

APPENDIX D

BIOLOGICAL RESOURCES

This appendix contains the following:

- FAA Letter to USFWS October 19, 2022
- USFWS Concurrence letter November 15, 2022
- Biological Resources Assessment

THIS PAGE LEFT INTENTIONALLY BLANK



U.S. Department
of Transportation
**Federal Aviation
Administration**

Memphis Airports District Office
2600 Thousand Oaks Boulevard
Suite 2250
Memphis, TN 38118-2486
Phone: 901-322-8180

October 19, 2022

Ms. Kathryn Matthews
NC Renewable Energy Coordinator &
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
PO Box 33726
Raleigh, NC 27636-3726

Dear Ms. Matthews:

**RE: NEPA Review for Proposed Project
Raleigh-Durham International Airport (RDU)
Wake and Durham Counties, North Carolina**

The Federal Aviation Administration (FAA) Memphis Airports District Office is reviewing a proposed project sponsored by the Raleigh-Durham Airport Authority (Airport Sponsor) at the Raleigh-Durham International Airport (RDU) in Wake and Durham Counties in NC. The proposed action, which is being reviewed pursuant to National Environmental Policy Act (NEPA), features building a replacement runway, adjacent taxiway and associated infrastructure.

The Proposed Action includes relocating Runway 5L/23R approximately 537 feet northwest of existing Runway 5L/23R and, after construction is complete, converting the existing Runway 5L/23R to a taxiway. The project also includes use of fill material from Airport borrow sites, use of water from Brier Creek Reservoir, construction of drainage improvements, relocation of a portion of Lumley Road, utility relocations, demolition of four buildings, relocation of aircraft navigational aids, acquisition of property, and removal and/or mitigation of obstacles in accordance with Federal Aviation Administration (FAA) safety standards.

To assist in the environmental review, the FAA is seeking input from the Fish and Wildlife Service to determine if the proposed action would impact the special purpose laws of the Endangered Species Act (ESA) and the Bald and Golden Eagle Protection Act (BGEPA). Based on a review of threatened and endangered species for the project area, the wildlife surveys performed in the area surrounding the project area and documented in the project’s biological report the FAA believes that the proposed project would result in a “may affect, not likely to adversely affect” (NLAA) determination for some species and “no effect” for other species. The following species and the proposed determinations are in the following chart:

Scientific Name	Common Name	Feed Status	Biological Conclusion
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic Sturgeon	E	No Effect
<i>Picoides borealis</i>	Red-cockaded Woodpecker	E	No Effect
<i>Necturus lewisi</i>	Neuse River Waterdog	T	NLAA
<i>Noturus furiosus</i>	Carolina Madtom	E	NLAA
<i>Fusconaia masoni</i>	Atlantic Pigtoe	T	NLAA
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	E	NLAA
<i>Rhus michauxii</i>	Michaux’s Sumac	E	No Effect
<i>Canis rufus</i>	Red Wolf	E	No Effect

The biological report can be downloaded from the following link:

<https://filesend.landrum-brown.com/download.aspx?f=26819-unDpe9zqJtxZ>

There is also one active bald eagle's nest that is within the area of review. The activities and construction of the proposed project would be cordoned off from the nest by providing a 660 –foot buffer around the nest during breeding season. In addition, preliminary noise modeling indicates that the nest would receive an increase of 2.6 dBA (weighted decibel level) from the project by 2033 when the proposed project would be fully operational.

The FAA would like to initiate informal consultation under the Endangered Species Act for the species listed in the table above. The proposed action appears to either not effect or have a may affect but not likely to adversely affect species protected by the ESA. In addition, the FAA would like to begin coordination under the BGEPA for the bald eagle.

Thank you for your time and assistance on this matter. If you have any questions, you may contact Michael Lamprecht by phone at (202) 267-6496 or email at Michael.Lamprecht@FAA.gov.

Sincerely,

Tommy L. Dupree, Manager
FAA, Memphis Airports District Office

Cc: William C. Sandifer, A.A.E., Executive Vice President-CEO, RDUAA
Chris Babb, Landrum & Brown



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Raleigh ES Field Office

Post Office Box 33726

Raleigh, North Carolina 27636-3726

November 15, 2022

Tommy L. Dupree, Manager
Memphis Airports District Office
2600 Thousand Oaks Blvd., Suite 2250
Memphis, TN 38118-2486

Subject: Proposed Runway 5L/23R Replacement Project; Raleigh-Durham International Airport
Wake County, North Carolina

Dear Mr. Dupree:

This letter is in response to your October 19, 2022 request for informal consultation and concurrence concerning federally listed species at the Raleigh-Durham International Airport (RDU), located in Wake County, North Carolina. The U.S. Fish and Wildlife Service (Service) has reviewed your letter and the October 7, 2022 Biological Resources Assessment (BRA) for the project. According to the submitted information, the project site has been identified for the construction of a replacement runway. The Service participated in a field meeting at the site on June 15, 2022. Our comments are provided in accordance with the Endangered Species Act of 1973, as amended, (ESA) and the Bald and Golden Eagle Act (BGEPA).

The Federal Aviation Administration (FAA) has made a determination of impacts to federally-listed species. Based on the results of species surveys conducted by Three Oaks Engineering, Inc., the Service concurs with the species determinations provided in your letter. We believe that the requirements of section 7 (a)(2) of the ESA have been satisfied for this project. Please remember that obligations under the ESA must be reconsidered if: (1) new information identifies impacts of this action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

Please note that the Service published its decision to list the tricolored bat (*Perimyotis subflavus*) (TCB) as endangered on September 14, 2022 (87 FR 56381–56393). This small bat species is known to occur in Wake County. It is an insectivore, and forages and roosts in forests and on the edges of forests. A final listing decision may come as soon as September, 2023. If the FAA would like to conference on this proposed species prior to listing, please let us know.

The October 19, 2022 letter and BRA state that there is one active bald eagle (*Haliaeetus leucocephalus*) nest, located approximately 1,900 feet from the existing runway. The FAA commits to providing a 660 – foot buffer around the nest during the bald eagle breeding season. In addition, preliminary noise modeling indicates that the nest would receive an increase of 2.6 dBA (weighted decibel level) from the project by 2033 when the proposed project would be fully operational. If the FAA commits to a buffer protecting the area within 660 feet of the bald eagle

nest from construction activities from December 1 to July 15 of any year, the Service agrees that the project is not likely to disturb nesting bald eagles. We recommend that the FAA consider the implementation of other recommendations in the National Bald Eagle Management Guidelines for the benefit of the bald eagle. The guidelines may be found here: <https://www.fws.gov/media/national-bald-eagle-management-guidelines>.

As we stated in the June 15, 2022 field meeting, the Service remains concerned about concerned about deforestation and the removal or fragmentation of contiguous forest. This area appears to provide a wildlife corridor between Umstead State Park and other areas to the northwest. Loss of the forested areas may push wildlife onto adjacent road rights-of-way and other areas that could pose a safety concern for humans and wildlife.

Further, tree removal may affect the TCB. During the spring, summer, and fall, TCB primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees (Veilleux et al. 2003; Perry and Thill 2007; Thames 2020). In addition, TCB have been observed roosting during summer among pine needles, eastern red cedar, within artificial roosts (e.g., barns, beneath porch roofs, bridges, concrete bunkers), and rarely within caves (Perry and Thill 2007; Thames 2020; Jones and Pagels 1968; Barbour and Davis 1969; Jones and Suttkus 1973; Hamilton and Whitaker 1979; Mumford and Whitaker 1982; Whitaker 1998; Feldhamer et al. 2003; Ferrara and Leberg 2005; Smith 2020, pers. comm; Humphrey et al. 1976; Briggler and Prather 2003; Damm and Geluso 2008). Female TCB exhibit high site fidelity, returning year after year to the same summer roosting locations (Allen 1921; Veilleux and Veilleux 2004a). Female TCB form maternity colonies and switch roost trees regularly (Veilleux and Veilleux 2004a; Quinn and Broders 2007; Poissant et al. 2010). Males roost singly (Perry and Thill 2007; Poissant et al. 2010). Effects to TCB from tree removal include potential injury or mortality of individuals roosting in trees that are removed, and loss of foraging, commuting, and roosting habitat. TCB may be injured or killed while fleeing disturbance during daylight hours due to an increased likelihood of predation. Indirect effects may include reduced fitness of TCB individuals through additional energy expenditure while searching for a new roost site, or a shift in home range. Replanting of tree species on the site would help restore foraging and roosting habitat for the TCB. The amount of mortality would not be determinable since dead TCBs would likely go unnoticed, and estimating such mortality is difficult since TCB density data is not available. Although mortality could potentially occur at any time of the year, it is assumed that mortality would be highest during the maternity season if maternity roost trees are felled.

We appreciate the opportunity to comment on this project. If you have any questions concerning these comments, please contact Kathy Matthews by e-mail at <kathryn_matthews@fws.gov>.

Sincerely,

Pete Benjamin
Field Supervisor



cc (via email):

Gabriela Garrison, NCWRC

Lyle Phillips, USACE

**Proposed Runway 5L/23R Replacement Project
Raleigh-Durham International Airport**

Biological Resources Assessment

December 6, 2022

Prepared for:

**Raleigh-Durham Airport Authority and
Federal Aviation Administration**



Prepared by:



**Three Oaks Engineering, Inc.
324 Blackwell Street, Suite 1200, Durham, NC 27701**

SUMMARY OF FINDINGS

The Raleigh-Durham Airport Authority (RDUAA or Airport) proposes to relocate existing runway 5L/23R 537 feet west of its current location. This includes the runway itself and all other associated construction tasks. To assess the potential environmental impacts associated with this project, an Environmental Assessment (EA) is being conducted by the Airport and the Federal Aviation Administration (FAA), to fulfill actions necessary under the National Environmental Policy Act (NEPA). The assessment of biological resources is a subset of the necessary natural resource survey tasks required to complete this EA. Three Oaks Engineering, Inc. (Three Oaks) has been tasked with compiling a biological resources assessment to accomplish this task. The purpose of this assessment is to address any biological resources associated with the project within the 1,436- acre Detailed Study Area (Appendix A, Figure 1).

This Biological Resources Assessment is being used by the FAA for consultation with the United States Fish and Wildlife Service (USFWS). The analysis includes an evaluation of the Detailed Study Area for potential impacts to ESA-listed threatened and endangered species and associated critical habitat under the jurisdiction of the USFWS. Table S1 summarizes the findings in this Biological Assessment.

Table S1. ESA federally protected species listed for the Detailed Study Area¹

Scientific Name	Common Name	Federal Status ²	Habitat Present	Biological Conclusion
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic Sturgeon	E	No	No Effect
<i>Picoides borealis</i>	Red-cockaded Woodpecker	E	Yes	No Effect
<i>Necturus lewisi</i>	Neuse River Waterdog	T	Yes	MANLAA ³
<i>Noturus furiosus</i>	Carolina Madtom	E	Yes	MANLAA ³
<i>Fusconaia masoni</i>	Atlantic Pigtoe	T	Yes	MANLAA ³
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	E	Yes	MANLAA ³
<i>Rhus michauxii</i>	Michaux’s Sumac	E	Yes	No Effect
<i>Canis rufus</i>	Red Wolf	E	Yes	No Effect

Note: Tricolored bat (*Perimyotis subflavus*) was proposed by USFWS for listing as Endangered on September 14, 2022. It is anticipated that FAA will request conference with USFWS to address this species prior to its official listing.

¹ USFWS Information for Planning and Consultation (IPaC) website checked December 6, 2022

² E – Endangered; T – Threatened

³ MANLAA – May Affect, Not Likely to Adversely Affect

Bald Eagle

One bald eagle nest was identified, approximately 1,900 feet north of the existing runway, in a loblolly pine stand between the Brier Creek Reservoir and a large stormwater impoundment. The nest was visited again on January 27, 2022, and it was confirmed that the nest was active, and a breeding pair was present. The nest location was also visited on June 15, 2022 with members of the FAA, United States Army Corps of Engineers (USACE), USFWS, NCWRC, and the Airport; the nest was still present, and a juvenile bald eagle was observed near the nest location. Construction will not be allowed within a 660-foot buffer around the nest during breeding season (December 1 – July 15 of any year) if the nest continues to be active.



LIST OF ACRONYMS

dBA – Decibel level, weighted
DNL – Day-Night Average Sound Level
DSA – Detailed Study Area
E – Endangered
EA – Environmental Assessment
ESA – Endangered Species Act
FAA – Federal Aviation Administration
IPaC – Information for Planning and Consultation
MANLAA – May Affect, Not Likely to Adversely Affect
MBTA – Migratory Bird Treaty Act
NCNHP – North Carolina Natural Heritage Program
NCPCC – North Carolina Plant Conservation Program
NCWRC – North Carolina Wildlife Resources Commission
NEPA – National Environmental Policy Act
NLEB – Northern Long-Eared Bat
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
RCW – Red-cockaded Woodpecker
RDU – Raleigh-Durham International Airport
RDUAA – Raleigh-Durham Airport Authority
SC – Special Concern
SC-V – Special Concern-Vulnerable
SR – Significantly Rare
T – Threatened
Three Oaks – Three Oaks Engineering, Inc.
US – United States
USACE – United States Army Corps of Engineers
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service



TABLE OF CONTENTS

SUMMARY OF FINDINGS i
LIST OF ACRONYMS ii
1.0 INTRODUCTION 1
2.0 METHODOLOGY 1
3.0 TERRESTRIAL COMMUNITIES 1
4.0 WILDLIFE AND HABITATS 3
5.0 PROTECTED SPECIES 3
 5.1 Endangered Species Act Protected Species 3
 5.2 Bald and Golden Eagle Protection Act 6
 5.3 North Carolina Natural Heritage Program State-Listed Species 7
 5.4 Migratory Bird Treaty Act 11
6.0 REFERENCES 15
Appendix A. Figures
 Figure 1. Vicinity Map
 Figure 2. Sheet Index
 Figure 3. Terrestrial Communities Map
Appendix B. Qualifications of Contributors
Appendix C. Aquatic Species Survey Report
Appendix D. USFWS Concurrence Letter

LIST OF TABLES

Table 1. Coverage of terrestrial communities in the DSA 1
Table 2. ESA federally protected species listed for the DSA¹ 4
Table 3. Potential noise level impacts on bald eagle nest 7
Table 4. NCNHP state-listed animal species listed for Wake County 9
Table 5. NCNHP state-listed plant species listed for Wake County 10
Table 6. Bird species subject to the MBTA 12



1.0 INTRODUCTION

The following Biological Resources Assessment has been completed to support the Environmental Assessment (EA) document and provide information on biological resources, such as terrestrial communities and protected species, within the 1,436-acre Detailed Study Area (DSA; Appendix A, Figures 1 and 2).

2.0 METHODOLOGY

The purpose of this assessment is to address biological resources associated with the project. Included in this assessment are the following:

- A description and mapping of vegetative communities;
- A discussion of wildlife and their habitats in/around the DSA;
- A listing of potential federal- and state-protected species; and
- An assessment of potential habitat and individuals in the DSA (including survey results) for federally protected species.

Three Oaks conducted site visits on the following dates in 2021: July 15, 20-21 | August 4-5, 10-11, 17, 19, 21, 29, and 31 | September 8, 15, 21, 22, 27, and 29 | October 4 | November 1, 15-19 | December 7-9. The site was also visited on January 27, 2022. A site visit with regulatory agencies was also completed on June 15, 2022 to review the DSA.

3.0 TERRESTRIAL COMMUNITIES

Six terrestrial communities were identified in the DSA. Figure 3 (Appendix A) shows the location and extent of these terrestrial communities. Terrestrial community data are presented in the context of total coverage of each type within the DSA (Table 1).

Table 1. Coverage of terrestrial communities in the DSA

Community	Notable Species (<i>Scientific Name</i>)	Coverage (acres)¹
Maintained/Disturbed	Fescue (<i>Festuca</i> spp.) Goldenrod (<i>Solidago</i> spp.) Sawtooth blackberry (<i>Rubus argutus</i>)	646.0
Mixed/Pine Hardwood Forest	White oak (<i>Quercus alba</i>) Loblolly pine (<i>Pinus taeda</i>) Tulip poplar (<i>Liriodendron tulipifera</i>)	148.2
Pine-dominant Forest	Loblolly pine (<i>Pinus taeda</i>) Sweetgum (<i>Liquidambar styraciflua</i>) Sourwood (<i>Oxydendrum arboreum</i>)	452.4
Hardwood Forest (Altered)	Tulip poplar (<i>Liriodendron tulipifera</i>) White oak (<i>Quercus alba</i>) Red maple (<i>Acer rubrum</i>)	13.7



Table 1. Coverage of terrestrial communities in the DSA (continued)

Community	Notable Species (<i>Scientific Name</i>)	Coverage (acres) ¹
Floodplain Forest	River birch (<i>Betula nigra</i>) Ironwood (<i>Carpinus caroliniana</i>) Lizard-tail (<i>Saururus cernuus</i>)	16.6
Lacustrine Fringe	Woolgrass (<i>Scirpus cyperinus</i>) Sericea lespedeza (<i>Lespedeza cuneata</i>) Cattail (<i>Typha latifolia</i>)	11.0
Total		1,287.9

¹ The remaining 150.1 acres of the DSA are comprised of open water in the form of large ponds and reservoirs.

