. Buildings capable of housing bats (abandoned houses, barns, sheds, etc.) will be surveyed opportunistically.

5. Reporting and Decision-making Process

NCDOT will develop monitoring methods and locations with technical advice from advisors from state and federal resource agencies and from academia. Their recommendations will be considered by the research group. The group will consist of staff from the NCDOT Biological Surveys Group, and representatives from USFWS, NCWRC and FHWA. The US Army Corps of Engineers (USACE) will remain informed as the research progresses, but has chosen to be silent member of the group. NCDOT will provide quarterly reports to USFWS, FHWA, NCWRC and USACE throughout the duration of the five year research study, and meetings will be held at least twice a year to provide results, to plan for future efforts, and to maintain coordination between agencies. Work will begin in 2015 and will be completed by the end of 2019. Final reports will be due by April 2020.

Products

Levels of effort for the various objectives may vary somewhat as the work progresses, if the research group determines it is appropriate. For example, if mist-netting proves to be rather unproductive, less effort will be needed for telemetry, freeing up more resources for acoustic surveys.

Initial mist-netting and acoustic planning/installation
Year-round acoustic surveys
Acoustic data interpretation and analysis
Northern long-eared netting and tracking
Roost data collection
WNS swabbing results
Quarterly reports
Preparation and submittal of final acoustical activity report
Preparation and submittal of final tracking/roost report
Final report

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APPENDIX D

ACTIVITY EFFECTS ANALYSIS SPREADSHEET

Activity Effects Analysis - New Construction (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	**clean water sources, insects**	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse direct effect or indirect	**Fill, Excavate** new opening direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or Indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent Loss of Roost Site**	**Noise, Vibration, Disturbance** at bridge or structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** *potential for all activities involving vehicles, equipment*	**Loss or Degradation** (sedimentation, fill, piping of streams)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**	**Sub-subactivity (source)**															
All	Vehicle and Heavy Equipment Use		May Affect	May Affect	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	NE	NE	NE
Staging Areas/Site Prep	Lighting	Outdoor Lighting Construction	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE
Staging Areas/Site Prep	Lighting	Portable Lighting (temporary)	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect - generators	May Affect	NE	NE	NE	NE
Staging Areas/Site Prep	Portable Fence Installation/ Removal		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Tree Clearing		NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect - chainsaw	NE	NE	May Affect	May Affect - dust	May Affect
Staging Areas/Site Prep	Shrubs/herbaceous veg clearing		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	May Affect - dust	NE
Staging Areas/Site Prep	Burn Vegetation Onsite		NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Haul Vegetation Offsite		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Use of Disposal Areas (terrestrial)		NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Redistribute Vegetation Onsite (mulch or salvage)		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Temporary Field Office		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE
Staging Areas/Site Prep	Grubbing		NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	May Affect - dust	NE
Staging Areas/Site Prep	Grading (cutting, filling, earthwork)		NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	May Affect - dust	NE
Staging Areas/Site Prep	Gravel workspace		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Temporary Access Road Construction - install geotextile fabric and rock		NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	May Affect	NE
Staging Areas/Site Prep	Rock Removal - Blasting (very uncommon)		NE	May Affect	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect- hot rock exposure	NE	May Affect - dust	NE
Staging Areas/Site Prep	Debris or Rock Disposal		NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Staging Areas/Site Prep	Dust Control (Road/Exposed Soil Pre-watering)		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect -positive - dust control	NE
Staging Areas/Site Prep	Install Erosion and Sediment Control BMPs (silt fence, check dams, sediment basin, temporary seeding)		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect - positive	NE	N