Maintained/Disturbed

The Maintained/Disturbed community includes roadside and utility rights-of-way; cleared areas adjacent to the runway, buildings, reservoirs, and stormwater ponds; and previously cleared areas that still have not developed into another terrestrial community type, including old building/yard footprints. Many of the maintained/disturbed areas are regularly mowed/maintained.

Mixed Pine/Hardwood Forest

The Mixed Pine/Hardwood Forest community is comprised of a mixed canopy of loblolly pine and various hardwood species. It has a moderate to open sub-canopy and relatively open shrub and herbaceous (i.e., plants with little to no persistent above-ground woody stem) layers. In the DSA, this community exists on hillslopes, hilltops, and, to a certain extent, in floodplains and on floodplain edges where floodplains are narrow and do not have a community type discernable from the surrounding upland communities.

Pine-dominant Forest

The Pine-dominant Forest community has a canopy primarily comprised of loblolly pine. Some hardwoods do exist in the canopy, but to a much lesser degree than the Mixed/Pine Hardwood Forest community. Depending on the location, shrub/sub-canopy density varies in thickness. The herbaceous layer is typically sparse.

Hardwood Forest (Altered)

The Hardwood Forest (Altered) community is specific to an area west of Pleasant Grove Church Road. At some point in the recent to moderate past, this area was altered/cleared; older aerial imagery suggests fields of unknown use. Pines are absent, which separates it from the adjacent community. Older hardwoods are present, with a thick herbaceous/grass layer. There is evidence of buildings formerly occupying this area and at least one monitoring well was observed. This community was upslope towards the hilltop.

Floodplain Forest

The Floodplain Forest community is located along Little Brier Creek near where it crosses Interstate 540. This floodplain is wide and flat and discernable from the surrounding upslope community types. A moderate canopy and sub-canopy exist, with a relatively open shrub layer. The herbaceous layer is thick in areas and the community contains a large wetland complex.



Lacustrine Fringe

The Lacustrine Fringe community exists along an artificial shelf that surrounds Brier Creek Reservoir. These areas are herbaceous-dominant and may flood when the reservoir water level is high. They appear man-made and have an altered substrate indicative of non-native soil/fill being brought into the area.

4.0 WILDLIFE AND HABITATS

Per the North Carolina Wildlife Resources Commissions (NCWRC), there are at least 1,099 species of wild animals in the State of North Carolina. This includes 121 species of mammals, 234 species of fish, 475 species of birds, 91 species of amphibians, 71 species of reptiles, 47-plus species of freshwater crustaceans, and 60 species of freshwater mussels.

With almost 650 acres of wooded/natural areas, plus multiple streams, wetlands, and open bodies of water, potential habitat for wildlife is abundant in the DSA and the wooded areas adjacent to the DSA. Wooded areas provide habitats for all major groups of fauna. These include bird species such as American crow (*Corvus brachyrhynchos*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), barred owl (*Strix varia*), black vulture (*Coragyps atratus*), and several passerine species. Mammal species may include rabbit species (*Sylvilagus* spp.), racoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), Eastern gray squirrel (*Sciurus carolinensis*), white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), and grey fox (*Urocyon cinereoargenteus*). Herp species such as green treefrog (*Hyla cinerea*), American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*), black rat snake (*Pantherophis obsoletus*), green anole (*Anolis carolinensis*), and marbled salamander (*Ambystoma opacum*) may also be present. Additional transient species may also be observed in the area.

There is an overlap between species within the wooded habitat and open, maintained habitat, with many bird species, white-tailed deer, and other species with dynamic ranges being common in the open spaces.

Aquatic habitats and associated terrestrial areas also provide abundant habitat for many species. Fish species such as Eastern mosquitofish (*Gambusia holbrooki*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*) and other *Lepomis* species, and largemouth bass (*Micropterus salmoides*) may be present. Mussel and clam species such as Eastern elliptio (*Elliptio complanata*) and Asian clam (*Corbicula fluminea*) may exist within the DSA, along with other bivalve species. Please see the Aquatic Species Survey Report in Appendix C for a more detailed list of aquatic species identified in the DSA.

Lacustrine fringe areas and mudflats associated with the large reservoirs (which also extend outside of the DSA) also provides habitat for migratory birds such as ducks, geese, and shorebirds (roseate spoonbill [*Platalea ajaja*] was observed), plus several turtle species.

5.0 PROTECTED SPECIES

5.1 Endangered Species Act Protected Species

As of December 6, 2022, the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) website lists six federally protected species, under the Endangered Species Act (ESA), that may have habitat that overlaps the DSA. The National Oceanic and



Atmospheric Administration (NOAA) – National Marine Fisheries Service (NMFS) lists one federally protected species, Atlantic sturgeon, which may occur in Wake County. Additionally, assessment of the red wolf was requested as part of this assessment.

One additional species, tricolored bat (*Perimyotis subflavus*), was proposed by USFWS for listing as Endangered on September 14, 2022. Since this species is not officially listed, it is not addressed below. However, it is anticipated that FAA will request conference with USFWS to address this species prior to its official listing.

On the Federal level, statuses that apply to species listed for the project include the following:

- **Endangered** - Any species which is in danger of extinction throughout all or a significant portion of its range.
- **Threatened** - Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Table 2 includes species applicable to this project. For each species, a discussion of the presence or absence of habitat is included below along with the Biological Conclusion rendered based on survey results in the DSA.

Table 2. ESA federally protected species listed for the DSA¹

Scientific Name	Common Name	Federal Status ²	Habitat Present	Biological Conclusion
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic Sturgeon	E	No	No Effect
<i>Picoides borealis</i>	Red-cockaded Woodpecker	E	Yes	No Effect
<i>Necturus lewisi</i>	Neuse River Waterdog	T	Yes	MANLAA ³
<i>Noturus furiosus</i>	Carolina Madtom	E	Yes	MANLAA ³
<i>Fusconaia masoni</i>	Atlantic Pigtoe	T	Yes	MANLAA ³
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	E	Yes	MANLAA ³
<i>Rhus michauxii</i>	Michaux's Sumac	E	Yes	No Effect
<i>Canis rufus</i>	Red Wolf	E	Yes	No Effect

¹ USFWS IPaC website checked December 6, 2022

² E – Endangered; T – Threatened

³ MANLAA – May Affect, Not Likely to Adversely Affect

Atlantic Sturgeon

USFWS/NMFS Optimal Survey Window: surveys not required; assume presence in appropriate waters

Biological Conclusion: No Effect

Suitable habitat for the Atlantic sturgeon does not exist within the DSA as no mainstem portion of the Neuse River is present within the DSA. Additionally, no Designated Critical Habitat is present within the DSA. Furthermore, a review of the Fall 2022 North Carolina



Natural Heritage Program (NCNHP) dataset indicates no known Atlantic sturgeon occurrences within the DSA or within proximity of the DSA.

Red-cockaded Woodpecker

USFWS Optimal Survey Window: year-round; November – Early March (optimal)

Biological Conclusion: No Effect

Suitable nesting (open to semi-open pine stands ≥ 60 years of age) and foraging (open to semi-open pine stands ≥ 30 years of age) habitat for the red-cockaded woodpecker (RCW) exists within the DSA, primarily within the Mixed Pine/Hardwood Forest and Pine-dominant Forest communities. Specifically, the wooded areas off of Pleasant Grove Church Road (on both the east and west side of the road) and directly north of the existing runway contain potential foraging habitat with nesting-sized trees. Loblolly pine is the predominant pine species present. No nesting cavities, potential starts, or individuals were identified within the DSA. However, due to the presence of potential habitat, a 0.5-mile survey surrounding suitable habitat was conducted. Suitable foraging and nesting habitat are present to the south and southeast of the DSA near and within William B. Umstead State Park; however, this habitat was more than 0.5 miles away and separated from the DSA by the airport, highways, and other roads that would present an impediment to RCWs attempting to move between the two areas, resulting in a lack of habitat connectivity. The areas of habitat within the DSA are surrounded in the remaining directions by an extensive anthropogenic landscape, which isolates the potential habitat from connectivity to other suitable habitat. No cavities, potential starts, or individuals were identified during the 0.5-mile survey. The airport and the noise produced there may also present an additional deterrence to any potential RCW settlement. A review of the Fall 2022 NCNHP dataset indicates no known occurrences of RCW within the DSA or within 1.0 mile of the DSA. Additionally, there are currently no extant RCW occurrences located in Wake County and USFWS recently recommended that surveys for this species would no longer be required in the County.

Neuse River Waterdog

USFWS Optimal Survey Window: winter months for trapping

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix C) for more details regarding this species.

Carolina Madtom

USFWS Optimal Survey Window: year-round

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix C) for more details regarding this species.



Atlantic Pigtoe

USFWS Optimal Survey Window: year-round

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix C) for more details regarding this species.

Dwarf Wedgemussel

USFWS Optimal Survey Window: year-round

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Habitat is present within the study area, but no individuals were identified during surveys. Although no individuals were located, due to the presence of habitat within the DSA and the project being located within the species' range, a Biological Conclusion of May Affect, Not Likely to Adversely Affect has been recommended for this species. Please see the attached Aquatic Species Survey Report (Appendix C) for more details regarding this species.

Michaux's Sumac

USFWS Optimal Survey Window: May – October

Biological Conclusion: No Effect

Suitable habitat for Michaux's sumac includes open areas caused by disturbances, usually along roadsides, in highway rights-of-way, or around margins of regularly maintained clearings. Suitable habitat for this species was present within the DSA along roadsides and other utility rights-of-way. Therefore, surveys were conducted by Three Oaks staff during the July, August, and September 2021 field visit dates. No individuals were found. Additionally, a review of the Fall 2022 NCNHP dataset indicates no known occurrences of Michaux's sumac within the DSA or within 1.0 mile of the DSA.

Red Wolf

USFWS Optimal Survey Window: year-round

Biological Conclusion: No Effect

Suitable habitat for this species was present within the DSA in the form of forested areas for cover and multiple habitat types for foraging. However, the only wild population in North Carolina is an experimental population that is tracked by USFWS, located on the Albemarle Peninsula near the coast, in/around Alligator River National Wildlife Refuge and Alligator River Game Land. Additionally, a review of the Fall 2022 NCNHP dataset indicates no known occurrences of red wolf within the DSA or within 1.0 mile of the DSA; no extant wild occurrences are present within Wake County.

5.2 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act is enforced by the USFWS. Golden Eagles do not nest in North Carolina. Habitat for the bald eagle primarily consists of mature forests in proximity to large bodies of open water for foraging. Large dominant trees are utilized for nesting sites, typically within 1.0 mile of open water.

A desktop-GIS assessment of the DSA, as well as the area within a 1-mile radius of the project limits, was performed on July 15, 2021, using the most currently available orthoimagery. Multiple water



bodies large enough or sufficiently open to be considered potential feeding sources were identified. Since foraging habitat was found within the review area, a survey of the DSA and the area within 660 feet of the project limits was conducted by Three Oaks staff during the July, August, and September 2021 field visits. One bald eagle nest was identified, approximately 1,900 feet north of the existing runway, in a loblolly pine stand between the Brier Creek Reservoir and a large stormwater impoundment. The nest was visited again on January 27, 2022, and it was confirmed that the nest was active, and a breeding pair was present. The nest location was also visited on June 15, 2022 with members of the FAA, United States Army Corps of Engineers (USACE), USFWS, NCWRC, and the Airport; the nest was still present, and a juvenile bald eagle was observed near the nest location. This is a previously non-reported nesting site. A review of the Fall 2022 NCNHP dataset revealed no additional occurrences of bald eagle within the DSA or within 1.0 mile of the DSA.

A noise study was completed to assess the potential impact of airport activities on the eagle nest (Table 3).

Table 3. Potential noise level impacts on bald eagle nest

Noise Level (DNL ¹ ; measured in dBA ²)	2019 Pre-COVID	2020-21 Existing Conditions	2028 No Action	2028 Proposed Action	2033 No Action	2033 Proposed Action
	63.81	61.25	64.4	67.08	64.85	67.5

¹ DNL – Day-Night Average Sound Level. DNL is a metric that reflects cumulative exposure to sound over a 24-hour period, expressed as the noise level for the average day of the year on the basis of annual aircraft operations.

² dBA – decibel level, weighted according to the weighting curves to approximate the way the human ear hears.

Due to the presence of the bald eagle nest, the suggested conservation measure is that construction will not be allowed within a 660-foot buffer around the nest during breeding season (December 1 – July 15 on any year) if the nest continues to be active. This will minimize/eliminate potential disturbance to nesting bald eagles.

Coordination with USFWS

A version of this Biological Resources Assessment (dated October 7, 2022) was submitted to the USFWS on October 19, 2022 for review and to request concurrence under informal consultation for the Biological Conclusions rendered for federally-listed species. In a letter dated November 15, 2022, the USFWS concurred with the Biological Conclusions rendered for this project and the conservation measures suggested for the bald eagle. A copy of the USFWS letter is included in Appendix D.

5.3 North Carolina Natural Heritage Program State-Listed Species

The NCNHP tracks state listed species that are not currently protected by the USFWS under the Federal ESA but are tracked by the State due to their rarity in North Carolina. These species are compiled in the NCNHP 2020 Rare Animal and Plant Lists.

The NCNHP Rare Plant List includes North Carolina legal status information from the North Carolina Plant Conservation Program (NCPCP), a unit of the Department of Agriculture and Consumer Services and the agency responsible for the listing and protection of North Carolina’s endangered



and threatened plants, under provisions of the North Carolina Plant Protection and Conservation Act (North Carolina General Statutes - Chapter 106, Article 19B). The NCNHP Rare Animal List contains species listed by the NCWRC. NCWRC is responsible for the listing and protection of the state's nongame species of mammals, birds, reptiles, amphibians, freshwater fishes, mollusks, and crustaceans, under North Carolina General Statutes - Chapter 113, Article 25.

On the State level, statuses that apply to species listed for Wake County include the following:

- Endangered - Any native or once-native species of wild animal whose continued existence as a viable component of the state's fauna is determined to be in jeopardy or any species of wild animal determined to be an Endangered species pursuant to the Federal ESA (General Statute 113-25.).
- Threatened - Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a Threatened species pursuant to the Federal ESA (General Statute 113-25.).
- Special Concern - Any species of wild animal native or once-native to North Carolina which is determined by the NCWRC to require monitoring, but which may be taken under regulations adopted under the provisions of the Article. (General Statute 113-25).
- Special Concern – Vulnerable - Any species or higher taxon of plant which is likely to become a threatened species within the foreseeable future. (North Carolina Administrative Code 02 NCAC 48F .0401).
- Significantly Rare - Any species which has not been listed as an Endangered, Threatened, or Special Concern species, but which exists in the state (or recently occurred in the state) in small numbers (generally fewer than 100 statewide populations) and has been determined by the NCNHP to need monitoring. Significantly Rare species include species of historical occurrence with some likelihood of rediscovery in the state and species substantially reduced in numbers by habitat destruction, direct exploitation, or disease (NCNHP designation).

NCNHP is not a regulatory agency; however, NCPCP, NCWRC, and other state agencies may include state-listed species when considering project commitments and/or conservation measures or may require permits if a species is to be collected, moved, or impacted. Surveys are typically not required (unless a project is on United States Forest Service [USFS] land, which this project is not); however, an assessment of habitat will allow for determination of what species have potential to be present, thus providing a more complete biological assessment of the DSA. Furthermore, a review of existing NCNHP data within the DSA and within 1.0 mile of the DSA identifies known occurrences of species that may be impacted by the project.

Tables 4 and 5 list the animal and plant species currently tracked by NCNHP and identify whether habitat is present within the DSA. A review of the July 2022 NCNHP dataset was completed for these species; species with known occurrences within proximity of the project are identified in the tables.

Of the species listed below, only the Savannah lilliput was identified within the DSA during surveys for the project. The species was thought to have been previously extirpated from the Neuse River Basin. Coordination with NCWRC may be required for this species to determine if any special considerations or conservation measures would be requested/required. Please see the attached Aquatic Species Survey Report (Appendix C) for more details regarding this species.



Table 4. NCNHP state-listed animal species listed for Wake County

Taxonomic Group	Scientific Name	Common Name	NC Status ¹	Federal Status ¹	County Status ²	Habitat Present
Amphibian	<i>Ambystoma talpoideum</i>	Mole Salamander	SC	None	Historical	Yes
Amphibian	<i>Ambystoma tigrinum</i>	Eastern Tiger Salamander	T	None	Current	No
Amphibian	<i>Eurycea quadridigitata</i>	Dwarf Salamander	SC	None	Historical	No
Amphibian	<i>Hemidactylum scutatum</i>	Four-toed Salamander	SC	None	Current	Yes ⁵
Bird	<i>Ammodramus henslowii</i> (syn. <i>Centronyx henslowii</i>)	Henslow's Sparrow	E	None	Historical	No
Bird	<i>Lanius ludovicianus</i>	Loggerhead Shrike	SC	None	Current	Yes
Bird	<i>Loxia curvirostra</i>	Red Crossbill	SC	None	Historical	No
Bird	<i>Peucaea aestivalis</i>	Bachman's Sparrow	SC	None	Historical	No
Crustacean	<i>Orconectes carolinensis</i> (syn. <i>Faxonius carolinensis</i>)	North Carolina Spiny Crayfish	SC	None	Current	Yes
Freshwater Bivalve	<i>Alasmidonta undulata</i>	Triangle Floater	T	None	Current	Yes
Freshwater Bivalve	<i>Elliptio lanceolata</i> ³	Yellow Lance	E	T	Current	Yes
Freshwater Bivalve	<i>Elliptio roanokensis</i> (syn. <i>Elliptio judithae</i>)	Roanoke Slabshell	SC	None	Current	Yes
Freshwater Bivalve	<i>Lampsilis radiata</i> (syn. <i>Lampsilis radiata radiata</i> , <i>Lampsilis fullerhati</i> , <i>Lampsilis radiata conspicua</i>)	Eastern Lampmussel	T	None	Current	Yes
Freshwater Bivalve	<i>Lasmigona subviridis</i>	Green Floater	E	None	Current	Yes ⁵
Freshwater Bivalve	<i>Strophitus undulatus</i>	Creeper	T	None	Current	Yes
Freshwater Bivalve	<i>Toxolasma pullus</i>	Savannah Lilliput	E	None	Current	Yes ⁵
Freshwater Bivalve	<i>Villosa constricta</i>	Notched Rainbow	T	None	Current	Yes
Freshwater Fish	<i>Lampetra aepyptera</i>	Least Brook Lamprey	T	None	Current	Yes
Freshwater Fish	<i>Notropis volucellus</i>	Mimic Shiner	T	None	Historical	Yes
Mammal	<i>Condylura cristata</i> pop. 1	Star-nosed Mole - Coastal Plain population	SC	None	Historical	No
Mammal	<i>Myotis austroriparius</i>	Southeastern Bat	SC	None	Current	No
Reptile	<i>Crotalus horridus</i>	Timber Rattlesnake	SC	None	Historical	No

Jim Mason, Senior Environmental Scientist
 Three Oaks Engineering, Inc.
 324 Blackwell Street, Suite 1200
 Durham, NC 27701



Table 4. NCNHP state-listed animal species listed for Wake County (continued)

Taxonomic Group	Scientific Name	Common Name	NC Status ¹	Federal Status ¹	County Status ²	Habitat Present
Reptile	<i>Heterodon simus</i>	Southern Hognose Snake	T	None	Historical	No
Sawfly, Wasp, Bee, or Ant	<i>Bombus affinis</i> ⁴	Rusty-patched Bumble Bee	SR	E	Historical	Yes

¹ E – Endangered; T- Threatened; SC – Special Concern; SR – Significantly Rare

² – Current - The species has been identified recently within the County (NCNHP does not define “recently” in their documentation).

Historical - Of historical occurrence, with some expectation that it may be rediscovered. Its presence may not have been verified in the past 20 years. An element is not automatically assigned a historical status if it has not been verified in the past 20 years; some effort must have been made to locate or relocate occurrences. A Historical status does not impact the State Status of a species.

³ This species is federally listed but does not have a range that overlaps with the project per USFWS IPaC; therefore, it is included here.

⁴ NCWRC does not currently list this species as protected by the State, as it is currently believed that there are no extant records in North Carolina. However, the species is listed as Endangered on the Federal level throughout its range, which includes North Carolina.

⁵ One known occurrence of this species was identified within 1.0 mile of the DSA; only the Savannah lilliput occurrence encroaches into the DSA.

Table 5. NCNHP state-listed plant species listed for Wake County

Taxonomic Group	Scientific Name	Common Name	NC Status ¹	Federal Status	County Status ²	Habitat Present
Vascular Plant	<i>Acmispon helleri</i>	Carolina Birdfoot-trefoil	T	None	Current	Yes
Vascular Plant	<i>Buchnera americana</i>	American Bluehearts	E	None	Historical	Yes
Vascular Plant	<i>Carex meadii</i>	Mead's Sedge	E	None	Historical	Yes
Vascular Plant	<i>Carex reniformis</i>	Kidney Sedge	T	None	Historical	Yes
Vascular Plant	<i>Cirsium carolinianum</i>	Carolina Thistle	E	None	Historical	Yes
Vascular Plant	<i>Cyperus granitophilus</i>	Granite Flatsedge	T	None	Current	No
Vascular Plant	<i>Cyperus virens</i>	Green Flatsedge	SC-V	None	Historical	Yes
Vascular Plant	<i>Dichanthelium annulum</i>	Ringed Witch Grass	E	None	Historical	Yes ³
Vascular Plant	<i>Gillenia stipulata</i>	Indian Physic	T	None	Historical	Yes
Vascular Plant	<i>Helenium brevifolium</i>	Littleleaf Sneezeweed	E	None	Historical	Yes
Vascular Plant	<i>Isoetes piedmontana</i>	Piedmont Quillwort	T	None	Current	No
Vascular Plant	<i>Lindera subcoriacea</i>	Bog Spicebush	SC-V	None	Current	No

Jim Mason, Senior Environmental Scientist
Three Oaks Engineering, Inc.
324 Blackwell Street, Suite 1200
Durham, NC 27701



Table 5. NCNHP state-listed plant species listed for Wake County (continued)

Taxonomic Group	Scientific Name	Common Name	NC Status ¹	Federal Status	County Status ²	Habitat Present
Vascular Plant	<i>Magnolia macrophylla</i>	Bigleaf Magnolia	SC-V	None	Current	No
Vascular Plant	<i>Micranthes pensylvanica</i>	Swamp Saxifrage	E	None	Historical	No
Vascular Plant	<i>Polygala senega</i>	Seneca Snakeroot	SC-V	None	Current	Yes
Vascular Plant	<i>Portulaca smallii</i>	Small's Portulaca	T	None	Current	No
Vascular Plant	<i>Pseudognaphalium helleri</i>	Heller's Rabbit-Tobacco	E	None	Current	Yes ³
Vascular Plant	<i>Ruellia humilis</i>	Low Wild-petunia	T	None	Current	Yes
Vascular Plant	<i>Ruellia purshiana</i>	Pursh's Wild-petunia	SC-V	None	Historical	Yes
Vascular Plant	<i>Sagittaria weatherbiana</i>	Grassleaf Arrowhead	E	None	Historical	Yes
Vascular Plant	<i>Scutellaria australis</i>	Southern Skullcap	E	None	Historical	Yes
Vascular Plant	<i>Scutellaria nervosa</i>	Veined Skullcap	E	None	Current	Yes
Vascular Plant	<i>Solidago radula</i>	Western Rough Goldenrod	E	None	Historical	Yes
Vascular Plant	<i>Symphyotrichum concinnum</i> (syn. <i>Symphyotrichum laeve</i> var. <i>concinnum</i>)	Narrow-leaved Smooth Aster	E	None	Historical	Yes
Vascular Plant	<i>Trifolium reflexum</i>	Buffalo Clover	T	None	Current	Yes
Vascular Plant	<i>Trillium pusillum</i> var. <i>virginianum</i>	Virginia Least Trillium	E	None	Current	Yes

¹ E – Endangered; T- Threatened; SC-V – Special Concern-Vulnerable; SR – Significantly Rare

² – *Current* – The species has been identified recently within the County (NCNHP does not define “recently” in their documentation)

Historical - Of historical occurrence, with some expectation that it may be rediscovered. Its presence may not have been verified in the past 20 years. An element is not automatically assigned a historical status if it has not been verified in the past 20 years; some effort must have been made to locate or relocate occurrences. A Historical status does not impact the State Status of a species.

³ One known occurrence of this species was identified within 1.0 mile of the DSA; however, none were located within the DSA itself.

5.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by USFWS. Bird species are listed by USFWS in the List of Migratory Birds protected by the MBTA, which is updated regularly. A migratory bird species is included on the list if it meets one or more of the following criteria:



- It occurs in the United States (US) or US territories as the result of natural biological or ecological processes and is currently, or was previously listed as, a species or part of a family protected by one of the four international treaties or their amendments that the MBTA implements (with Canada, Mexico, Japan, and Russia);
- Revised taxonomy results in it being newly split from a species that was previously on the list, and the new species occurs in the US or US territories as the result of natural biological or ecological processes; or
- New evidence exists for its natural occurrence in the US or US territories resulting from natural distributional changes and the species occurs in a protected family.

Table 6 below includes the MBTA species listed for Wake County, which may occur in the DSA, per NCWRC. All species in this list are designated as occurring in the State and County; have been recorded on the Cornell Lab of Ornithology eBird website (a citizen science database of bird species observations) within the last 10 years; and are known to breed in the State. Bald Eagle is also included as a MBTA species; however, it is not included in this list since it is already addressed in Section 5.2. Surveys and/or conservation measures may be recommended/required for these species or authorization may be required to impact species habitat; however, input/coordination with NCWRC and USFWS will be required to determine whether either will be needed for this project.

Table 6. Bird species subject to the MBTA

<i>Scientific Name</i>	Common Name
<i>Accipiter cooperii</i>	Cooper's Hawk
<i>Accipiter striatus</i>	Sharp-shinned Hawk
<i>Agelaius phoeniceus</i>	Red-winged Blackbird
<i>Aix sponsa</i>	Wood Duck
<i>Ammodramus savannarum</i>	Grasshopper Sparrow
<i>Antrostomus carolinensis</i>	Chuck-will's-widow
<i>Antrostomus vociferus</i>	Eastern Whip-poor-will
<i>Archilochus colubris</i>	Ruby-throated Hummingbird
<i>Ardea herodias</i>	Great Blue Heron
<i>Baeolophus bicolor</i>	Tufted Titmouse
<i>Branta canadensis</i>	Canada Goose
<i>Bubo virginianus</i>	Great Horned Owl
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Buteo lineatus</i>	Red-shouldered Hawk
<i>Butorides virescens</i>	Green Heron
<i>Cardinalis cardinalis</i>	Northern Cardinal
<i>Cathartes aura</i>	Turkey Vulture
<i>Chaetura pelagica</i>	Chimney Swift
<i>Charadrius vociferus</i>	Killdeer
<i>Chordeiles minor</i>	Common Nighthawk
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
<i>Colaptes auratus</i>	Northern Flicker



Table 6. Bird species subject to the MBTA (continued)

Scientific Name	Common Name
<i>Colinus virginianus</i>	Northern Bobwhite
<i>Contopus virens</i>	Eastern Wood-Pewee
<i>Coragyps atratus</i>	Black Vulture
<i>Corvus brachyrhynchos</i>	American Crow
<i>Corvus ossifragus</i>	Fish Crow
<i>Cyanocitta cristata</i>	Blue Jay
<i>Dryobates pubescens</i>	Downy Woodpecker
<i>Dryobates villosus</i>	Hairy Woodpecker
<i>Dryocopus pileatus</i>	Pileated Woodpecker
<i>Dumetella carolinensis</i>	Gray Catbird
<i>Empidonax virescens</i>	Acadian Flycatcher
<i>Eremophila alpestris</i>	Horned Lark
<i>Falco sparverius</i>	American Kestrel
<i>Geothlypis formosa</i>	Kentucky Warbler
<i>Geothlypis trichas</i>	Common Yellowthroat
<i>Hirundo rustica</i>	Barn Swallow
<i>Hylocichla mustelina</i>	Wood Thrush
<i>Icteria virens</i>	Yellow-breasted Chat
<i>Icterus spurius</i>	Orchard Oriole
<i>Ictinia mississippiensis</i>	Mississippi Kite
<i>Lanius ludovicianus</i>	Loggerhead Shrike
<i>Limnothlypis swainsonii</i>	Swainson's Warbler
<i>Megaceryle alcyon</i>	Belted Kingfisher
<i>Megascops asio</i>	Eastern Screech-Owl
<i>Melanerpes carolinus</i>	Red-bellied Woodpecker
<i>Melospiza melodia</i>	Song Sparrow
<i>Mimus polyglottos</i>	Northern Mockingbird
<i>Mniotilta varia</i>	Black-and-white Warbler
<i>Molothrus ater</i>	Brown-headed Cowbird
<i>Myiarchus crinitus</i>	Great Crested Flycatcher
<i>Pandion haliaetus</i>	Osprey
<i>Parkesia motacilla</i>	Louisiana Waterthrush
<i>Passerina caerulea</i>	Blue Grosbeak
<i>Passerina cyanea</i>	Indigo Bunting
<i>Pipilo erythrophthalmus</i>	Eastern Towhee
<i>Piranga olivacea</i>	Scarlet Tanager
<i>Piranga rubra</i>	Summer Tanager



Table 6. Bird species subject to the MBTA (continued)

Scientific Name	Common Name
<i>Poecile carolinensis</i>	Carolina Chickadee
<i>Poliophtila caerulea</i>	Blue-gray Gnatcatcher
<i>Progne subis</i>	Purple Martin
<i>Protonotaria citrea</i>	Prothonotary Warbler
<i>Quiscalus quiscula</i>	Common Grackle
<i>Regulus satrapa</i>	Golden-crowned Kinglet
<i>Sayornis phoebe</i>	Eastern Phoebe
<i>Scolopax minor</i>	American Woodcock
<i>Seiurus aurocapilla</i>	Ovenbird
<i>Setophaga americana</i>	Northern Parula
<i>Setophaga citrina</i>	Hooded Warbler
<i>Setophaga coronata</i>	Yellow-rumped Warbler
<i>Setophaga discolor</i>	Prairie Warbler
<i>Setophaga dominica</i>	Yellow-throated Warbler
<i>Setophaga pinus</i>	Pine Warbler
<i>Setophaga ruticilla</i>	American Redstart
<i>Sialia sialis</i>	Eastern Bluebird
<i>Sitta carolinensis</i>	White-breasted Nuthatch
<i>Sitta pusilla</i>	Brown-headed Nuthatch
<i>Spinus tristis</i>	American Goldfinch
<i>Spizella passerina</i>	Chipping Sparrow
<i>Spizella pusilla</i>	Field Sparrow
<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow
<i>Strix varia</i>	Barred Owl
<i>Sturnella magna</i>	Eastern Meadowlark
<i>Tachycineta bicolor</i>	Tree Swallow
<i>Thryothorus ludovicianus</i>	Carolina Wren
<i>Toxostoma rufum</i>	Brown Thrasher
<i>Troglodytes aedon</i>	House Wren
<i>Turdus migratorius</i>	American Robin
<i>Tyrannus tyrannus</i>	Eastern Kingbird
<i>Tyto alba</i>	Barn Owl
<i>Vireo griseus</i>	White-eyed Vireo
<i>Vireo olivaceus</i>	Red-eyed Vireo
<i>Vireo solitarius</i>	Blue-headed Vireo
<i>Zenaida macroura</i>	Mourning Dove



6.0 REFERENCES

- Cornell Lab of Ornithology. eBird. <https://ebird.org>.
- Federal Aviation Administration. 2007. Environmental Desk Reference for Airport Actions. Office of Airport Planning and Programming, Airports Planning and Environmental Division, APP-400.
- National Oceanic and Atmospheric Administration Fisheries. Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) species profile. <https://www.fisheries.noaa.gov/species/atlantic-sturgeon>.
- North Carolina Natural Heritage Program (NCNHP). 2022. Natural Heritage Data Explorer, Fall (October) 2022 Quarterly Dataset [Web Application]. NCDNCR, Raleigh, NC. <http://ncnhde.natureserve.org>.
- North Carolina Wildlife Resources Commission (NCWRC). North Carolina Species. <https://www.ncwildlife.org/Conserving/Species>.
- Ratcliffe, Judith. 2020. Natural Heritage Program List of Rare Animal Species of North Carolina. North Carolina Department of Natural and Cultural Resources. Raleigh, NC.
- Schafale, M.P. 2012. Guide to the Natural Communities of North Carolina: Fourth Approximation. North Carolina Natural Heritage Program, North Carolina Department of Environmental Quality (NCDEQ). Raleigh, North Carolina. 208 pp.
- United States Fish and Wildlife Service. Environmental Conservation Online System (ECOS). <https://ecos.fws.gov/ecp/>.
- United States Fish and Wildlife Service. Information for Planning and Consultation (IPaC). <https://ipac.ecosphere.fws.gov/>.
- Weakley, Alan S. (Working Draft). Flora of the Southern and Mid-Atlantic States. University of North Carolina Herbarium (NCU), North Carolina Botanical Garden. Chapel Hill, NC. 1,848 pp.
- Wichmann, Brenda. 2020. Natural Heritage Program List of Rare Plant Species of North Carolina. North Carolina Department of Natural and Cultural Resources. Raleigh, NC.