Activity Effects Analysis - New Construction (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	**clean water sources, insects**	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse direct effect or indirect	**Fill, Excavate** new opening direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or Indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent Loss of Roost Site**	**Noise, Vibration, Disturbance** at bridge or structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** *potential for all activities involving vehicles, equipment*	**Loss or Degradation** (sedimentation, fill, piping of streams)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**	**Sub-subactivity (source)**															
Staging Areas/Site Prep	Wetland fill		NE	NE	NE	May Affect- altered site hydrology	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - fill	NE	NE
Staging Areas/Site Prep	Debris Removal		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	May Affect	NE
Staging Areas/Site Prep	Blasting		NE	May Affect	May Affect	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect- Hot Rock Exposure	NE	May Affect - dust	NE
Staging Areas/Site Prep	Structure Demolition (other than bridge, e.g., house)		NE	May Affect	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	NE	NE	NE	May Affect - dust	NE
Staging Areas/Site Prep	Install Drainage Features	Isolate, Stream Diversion, Dewater	NE	NE	NE	May Affect- altered site hydrology	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Excavation (pipe trench, ditch creation & stream relocation if necessary)	NE	May Affect	May Affect	May Affect- altered site hydrology	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Culvert Jacking or Drilling	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Lay Pipe and Cover	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Headwall Construction - retaining wall on outlet side of flow diversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Install Armoring	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Regrade Stream, Place Bed Material/Habitat Features	NE	NE	NE	May Affect- altered site hydrology	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Install Drainage Features	Restore Flow	NE	NE	NE	May Affect- altered site hydrology	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect - piping of streams OR sedimentation	NE	NE
Staging Areas/Site Prep	Utility Lines	Utility Relocation or Placement – Above Ground	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE

Activity Effects Analysis - New Construction (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	**clean water sources, insects**	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse direct effect or indirect	**Fill, Excavate** new opening direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or Indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent Loss of Roost Site**	**Noise, Vibration, Disturbance** at bridge or structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** *potential for all activities involving vehicles, equipment*	**Loss or Degradation** (sedimentation, fill, piping of streams)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**	**Sub-subactivity (source)**															
Staging Areas/Site Prep	Utility Lines	Utility Relocation or Placement – Below Ground (trenching or horizontal bore or directional)	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect - potential frac out	May Affect - sedimentation	NE	NE
Staging Areas/Site Prep	Pre-watering of Roads and Exposed Areas in for Dust Control or Grading		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect -positive-dust control	NE
Offsite Use Areas	Borrow Sites		NE	May Affect	May Affect	May Affect- altered site hydrology	NE	May Affect	NE	NE	NE	May Affect	NE	NE	NE	May Affect	May Affect
Offsite Use Areas	Waste Disposal Sites		NE	May Affect	May Affect	May Affect- altered site hydrology	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	May Affect	May Affect
Road Surface, Bike/Ped Facility Construction	Construct Stormwater Facilities		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect - positive	NE	NE
Road Surface, Bike/Ped Facility Construction	Final Grading and Road/Trail Bed Preparation		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect - dust	NE
Road Surface, Bike/Ped Facility Construction	Road Median Construction – Barrier Wall		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Road Surface, Bike/Ped Facility Construction	Construct Retaining Wall (mechanically stabilized earth, soil nail, sheet pile, etc.)		NE	May Affect	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Road Surface, Bike/Ped Facility Construction	Course Aggregate Application, Concrete or Asphalt Application		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect - dust	NE
Road Surface, Bike/Ped Facility Construction	Striping, Pavement Markers and Signage		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Road Surface, Bike/Ped Facility Construction	Guard Rail Installation		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Road Surface, Bike/Ped Facility Construction	Noise Wall Construction		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect, but potential positive effect post-construction	NE	NE	NE	NE	NE
Road Surface, Bike/Ped Facility Construction	Sidewalk, Curb and Gutter Installation		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect - run-off from gutter	NE