Appendix A
Figures





Prepared For:



**Raleigh-Durham International Airport
Proposed Runway 5L/23R Replacement
Federal Environmental Assessment
Vicinity Map**
Wake County, North Carolina

Date: September, 2022

Scale: 0 1,000 2,000 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
1





Prepared For:



Raleigh-Durham International Airport

Proposed Runway 5L/23R Replacement

Federal Environmental Assessment

Sheet Index Map

Wake County, North Carolina

Date: September 2022

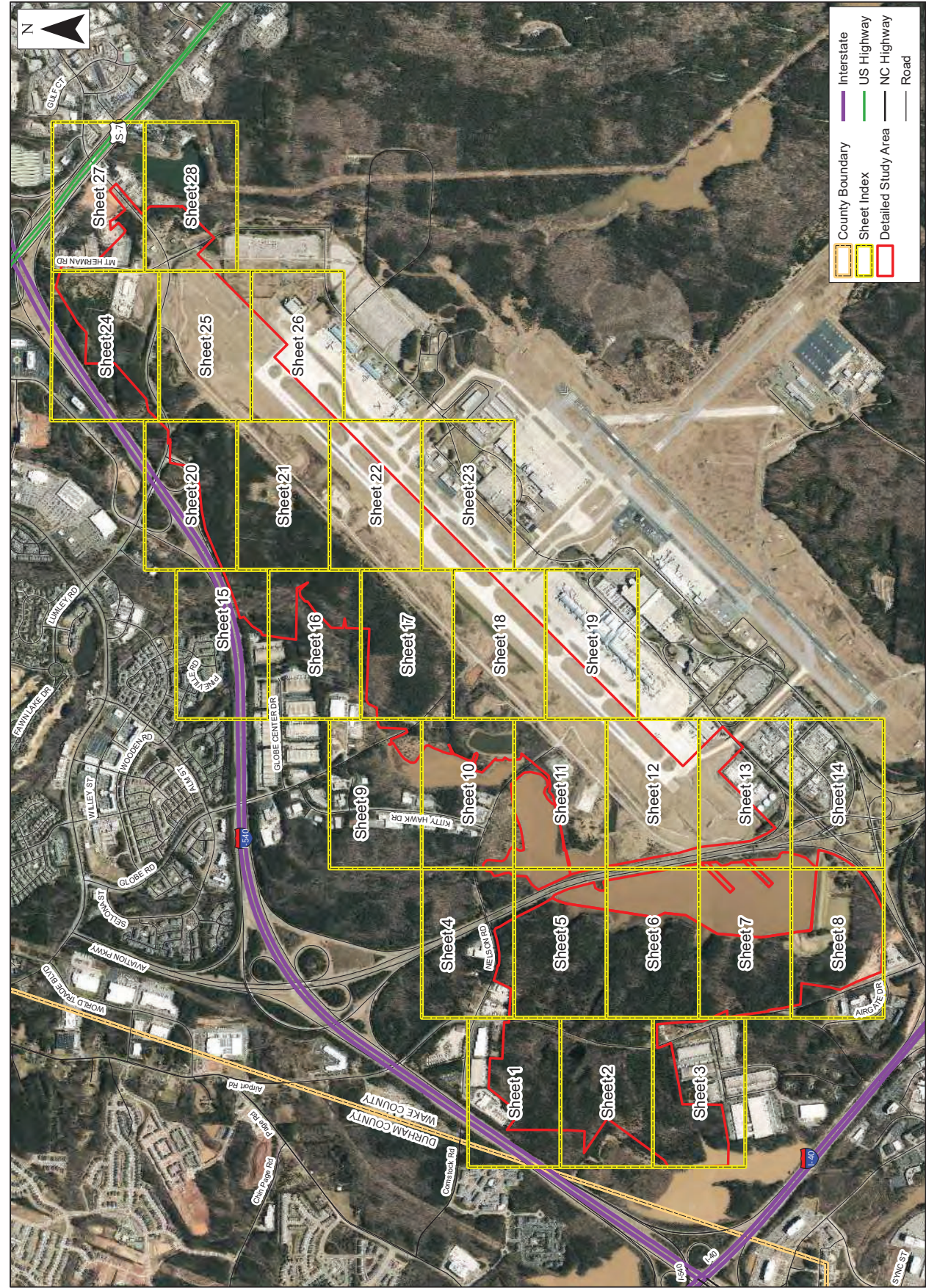
Scale: 0 500 1,000 FT

Job No.: 19-018

Drawn By: KEMS

Checked By: NDH

Figure 2





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3
Sheet 1





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

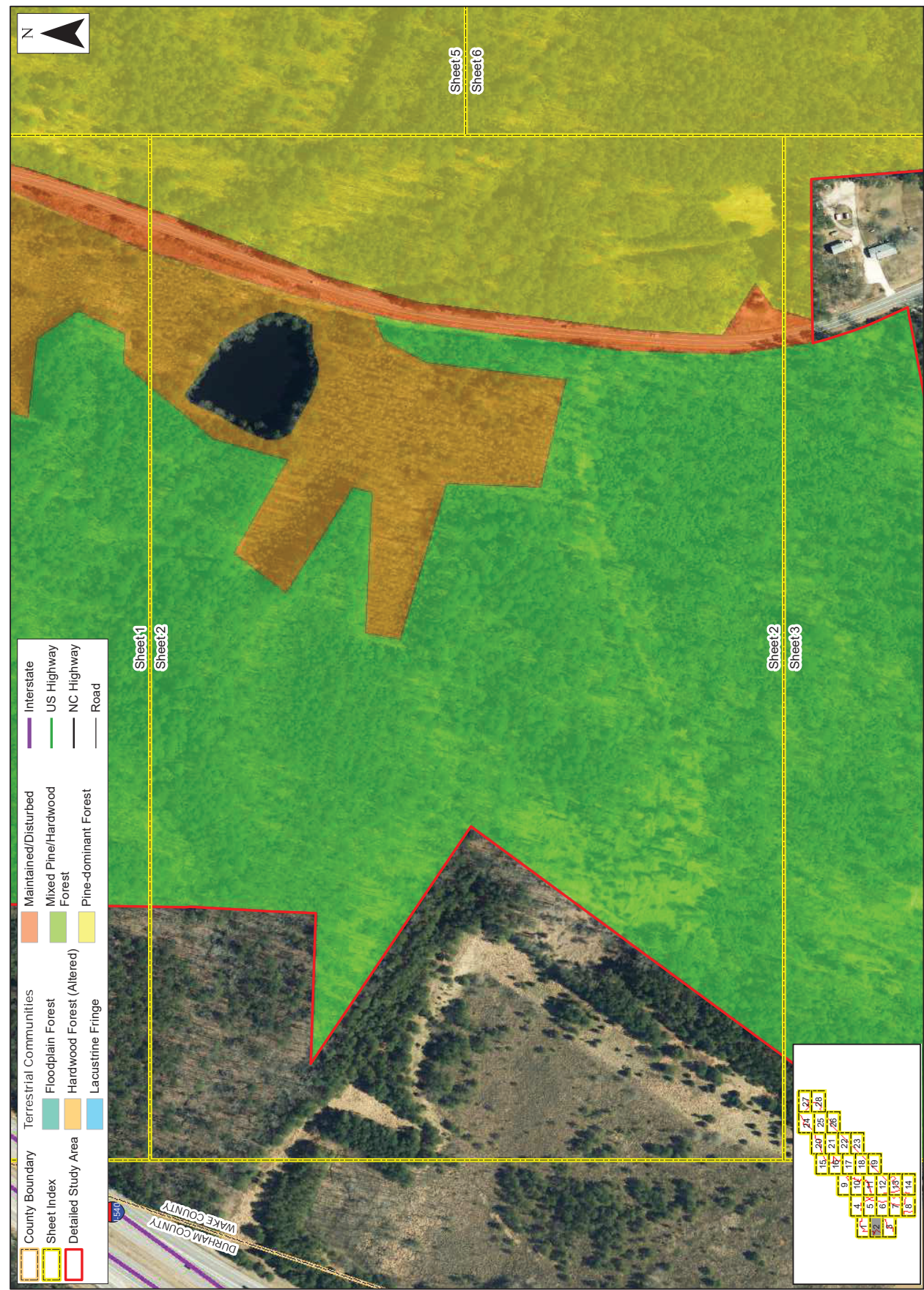
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 2





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3
Sheet 3





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

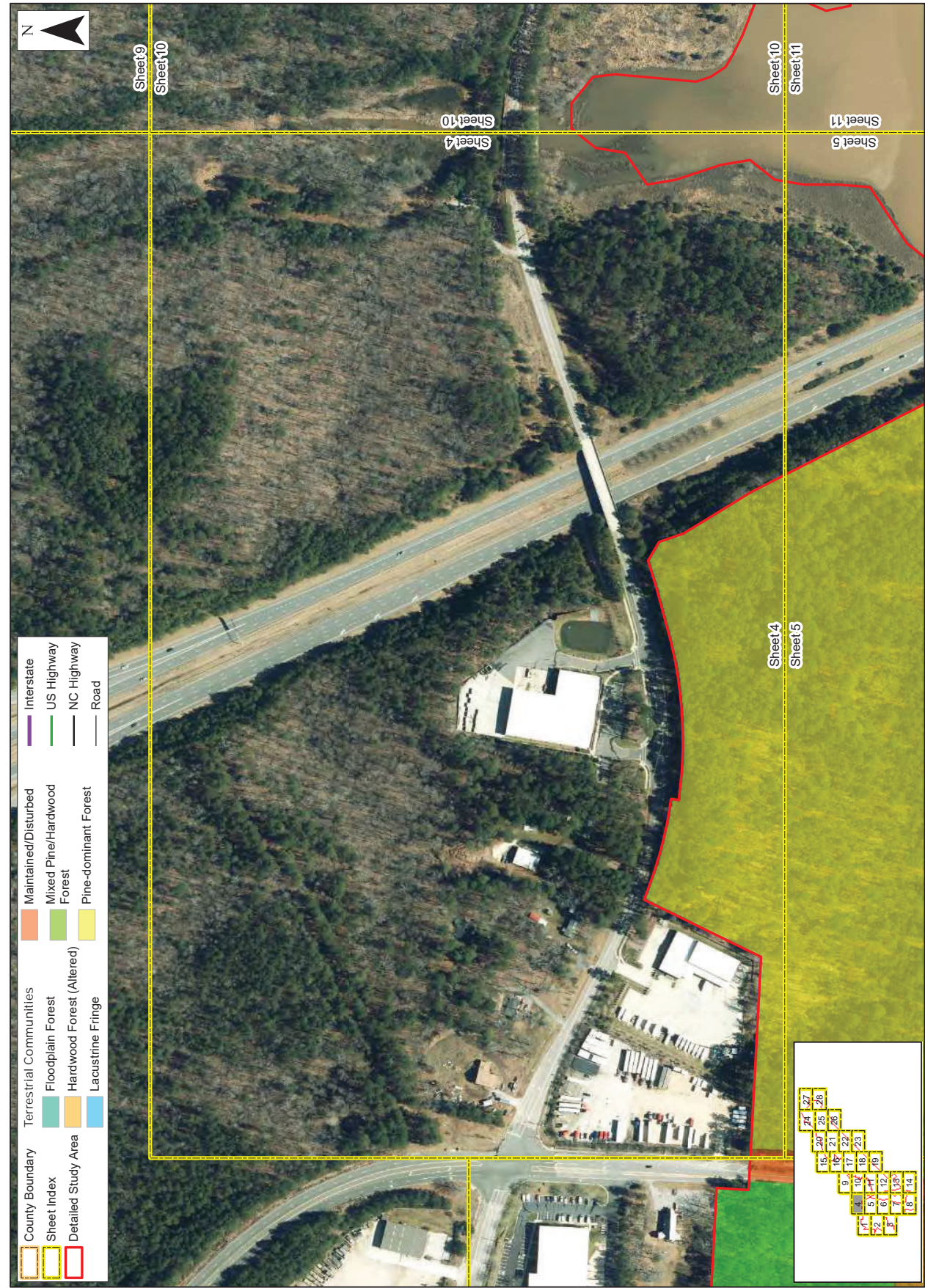
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 4





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3
Sheet 5



- County Boundary
- Sheet Index
- Detailed Study Area
- Terrestrial Communities
 - Floodplain Forest
 - Hardwood Forest (Altered)
 - Lacustrine Fringe
- Maintained/Disturbed
- Mixed Pine/Hardwood Forest
- Pine-dominant Forest
- Interstate
- US Highway
- NC Highway
- Road





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

Scale: 0 100 200 FT

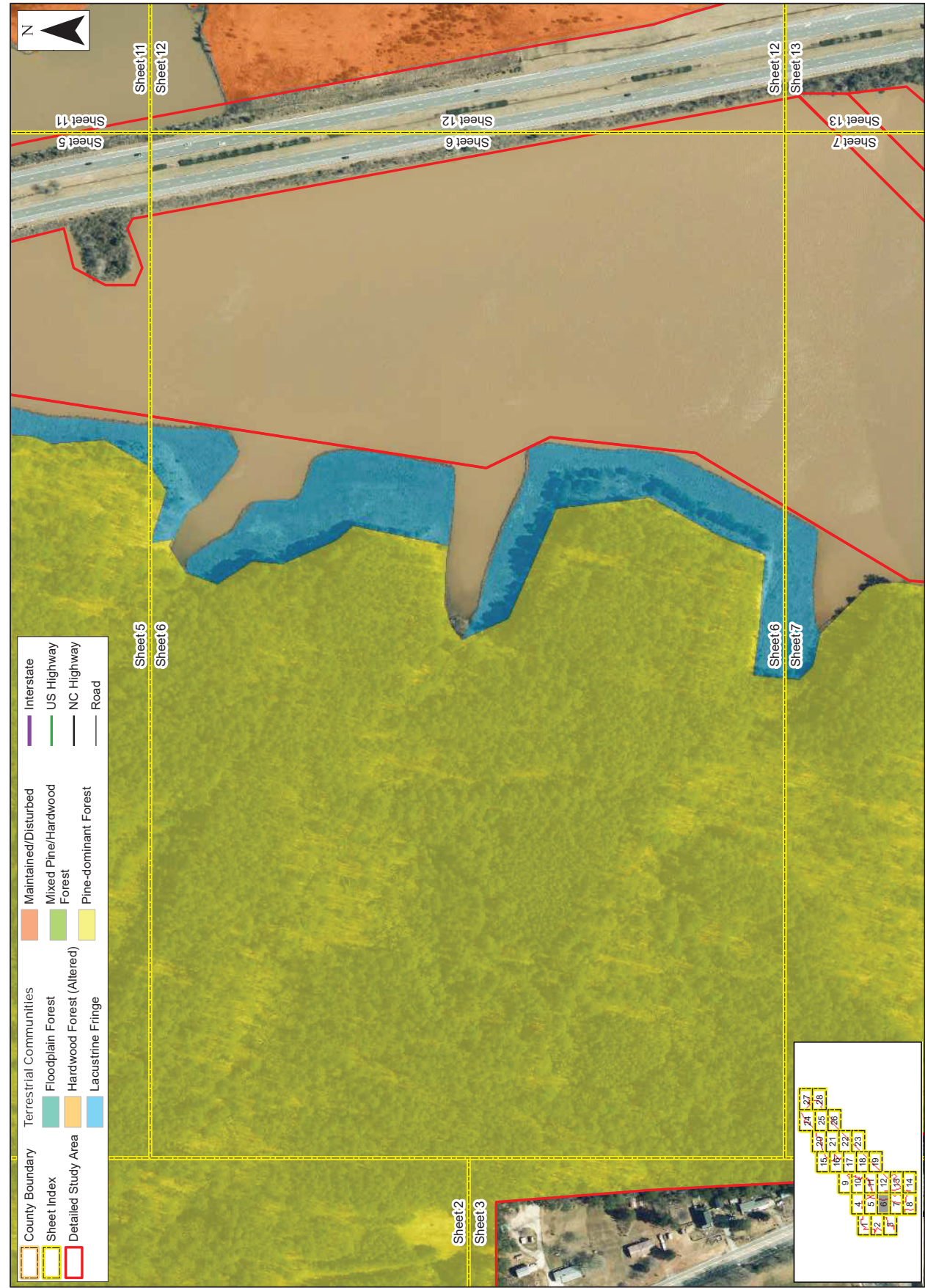
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 6





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

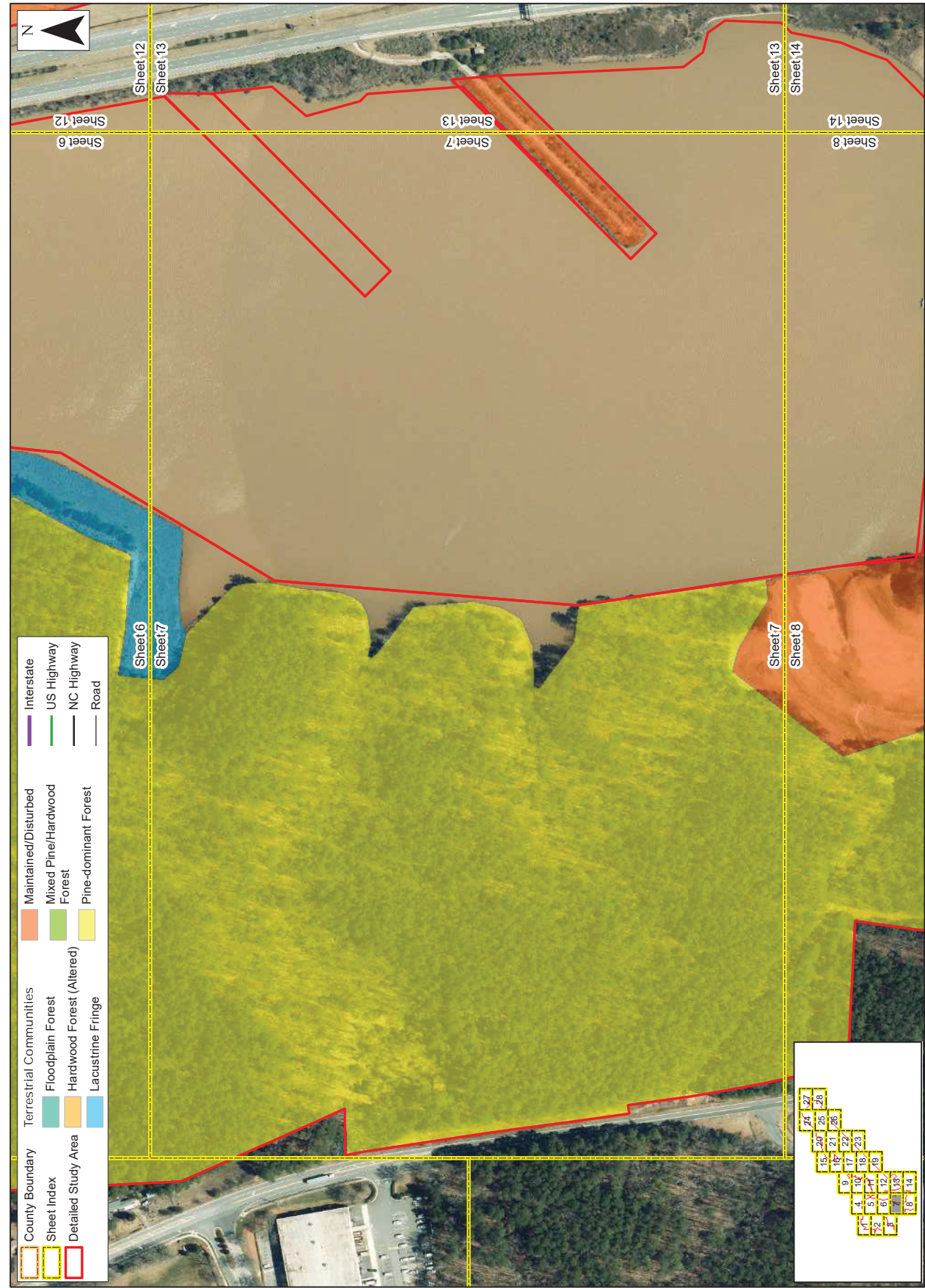
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 7





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

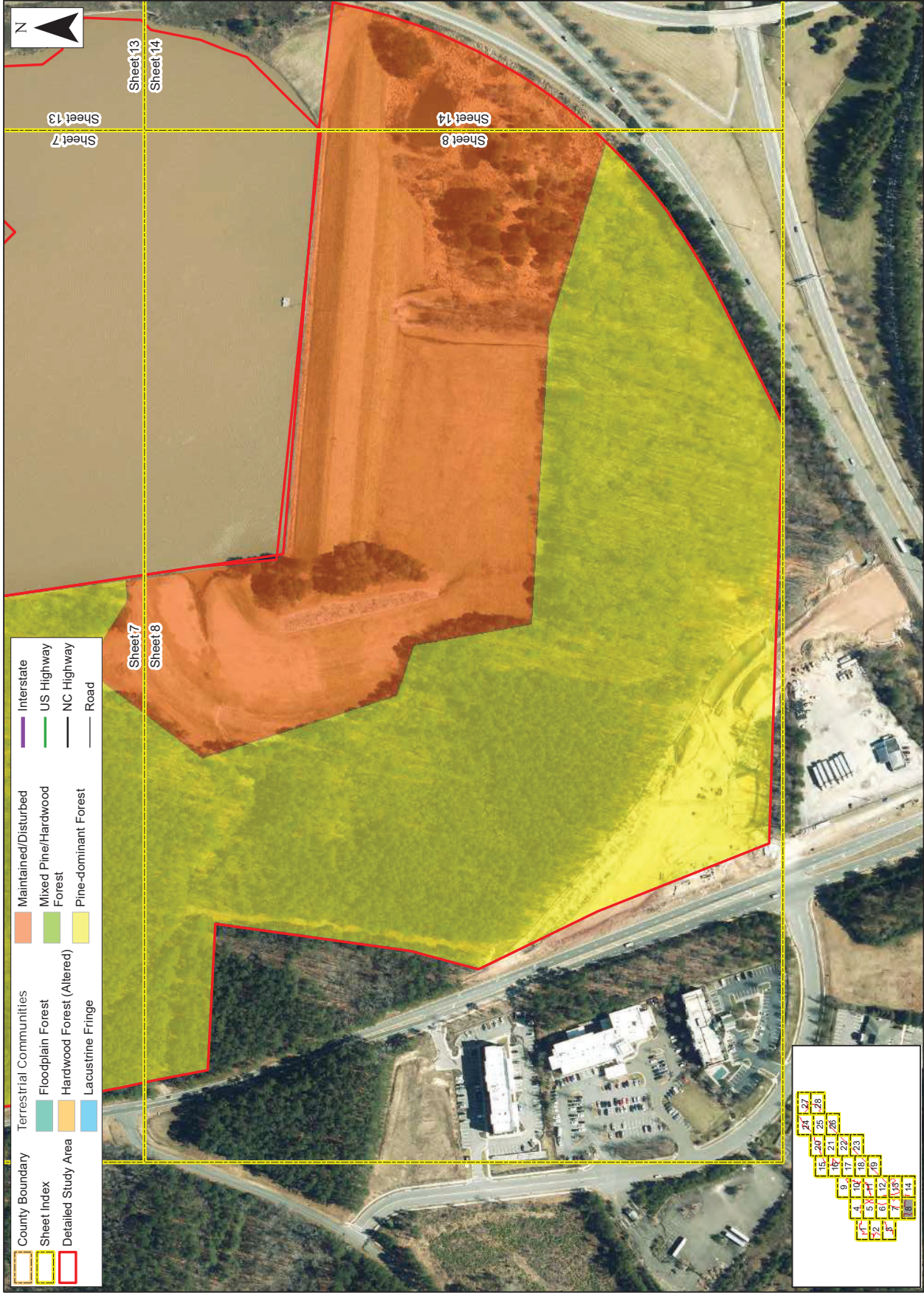
Date: September, 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3
Sheet 8





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

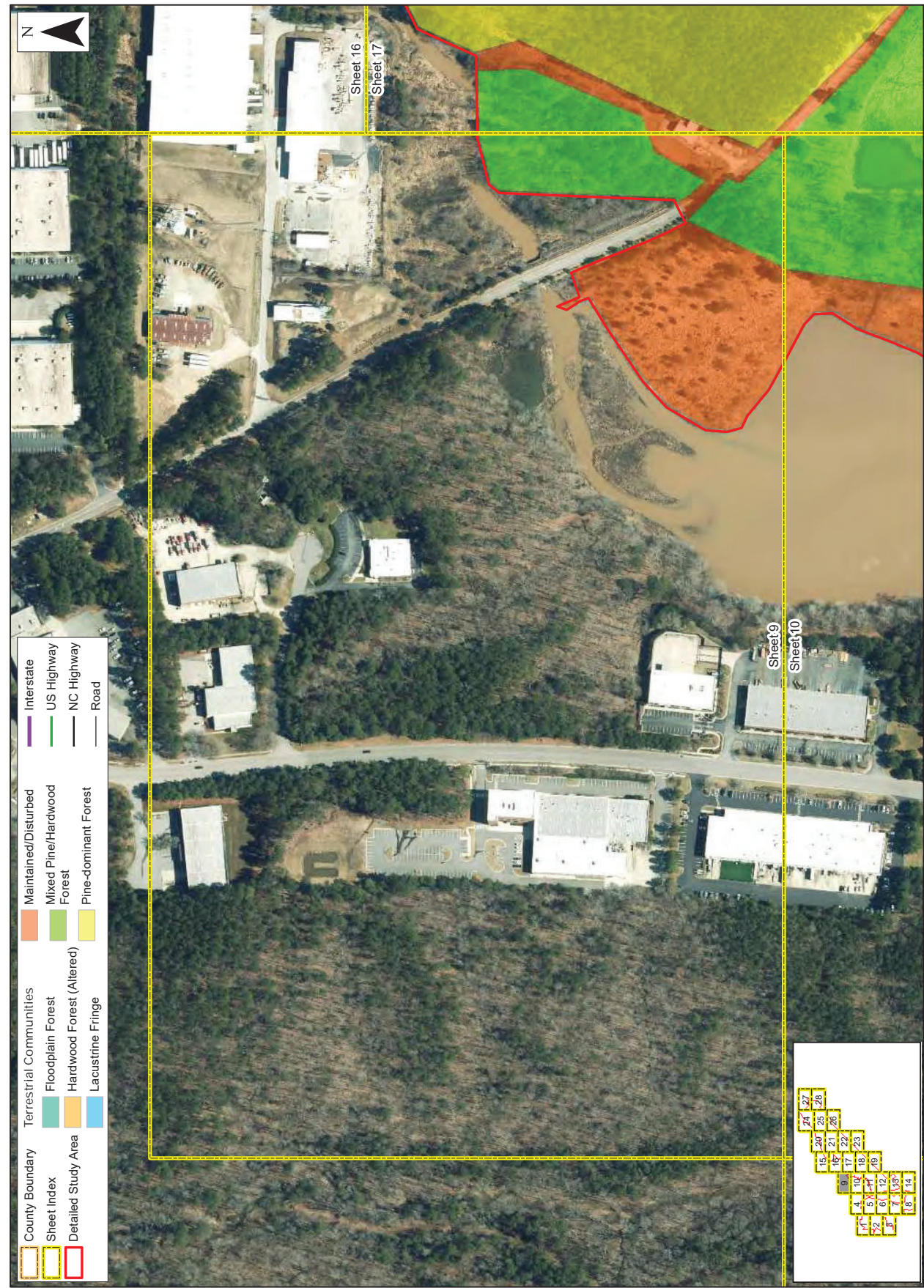
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 9



- County Boundary
- Sheet Index
- Detailed Study Area
- Terrestrial Communities
- Floodplain Forest
- Hardwood Forest (Altered)
- Lacustrine Fringe
- Maintained/Disturbed
- Mixed Pine/Hardwood Forest
- Pine-dominant Forest
- Interstate
- US Highway
- NC Highway
- Road





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

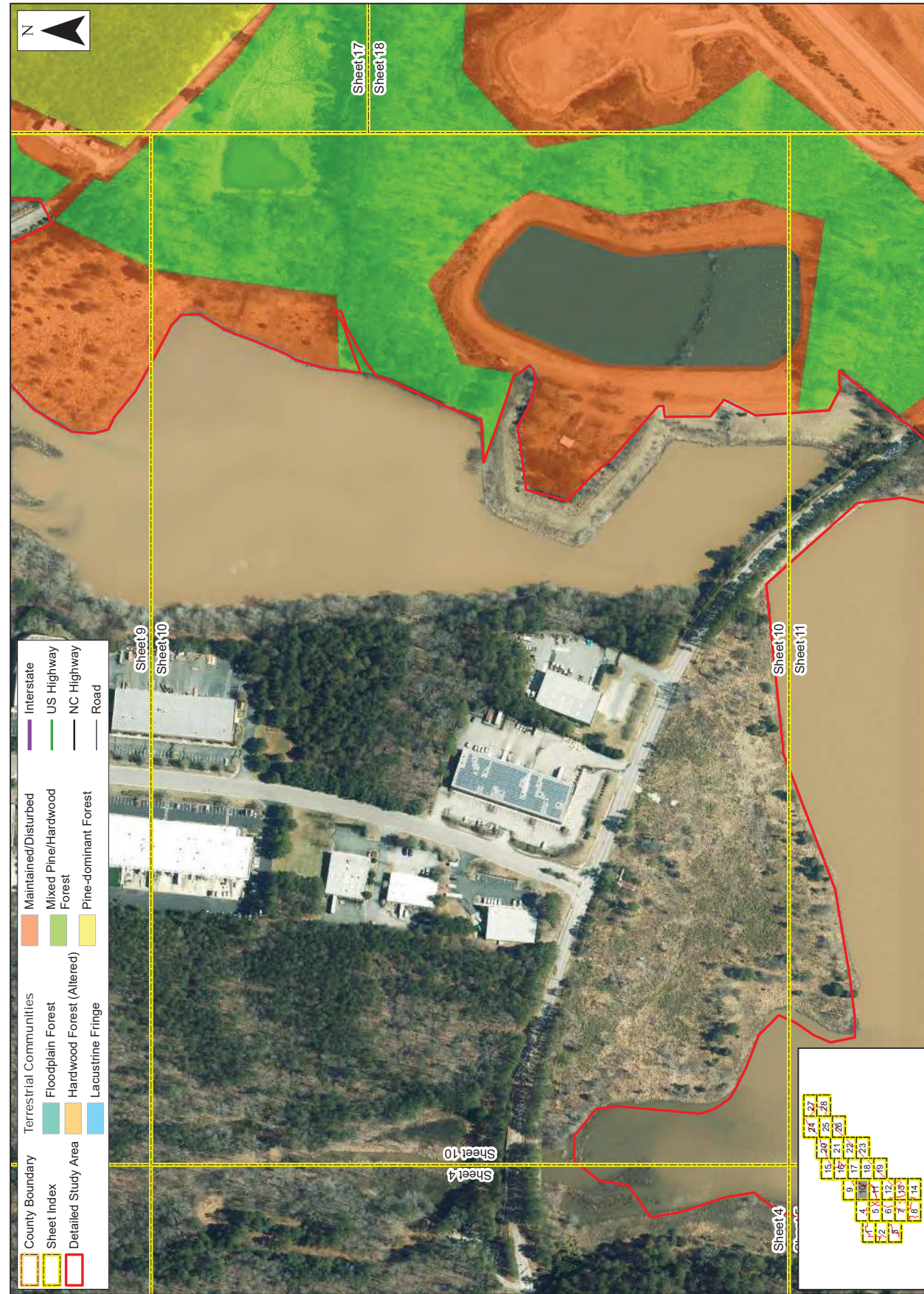
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 10