Activity Effects Analysis - New Construction (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	**clean water sources, insects**	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse direct effect or indirect	**Fill, Excavate** new opening direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or Indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent Loss of Roost Site**	**Noise, Vibration, Disturbance** at bridge or structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** *potential for all activities involving vehicles, equipment*	**Loss or Degradation** (sedimentation, fill, piping of streams)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**	**Sub-subactivity (source)**															
New Rail Construction - adding parallel line	Subgrade Installation - build up ballast/railbed		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect - sedimentation	May Affect - dust	NE
New Rail Construction - adding parallel line	Lay Track		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Bridge Construction (new, replace, widen existing)	Barge Use		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Construction (new, replace, widen existing)	Temporary Work Trestle/Detour bridge/Causeway Construction and Removal	Impact/vibratory Pile Driving	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	May Affect - sedimentation, fill	NE	NE
Bridge Construction (new, replace, widen existing)	Temporary Work Trestle/Detour bridge/Causeway Construction and Removal	Deck Installation	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Construction (new, replace, widen existing)	Temporary Work Trestle/Detour bridge/Causeway Construction and Removal	Remove Piles (vibratory hammer, direct pull, etc.)	NE	May Affect- vibration	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Bridge Demolition (for replacement)	Work Area Isolation (cofferdam installation [casing, sheet pile, etc.], impact/vibratory pile driving, dewatering)	NE	May Affect- vibration	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Bridge Demolition (for replacement)	Remove Piles, Footings, Piers, Bridge Decking, railbed, etc.	NE	May Affect	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Bridge Demolition (for replacement)	Pile Removal (vibratory pile driver, clamshell bucket, containment boom)	NE	May Affect- vibration	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Bridge Demolition (for replacement)	Wire Saw Concrete Cutting, Crane Use	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	NE	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Bridge Demolition (for replacement)	Hoe Ram Use, Debris Containment, Excavation	NE	May Affect- vibration	May Affect	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE

Activity Effects Analysis - New Construction (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	**clean water sources, insects**	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse direct effect or indirect	**Fill, Excavate** new opening direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or Indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent Loss of Roost Site**	**Noise, Vibration, Disturbance** at bridge or structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** *potential for all activities involving vehicles, equipment*	**Loss or Degradation** (sedimentation, fill, piping of streams)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**	**Sub-subactivity (source)**															
Bridge Construction (new, replace, widen existing)	Substructure Construction (piers, shafts, shaft caps, footings, abutments, foundations)	Drilled Shaft Construction (auger drills hole within casing) or impact pile driving	NE	May Affect- vibration	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Substructure Construction (piers, shafts, shaft caps, footings, abutments, foundations)	Work Area Isolation (cofferdam installation, impact or vibratory pile driving, dewatering)	NE	May Affect- vibration	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Substructure Construction (piers, shafts, shaft caps, footings, abutments, foundations)	Install Casing, Rebar	NE	May Affect	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	NE - done in area that has been isolated (in the dry)	NE	NE
Bridge Construction (new, replace, widen existing)	Substructure Construction (piers, shafts, shaft caps, footings, abutments, foundations)	Pour Concrete	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE - done in area that has been isolated (in the dry)	NE - done in area that has been isolated (in the dry)	NE	NE
Bridge Construction (new, replace, widen existing)	Substructure Construction (piers, shafts, shaft caps, footings, abutments, foundations)	Spread Footing Construction	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE - done in area that has been isolated (in the dry)	NE - done in area that has been isolated (in the dry)	NE	NE
Bridge Construction (new, replace, widen existing)	Substructure Construction (piers, shafts, shaft caps, footings, abutments, foundations)	Riprap Installation	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - sedimentation	NE	NE
Bridge Construction (new, replace, widen existing)	Superstructure Construction	Pier Tables, Cantilevers, Decking, etc. Crane Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	NE	NE	NE
Post-construction work	Temporary BMP Removal (silt fence, check dam, sediment basin)		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Post-construction work	Fence installation		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Post-construction work	Landscaping/ Beautification/ Site Stabilization		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Post-construction work	Install post-construction stormwater BMPs		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect - positive	NE	NE
Billboard Permit Granting	Tree & Vegetation Clearing (more limited than for road construction)		NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect - chainsaw	NE	NE	NE	NE	May Affect
Billboard Permit Granting	Billboard Installation		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Billboard Permit Granting	Billboard Lighting		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE