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

Scale: 0 100 200 FT

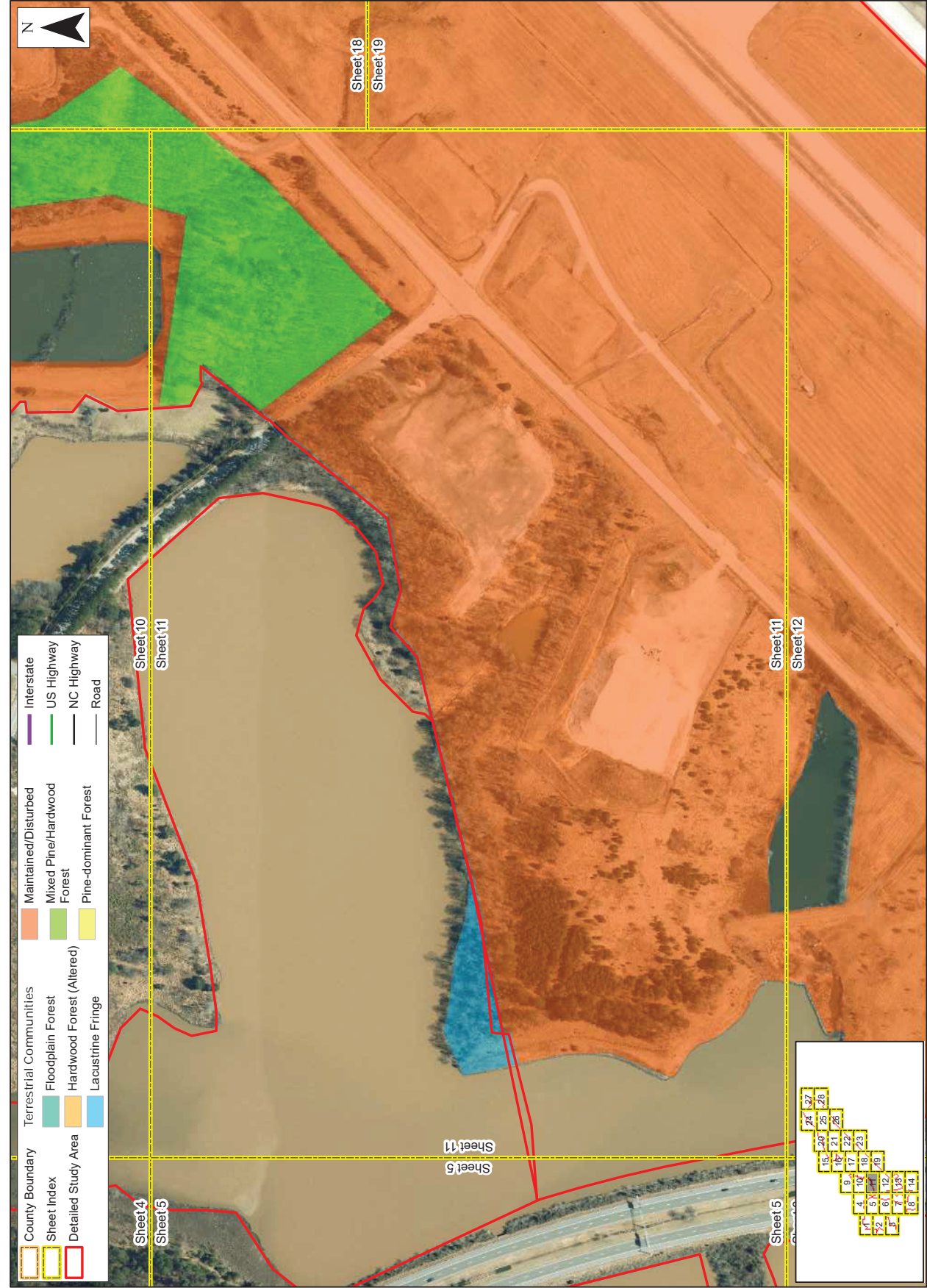
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 11





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

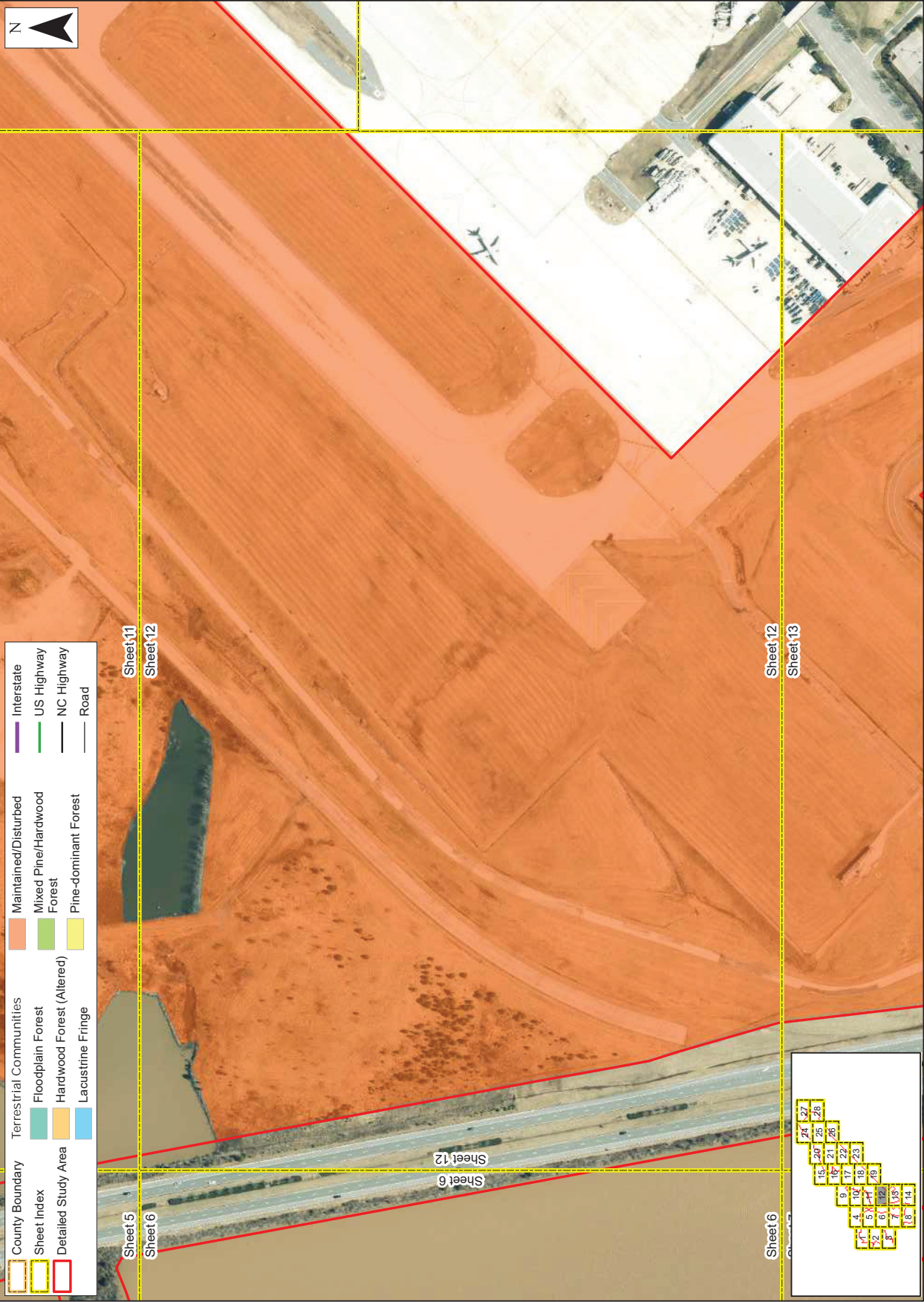
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 12



	County Boundary		Terrestrial Communities		Interstate
	Sheet Index		Floodplain Forest		US Highway
	Detailed Study Area		Hardwood Forest (Altered)		NC Highway
			Lacustrine Fringe		Road
			Maintained/Disturbed		
			Mixed Pine/Hardwood Forest		
			Pine-dominant Forest		





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

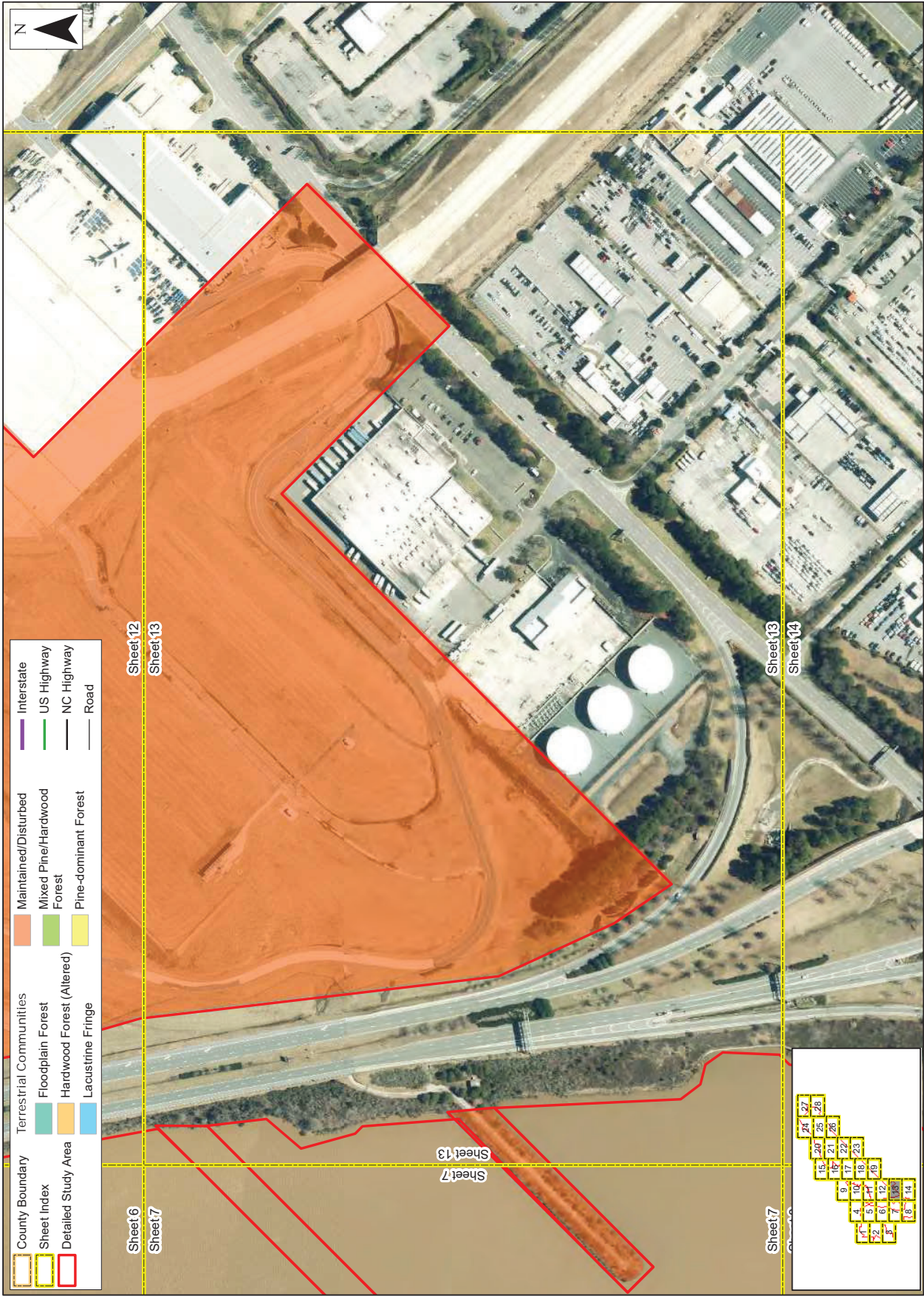
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 13



	County Boundary		Lacustrine Fringe		Interstate
	Sheet Index		Floodplain Forest		US Highway
	Detailed Study Area		Hardwood Forest (Altered)		NC Highway
			Maintained/Disturbed Forest		Road
			Pine-dominant Forest		
			Terrestrial Communities		
			Mixed Pine/Hardwood Forest		

24	27		
15	20	25	28
16	21	26	
7	22		
9	10	18	23
4	5	11	19
2	6	12	13
3	7	8	14



Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

Job No.: 19-018

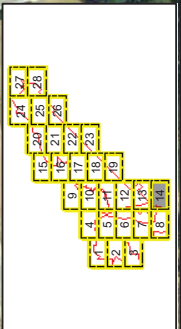
Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 14



- County Boundary
- Sheet Index
- Detailed Study Area
- Terrestrial Communities
- Floodplain Forest
- Hardwood Forest (Altered)
- Lacustrine Fringe
- Maintained/Disturbed
- Mixed Pine/Hardwood Forest
- Pine-dominant Forest
- Interstate
- US Highway
- NC Highway
- Road





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 15





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

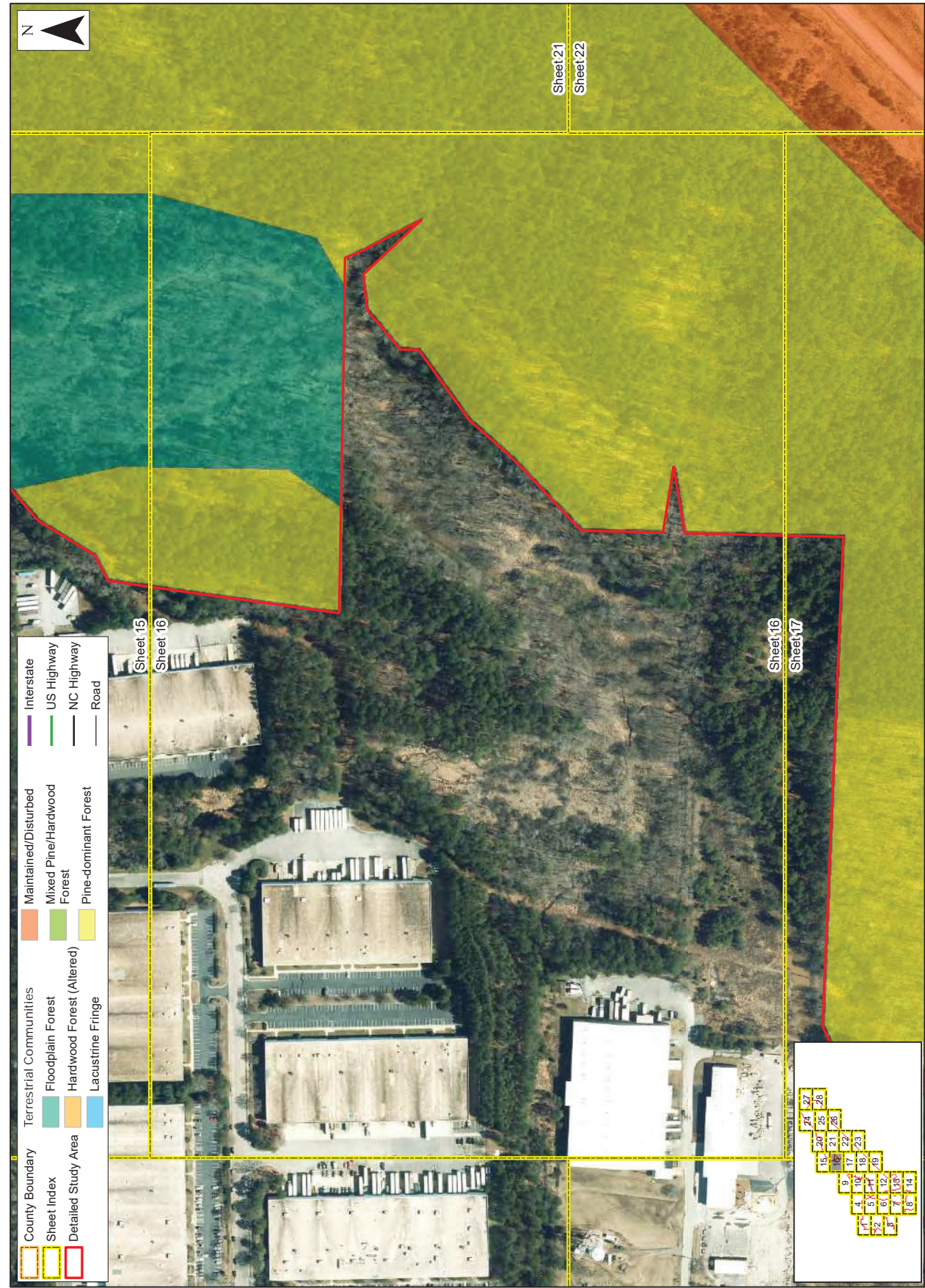
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 16



- | | | | |
|---------------------|---------------------------|----------------------------|------------|
| County Boundary | Floodplain Forest | Maintained/Disturbed | Interstate |
| Sheet Index | Hardwood Forest (Altered) | Mixed Pine/Hardwood Forest | US Highway |
| Detailed Study Area | Lacustrine Fringe | Pine-dominant Forest | NC Highway |
| | | | Road |