Activity Effects Analysis - New Construction (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	**clean water sources, insects**	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse direct effect or indirect	**Fill, Excavate** new opening direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or Indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent Loss of Roost Site**	**Noise, Vibration, Disturbance** at bridge or structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** *potential for all activities involving vehicles, equipment*	**Loss or Degradation** (sedimentation, fill, piping of streams)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**	**Sub-subactivity (source)**															
The Road as a Structure	The Road as a Structure (temporary and permanent)		May Affect - new roads, widening, more lanes, raise road profile	May Affect- new roads may increase site access and human disturbance	NE	May Affect - increased impervious surface	NE	NE	NE	NE	NE	May Affect - if change in speed/capacity from baseline	NE	May Affect - runoff and small spills	NE	May Affect - maintenance using deicers & herbicides	NE
Lights as Structures	Lights as Structures		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE
Bridge as a Structure	Bridges as Structures		May Affect - if new or widened bridge, or raised road profile	NE	NE	NE	NE	NE	NE	NE	May Affect - if change in speed/capacity from baseline	May Affect - if change in speed/capacity from baseline	NE	May Affect - runoff and small spills	NE	May Affect - maintenance using deicers & herbicides	NE

Activity Effects Analysis - Safety and Mobility Improvement (Category)

Activities not covered in New Construction	Resources - simplified	NA	Hibernacula	Hibernacula	Hibernacula	Natural roosts	Natural roosts	Artificial roosts (bridges/ structures)	Artificial roosts (bridges/ structures)	Artificial roosts (bridges/ structures)	Roosting and foraging habitat	Roosting and foraging habitat	Drinking water, aquatic foraging habitat	Drinking water, aquatic foraging habitat	Drinking water, aquatic foraging habitat	Roosting and foraging habitat
	General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	clean water sources, insects	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
	Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse- direct or indirect	**Fill, Excavate** direct effect (crush bats) or indirect	**Flooding** direct effect (drown bats) or indirect (alter hib)	**Smoke Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge/ structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**															
All	Vehicle and Heavy Equipment Use	See PREVIOUS WORKSHEET - New Construction														
Intelligent Transportation Systems	Sign/camera installations	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Railroad Protective Device Installation	Sign/gate/lights installation	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Railroad Grade Separation	Staging Areas & Project Site Prep	See PREVIOUS WORKSHEET-New Construction														
Railroad Grade Separation	Install Drainage Features	See PREVIOUS WORKSHEET - New Construction														
Railroad Grade Separation	Utility Lines	See PREVIOUS WORKSHEET - New Construction														
Railroad Grade Separation	Pre-watering of exposed areas in construction site for dust control or grading	See PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Construct Stormwater Facilities	See PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Final grading and road/rail bed preparation	See Final Grading and Road/Trail Bed Preparation from PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Roadway Overpass/Underpass Construction	See Bridge Construction from PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Retaining wall (mechanically stabilized earth, soil nail, sheet pile, etc.) construction	See PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Course aggregate application, concrete or asphalt application	See PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Striping, pavement markers and signage	See PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Railroad Crossing Gate Installation	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Road bed, railroad bed prep and construction	Guard rail installation	See PREVIOUS WORKSHEET - New Construction														
Road bed, railroad bed prep and construction	Sidewalk, curb and gutter construction	See PREVIOUS WORKSHEET - New Construction														
Post-construction work	Temporary BMP Installation/ Removal (silt fence, check dam, sediment basin)	See PREVIOUS WORKSHEET - New Construction														

Activity Effects Analysis - Safety and Mobility Improvement (Category)

Activities not covered in New Construction	**Resources - simplified**	**NA**	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
	General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	clean water sources, insects	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
	Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance and collapse- direct or indirect	**Fill, Excavate** direct effect (crush bats) or indirect	**Flooding** direct effect (drown bats) or indirect (alter hib)	**Smoke Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge/ structure	**Noise** construction, road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**															
Signal System Improvements		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Activity Effects Analysis - Maintenance and Presevation (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**All - hib, roosting, foraging, travel areas**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	clean water sources, insects	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise Vibration** may cause disturbance and collapse- direct or indirect	**Fill Excavate** direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or indirect (alter hib)	**Smoke Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** (direct effects - at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge/ structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity	**Subactivity**	**Sub-subactivity**															
All	Vehicle and Heavy Equipment Use		See PREVIOUS WORKSHEET - New Construction														
Bridge Painting	Construct Scaffoldling		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Painting	Install Full Containment (includes vacuum system for capturing wash water)		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Painting	Pressure Wash Bridge (graffiti removal)		NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Painting	Sandblast Bridge		NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Painting	Prime/Paint Bridge		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Painting	Remove Containment and Scaffolding		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Install Scaffolding and Containment		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Replace Rivits, Degraded steel, Bridge railing, Joint Seals, bearing work		NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Seal Cracks (shotcrete)		NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Repair Concrete Spalling		NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Repair Bridge Approaches		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Repair/Replace Electrical System		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Bridge Deck Replacement (e.g., concrete, timber)	Install Scaffolding and Containment	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Bridge Deck Replacement (e.g., concrete, timber)	Mill, Break up, or use Hydrodemolition to Remove Existing Deck	NE	May Affect	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Bridge Deck Replacement (e.g., concrete, timber)	Use Vacuum Truck or Sweeper to Remove Debris	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Bridge Deck Replacement (e.g., concrete, timber)	Repair/Replace Finger Joints	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Bridge Deck Replacement (e.g., concrete, timber)	Pour New Deck	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Bridge Deck Replacement (e.g., concrete, timber)	Remove Containment and Scaffolding	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Divert Flow, Dewater	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Clean Culvert	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	May Affect	May Affect	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Install Culvert Liner (Complete or Invert)	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Patch Repair (Metal or Concrete, Coat and Seal)	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Headwall or Outfall Repair (Concrete Work or Riprap Installation)	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Repair Joints (Band Installation, Inject Grout)	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Line with Shotcrete or Gunnite	NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	May Affect	NE	NE	NE
Bridge Rehab	Culvert Cleaning/Repair	Sandblast/Repaint/ Recoat	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	May Affect	NE	NE	NE
Drainage Improvement	Clean and Reshape Ditches (remove vegetation, sediment, debris)		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	NE

Activity Effects Analysis - Maintenance and Presevation (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**All - hib, roosting, foraging, travel areas**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	clean water sources, insects	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise Vibration** may cause disturbance and collapse- direct or indirect	**Fill Excavate** direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or indirect (alter hib)	**Smoke Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** (direct effects - at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge/ structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity	**Subactivity**	**Sub-subactivity**															
Drainage Improvement	Culvert Repair Work (as previously described		See Above														
Drainage Improvement	Clean Catch Basins/Inlets (manually or vacuum truck)		NE	NE	NE	NE	NE	NE	NE	NE	May Affect - catch basins on bridges	May Affect	NE	NE	NE	NE	NE
Drainage Improvement	Remove Beaver Dams from Culvert Ends		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Drainage Improvement	Remove Sediment from Retention/Detention Facilities		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect - positive	NE	NE
Drainage Improvement	Dispose of Debris and Vegetation		NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Guardrail Replacement	Remove Damaged Guardrail		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Guardrail Replacement	Install Posts w/Post Driver		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Guardrail Replacement	Install Steel Beam		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Overlay	Apply Tack Coat and New Pavement Layer		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Pavement Rehab/Chip Seal	Seal Cracks w/Liquid Asphalt		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Pavement Rehab/Chip Seal	Blanket Application of Liquid Asphalt		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Pavement Rehab/Chip Seal	Apply Aggregate		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Pavement Rehab/Chip Seal	Finish w/Power Roller		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Resurfacing	Grind (mill) Existing Pavement		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Resurfacing	Collect and Dispose of Pavement Grindings/Slurry		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Resurfacing	Dowel Bar Placement (if concrete)		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Resurfacing	Apply New Pavement		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Herbicide Spraying within ROW			NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect	May Affect
Mowing			NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Branch/Limb Removal along ROW			NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect	NE	NE	NE	NE	May Affect
Hazard tree removal			NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect	NE	NE	NE	NE	May Affect
Repair ROW fence			NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Facility Rehabilitation	Install/remove Erosion and Sediment Control BMPs		See PREVIOUS WORKSHEET - New Construction														
Facility Rehabilitation	Minor Vegetation Removal		NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	NE	NE	May Affect
Facility Rehabilitation	Overlay, Paving		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Facility Rehabilitation	Excavation		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Facility Rehabilitation	Septic Upgrades		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Facility Rehabilitation	Herbicide Application		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE
Facility Rehabilitation	Painting/Striping/ Signing		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Facility Rehabilitation	Rehab historic rail buildings & other non-bridge structures		NE	NE	NE	NE	NE	NE	May Affect	May Affect	May Affect	May Affect	NE	NE	NE	NE	NE
Reconstruct Existing Rail	Install new rail, concrete ties, and resurface stone ballast		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE