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

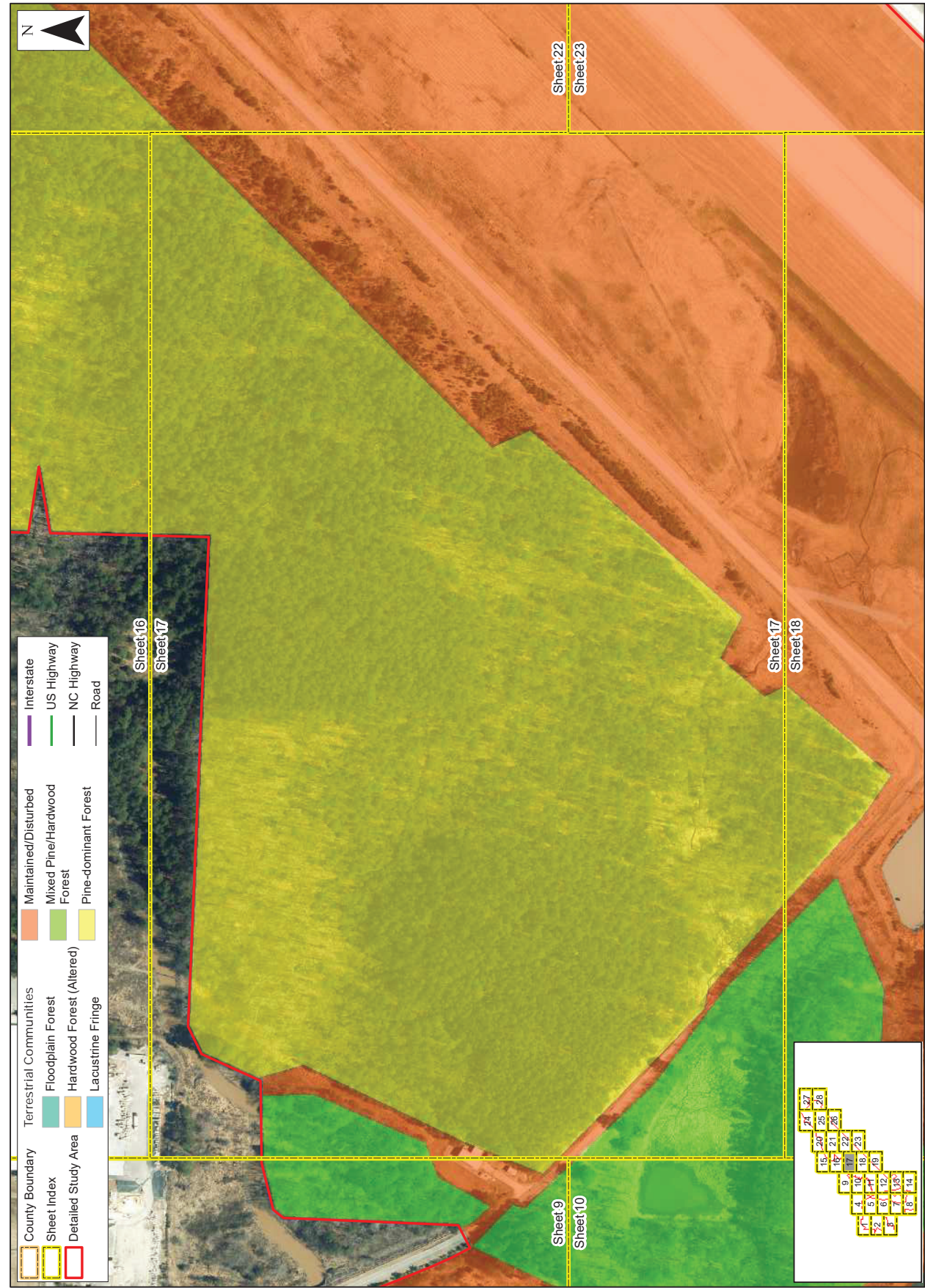
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 17





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 18



- County Boundary
- Sheet Index
- Detailed Study Area
- Terrestrial Communities
- Floodplain Forest
- Hardwood Forest (Altered)
- Lacustrine Fringe
- Maintained/Disturbed
- Mixed Pine/Hardwood Forest
- Pine-dominant Forest
- Interstate
- US Highway
- NC Highway
- Road





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 19



- | | | | | | |
|--|---------------------|--|----------------------------|--|------------|
| | County Boundary | | Terrestrial Communities | | Interstate |
| | Sheet Index | | Floodplain Forest | | US Highway |
| | Detailed Study Area | | Hardwood Forest (Altered) | | NC Highway |
| | | | Lacustrine Fringe | | Road |
| | | | Maintained/Disturbed | | |
| | | | Mixed Pine/Hardwood Forest | | |
| | | | Pine-dominant Forest | | |

Sheet 18
Sheet 19

Sheet 11
Sheet 12





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

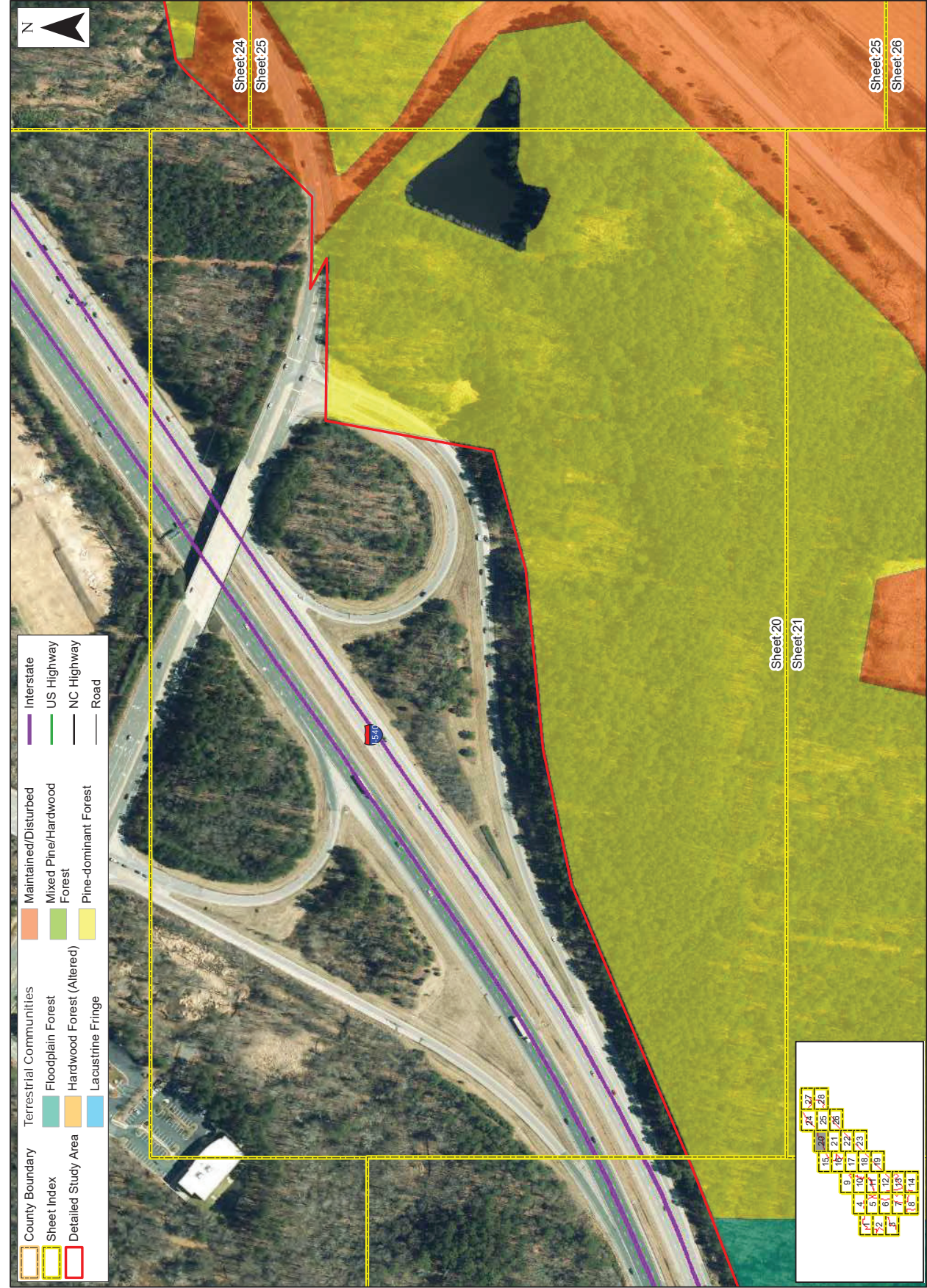
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 20



Sheet 24

Sheet 25

Sheet 25

Sheet 26

Sheet 20

Sheet 21





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 21



	County Boundary		Interstate
	Sheet Index		US Highway
	Detailed Study Area		NC Highway
	Terrestrial Communities		Road
	Floodplain Forest		
	Hardwood Forest (Altered)		
	Lacustrine Fringe		
	Maintained/Disturbed		
	Mixed Pine/Hardwood Forest		
	Pine-dominant Forest		





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 22



	County Boundary		Terrestrial Communities		Interstate
	Sheet Index		Floodplain Forest		US Highway
	Detailed Study Area		Hardwood Forest (Altered)		NC Highway
			Lacustrine Fringe		Road
			Maintained/Disturbed		
			Mixed Pine/Hardwood Forest		
			Pine-dominant Forest		

Sheet 21
Sheet 22

Sheet 22
Sheet 23

Sheet 16
Sheet 17





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

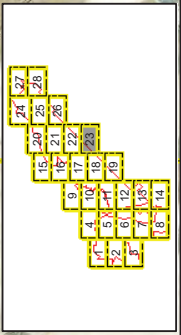
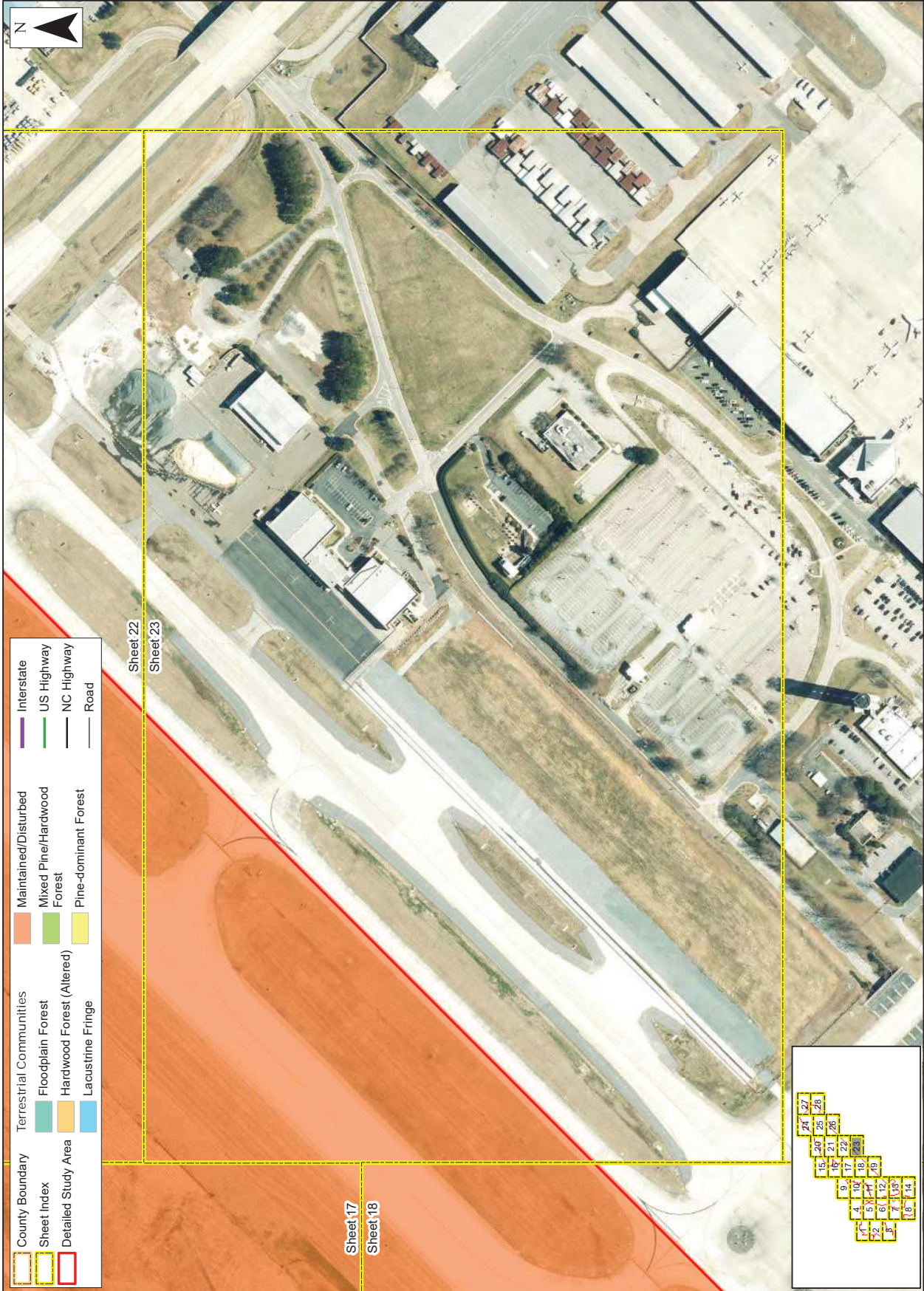
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 23



Sheet 17
Sheet 18

Sheet 22
Sheet 23



Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

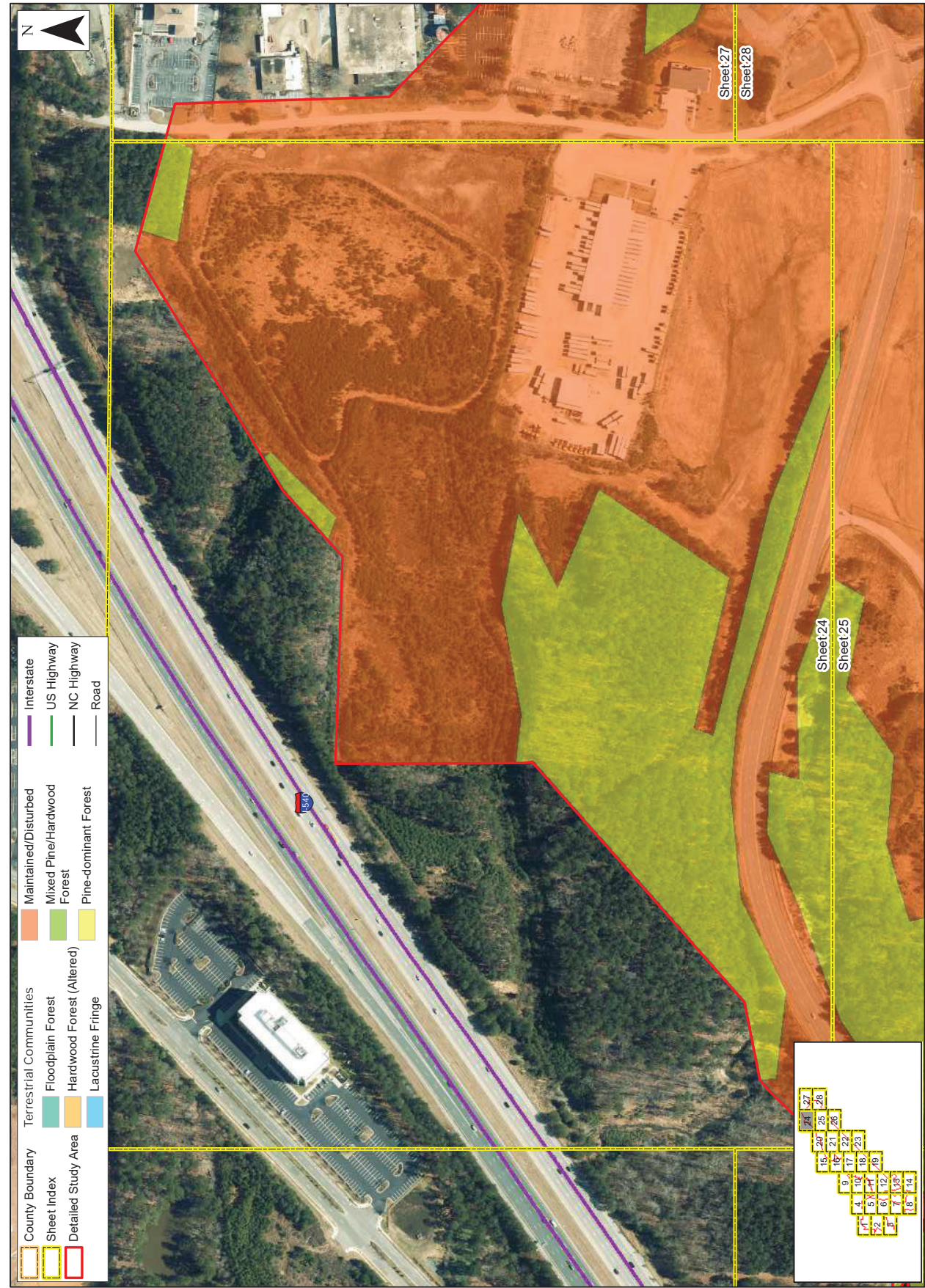
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 24



- County Boundary
- Sheet Index
- Detailed Study Area
- Terrestrial Communities
- Floodplain Forest
- Hardwood Forest (Altered)
- Lacustrine Fringe
- Interstate
- US Highway
- NC Highway
- Road
- Maintained/Disturbed
- Mixed Pine/Hardwood Forest
- Pine-dominant Forest