Activity Effects Analysis - Maintenance and Presevation (Category)

		Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**All - hib, roosting, foraging, travel areas**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
		General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	clean water sources, insects	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
		Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise Vibration** may cause disturbance and collapse- direct or indirect	**Fill Excavate** direct effect (crush bats) or indirect (alter hib)	**Flooding** direct effect (drown bats) or indirect (alter hib)	**Smoke Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** (direct effects - at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge/ structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity	**Subactivity**	**Sub-subactivity**															
Reconstruct Existing Rail	Pavement resurfacing at crossings and approaches		NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE
Reconstruct Existing Rail	Upgrade signals and warning systems		NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Snow Removal/Deicers			NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE
Bridge Inspections (human presence)			NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	NE
Portable Lighting			See PREVIOUS WORKSHEET - New Construction														

Activity Effects Analysis - Disaster Response, Bank Stabilization and Sinkhole Repair (Category)

	Resources - simplified	NA	Hibernacula	Hibernacula	Hibernacula	Natural roosts	Natural roosts	Artificial roosts (bridges/ structures)	Artificial roosts (bridges/ structures)	Artificial roosts (bridges/ structures)	Roosting and foraging habitat	Roosting and foraging habitat	Drinking water, aquatic foraging habitat	Drinking water, aquatic foraging habitat	Drinking water, aquatic foraging habitat	Roosting and foraging habitat
	General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	Clean water sources, insects	Clean water sources, insects	Clean water sources, insects	forest patches and travel corridors
	Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance & collapse - direct effect or indirect	**Fill, Excavate** can be direct effect (crush bats) or indirect (alter hib)	**Flooding** can be direct effect (drown bats) or indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent loss of roost site**	**Noise, Vibration, Disturbance** at bridge/ structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** - potential for all activities involving vehicles/ machinery	**Loss or degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**															
All	Vehicle and Heavy Equipment Use	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Debris Removal	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Construct Temporary Access Road	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Construct Temporary Bridge	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Grading	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Install/Remove Temporary Erosion Control BMPs	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Barge Use	See PREVIOUS WORKSHEET - New Construction														
Disaster Response	Road Reconstruction (rebuild roadbed, add drainage structures, repave, paint) - putting things back with minor changes	See Road Surface, Bike/Ped Facility Prep and Construction in PREVIOUS WORKSHEET - New Construction														
Disaster Response	Fill newly created breaches (in causeways, roadways, etc.)	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	May Affect	NE
Disaster Response	Sandbag installation/replacement	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	NE
Disaster Response	Water removal (pumping water from flooded areas)	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect	NE	NE
Bank Stabilization /Flood Damage /Scour Repair	Culvert Cleaning/Repair	See PREVIOUS WORKSHEET - Maintenance and Preservation														
Bank Stabilization /Flood Damage /Scour Repair	Disposed of Debris and Vegetation	See PREVIOUS WORKSHEET - Maintenance and Preservation														
Bank Stabilization /Flood Damage /Scour Repair	Construct Temporary Access Road	See PREVIOUS WORKSHEET - New Construction														
Bank Stabilization /Flood Damage /Scour Repair	Tree Clearing/Vegetation Clearing	See PREVIOUS WORKSHEET - New Construction														
Bank Stabilization /Flood Damage /Scour Repair	Haul Vegetation off Site	See PREVIOUS WORKSHEET - New Construction														
Bank Stabilization /Flood Damage /Scour Repair	Grading (earthwork)	See PREVIOUS WORKSHEET - New Construction														
Bank Stabilization /Flood Damage /Scour Repair	Riprap Installation	See PREVIOUS WORKSHEET - New Construction														
Bank Stabilization /Flood Damage /Scour Repair	Willow Staking	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect - positive	NE	NE
Bank Stabilization /Flood Damage /Scour Repair	Instream Structure Installation (weirs, barbs, logjams, etc.)	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect	May Affect - sedimentation but also potential beneficial effects	NE	NE
Bank Stabilization /Flood Damage /Scour Repair	Landscaping/Site Stabilization	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect - positive	NE	NE
Bank Stabilization /Flood Damage /Scour Repair	Install/Remove Temporary Erosion Control BMPs	See PREVIOUS WORKSHEET - New Construction														
Sinkhole Repair	Excavate and/or flush loose material	NE	NE	May Affect	May Affect	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	NE	NE
Sinkhole Repair	Place non-concrete fill material	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	NE	NE
Sinkhole Repair	Place concrete fill	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	NE	NE
Sinkhole Repair	Compact fill	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	NE	NE

Activity Effects Analysis - Disaster Response, Bank Stabilization and Sinkhole Repair (Category)

	Resources - simplified	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
	General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	Clean water sources, insects	Clean water sources, insects	Clean water sources, insects	forest patches and travel corridors
	Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance & collapse - direct effect or indirect	**Fill, Excavate** can be direct effect (crush bats) or indirect (alter hib)	**Flooding** can be direct effect (drown bats) or indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent loss of roost site**	**Noise, Vibration, Disturbance** at bridge/ structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills, Contaminants** - potential for all activities involving vehicles/ machinery	**Loss or degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**															
Sinkhole Repair	Restore roadway	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	May Affect	NE	NE
All	Portable Lighting	See PREVIOUS WORKSHEET - New Construction														

Activity Effects Analysis - Transportation Enhancements (Category)

These activities may require staging areas, similar to New Construction. That breakdown is not	**Resources - simplified**	NA	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
repeated here to reduce redundancy.	**General Parameters**	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	clean water sources, insects	clean water sources, insects	clean water sources, insects	forest patches and travel corridors
	Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise Vibration** may cause disturbance & collapse- direct effect or indirect	**Fill Excavate** direct effect (crush bats) or indirect (alter hib)	**Flooding** can direct effect (drown bats) or indirect (alter hib)	**Smoke Heat** direct effects consider hib and summer	**Crushing** direct effects at natural roosts	**Crushing** direct effects at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge /structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, Fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**															
All	Vehicle and Heavy Equipment Use	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Portable Lighting	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Lights as a structure	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Portable Fence Installation/Removal	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Staging Area/Site Prep	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Install Drainage Features	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Utility Lines	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Pre-watering of Roads and Exposed Areas in Construction Site for Dust Control or Grading	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Road and Parking Lot Surface Preparation and Construction	See Road Surface, Bike/Ped Facility Prep and Construction in PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Construct Stormwater Facilities	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Final Grading and Road/Parking Lot Bed Preparation	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Construct Retaining Wall (MSE, soil nail, sheet pile, soldier pile, etc.)	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Course Aggregate Application, concrete or asphalt application	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Striping, Pavement Markers and Signage	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Guard Rail Installation	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Sidewalk Installation	See PREVIOUS WORKSHEET - New Construction														
Construct turnouts, overlooks, historic markers, viewpoints*	Information Kiosk & Historic Marker Construction	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE
Construct turnouts, overlooks, historic markers, viewpoints*	Post-construction work	See PREVIOUS WORKSHEET - New Construction														

*Activities are generally consistent with new roadway construction, however these projects are much smaller in scale typically (less vegetation removal, disturbance, etc).

Activity Effects Analysis-Conservation Measures (Category)

	Resources - simplified	**NA**	**Hibernacula**	**Hibernacula**	**Hibernacula**	**Natural roosts**	**Natural roosts**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Artificial roosts (bridges/ structures)**	**Roosting and foraging habitat**	**Roosting and foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Drinking water, aquatic foraging habitat**	**Roosting and foraging habitat**
	General Parameters	NA	low noise levels, safety	suitable roosting location	suitable roosting location	NA	NA	NA	suitable roosting location	low-mod noise levels, safety	low-mod noise levels, safety	low-mod light levels, safety	Clean water sources, insects	Clean water sources, insects	Clean water sources, insects	forest patches and travel corridors
	Stressor	**Collision** bats not anticipated to collide with structures or slow-moving vehicles	**Noise, Vibration** may cause disturbance & collapse- direct or indirect effect	**Fill, Excavate** direct effect (crush bats) or indirect (alter hib)	**Flooding** can be direct effect (drown bats) or indirect (alter hib)	**Smoke, Heat** direct effects consider hib and summer	**Crushing** direct effects	**Crushing** direct effects at artificial roosts	**Permanent loss of roost site**	**Noise Vibration Disturbance** at bridge/ structure	**Noise** Construction, Road use (e.g., increase capacity) - baseline noise vs. new activity noise	**Light**	**Spills Contaminants -** potential for all activities involving vehicles/ machinery	**Loss or Degradation** (sedimentation, fill)	**Degradation** (dust, deicers, herbicides)	**Loss, fragmentation** (tree removal)
Activity (source)	**Subactivity (source)**															
NLEB Research Project*	Human Activity	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	NE
NLEB Research Project*	Vehicles	May Affect	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NLEB Research Project*	Bat Surveys/Captures	Addressed through ESA10(a)(1)(A) permits														
Construct Wildlife Passage Facilities (overpass, underpass, culverts)	Construction	See Bridge Construction & Install Drainage Features in PREVIOUS WORKSHEET - New Construction														
Construct Wildlife Passage Facilities (overpass, underpass, culverts)	Final grading wildlife trail bed preparation	See Final Grading and Road/Trail Bed Prep in PREVIOUS WORKSHEET - New Construction														
Construct Wildlife Passage Facilities (overpass, underpass, culverts)	Post-construction work	See PREVIOUS WORKSHEET - New Construction														
Wildlife Passage as a Structure		May Affect - positive - bats may use crossing	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect - positive - may provide connectivity
Stormwater Treatment	Install detention/ retention basin	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	May Affect - positive	May Affect - positive	NE
Stormwater Treatment	Develop pollution prevention plan	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect-positive	May Affect-positive	May Affect-positive	NE
Stream and Wetland Mitigation	Restoration of hydrology and vegetation to wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	NE	May Affect-positive	May Affect-positive	May Affect-positive	May Affect-positive
Stream and Wetland Mitigation	Bank stabilization and in-channel habitat restoration of streams	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect	NE	NE	May Affect - sedimentation, but positive effects too	NE	NE
Stream and Wetland Mitigation	Reforestation of riparian buffers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect-positive	May Affect-positive
Endangered Plant Conservation	Thinning (tree removal) - very limited use	NE	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	NE	NE	May Affect - positive- girdled trees may provide roosts sites once they die
Endangered Plant Conservation	Prescribed burning - very limited use	NE	NE	NE	NE	May Affect	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Endangered Plant Conservation	Invasive plant control, including manually applied herbicides	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	May Affect	May Affect - positive- controlling invasives vines & shrubs may enhance habitat

* Data from this research will be beneficial to NLEB as it can be used to target the most effective means to manage and protect NLEB in eastern North Carolina.