Sheet 27
Sheet 28

Sheet 24
Sheet 25



Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September 2022

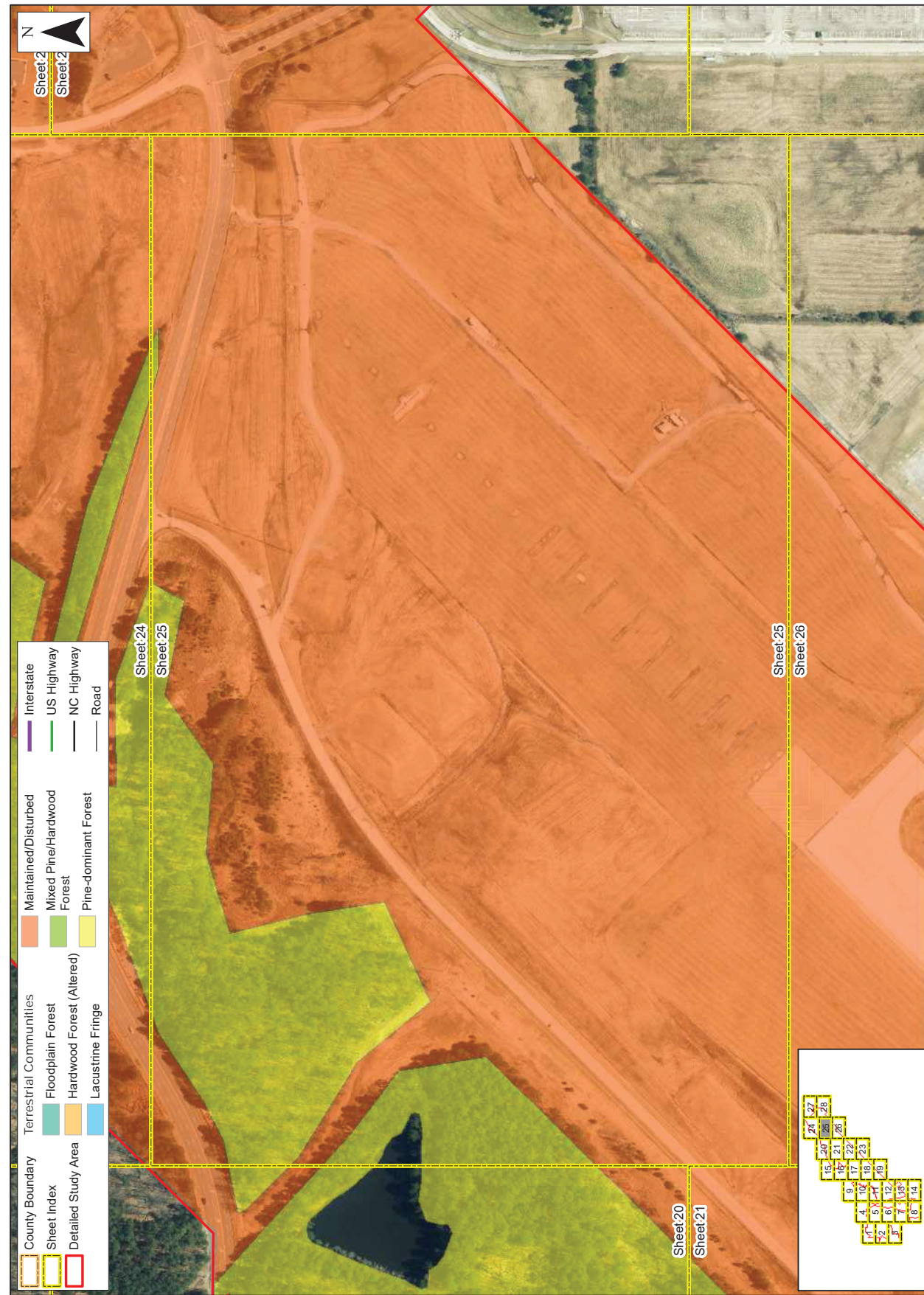
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 25





Prepared For:



Raleigh-Durham International Airport

Proposed Runway 5L/23R Replacement

Federal Environmental Assessment Terrestrial Communities Wake County, North Carolina

Date: September 2022

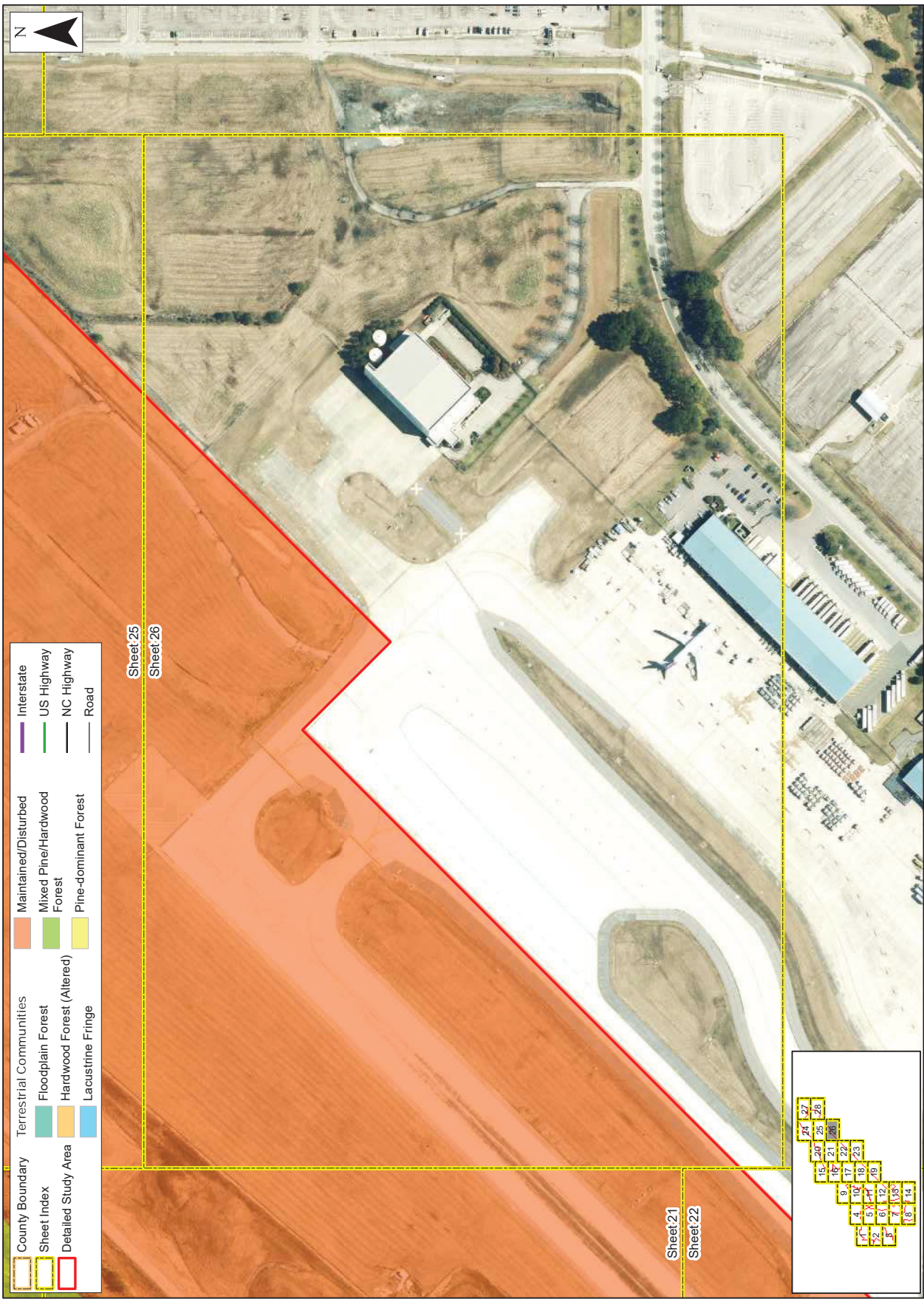
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure 3

Sheet 26





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

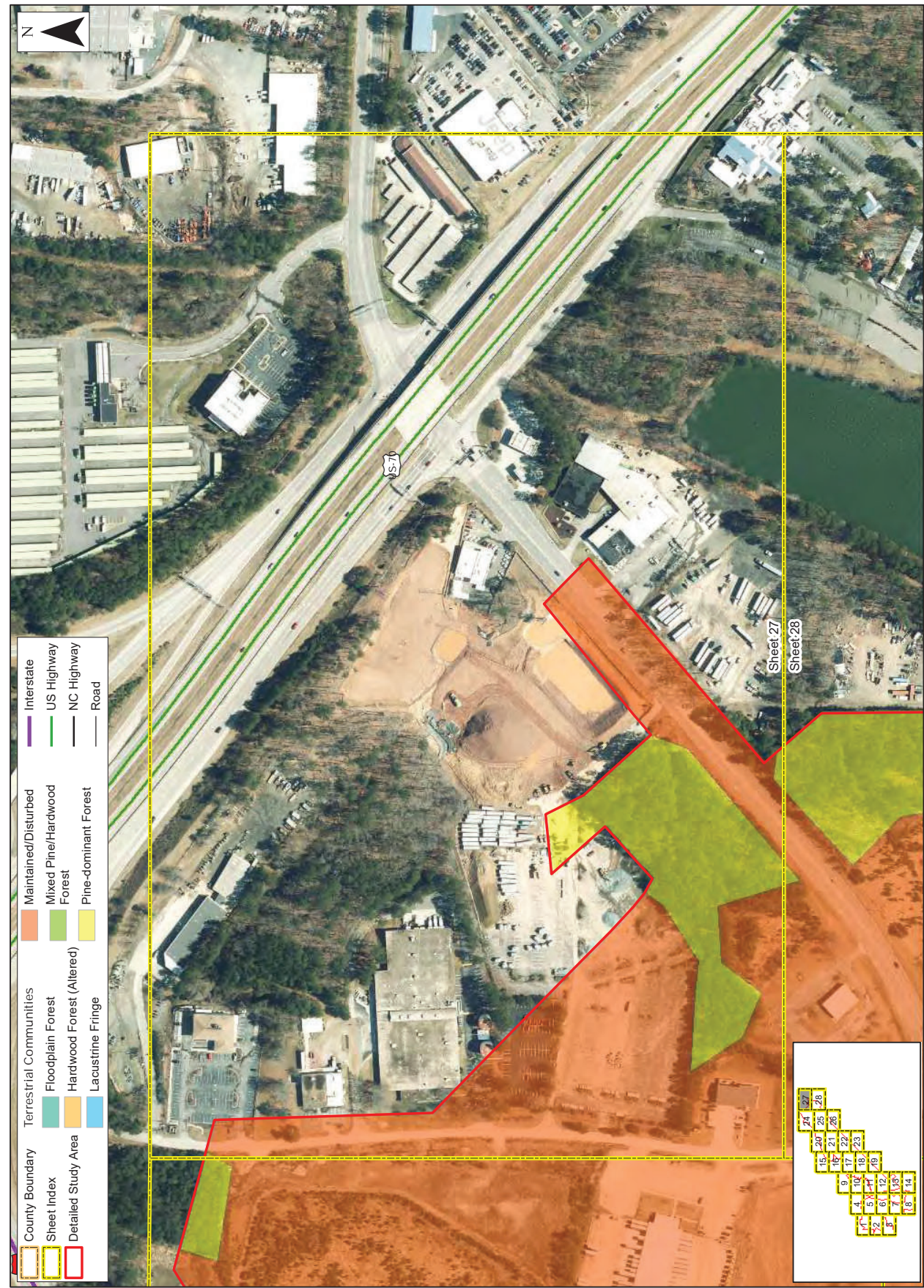
Scale: 0 100 200 FT

Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure
3

Sheet 27





Prepared For:



Raleigh-Durham
International
Airport

Proposed
Runway
5L/23R
Replacement

Federal
Environmental
Assessment
Terrestrial
Communities
Wake County,
North Carolina

Date: September, 2022

Scale: 0 100 200 FT

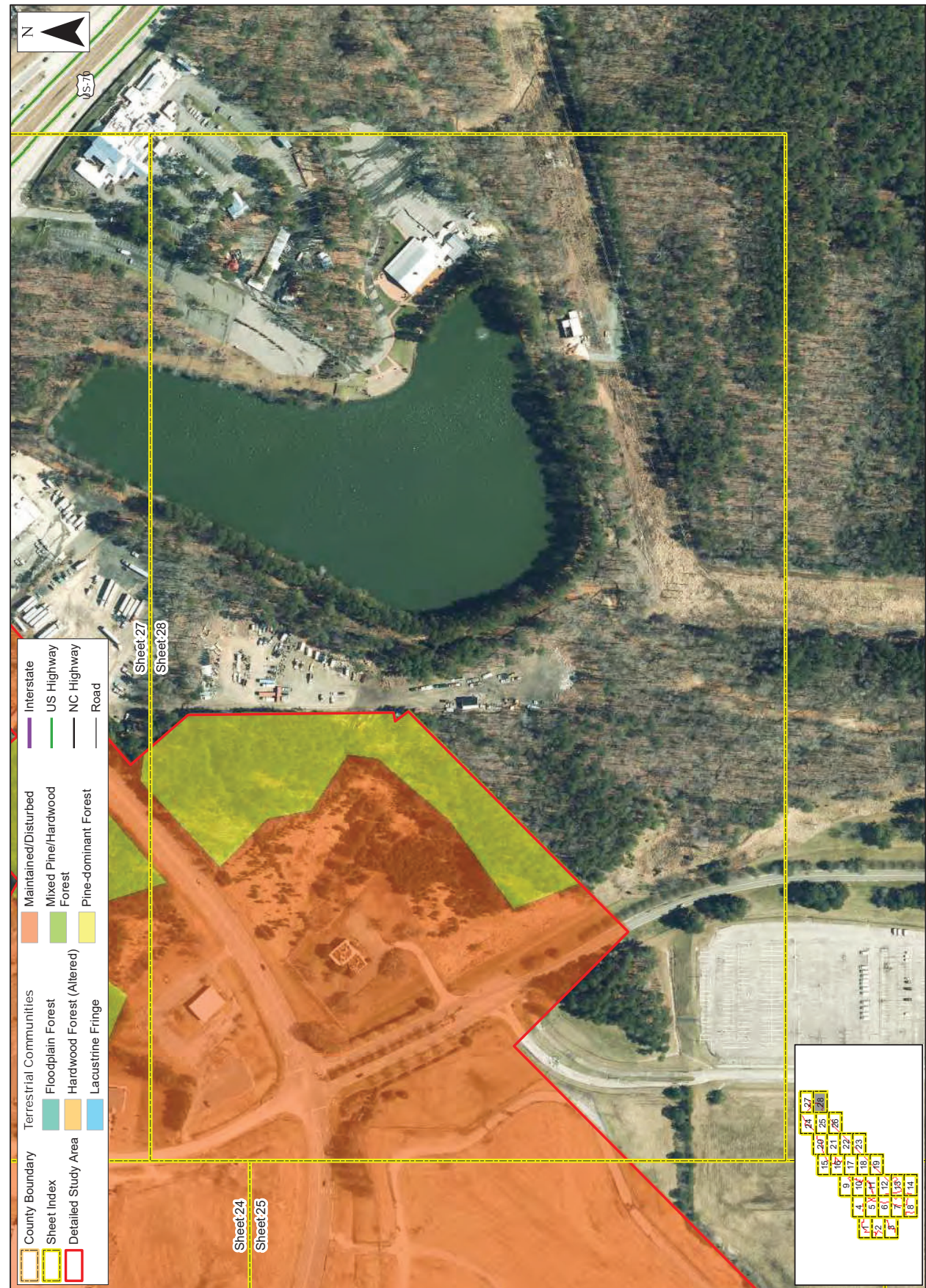
Job No.: 19-018

Drawn By: KEMS
Checked By: NDH

Figure

3

Sheet 28



Appendix B
Qualifications of Contributors

Investigator: Tom Dickinson
Education: B.S. Forestry/Natural Resources, Sewanee: The University of the South, 2001
Experience: Environmental Supervisor/Aquatic Biologist, Three Oaks Engineering, June 2015-present
Responsibilities: Environmental Scientist, The Catena Group. June 2003-June 2015
Aquatics surveys and reporting

Investigator: Trevor Hall
Education: BS, Environmental Science: Ecology and Organismal Biology, University of Delaware, 2016
Experience: Environmental Scientist, Three Oaks Engineering, July 2021-Present
Jr. Environmental Scientist, NV5 Consultants and Engineers, April 2019-July 2021
Senior Fisheries Technician, North Carolina State University, October 2018-April 2019
Responsibilities: Terrestrial and aquatic surveys, aquatics reporting

Investigator: Nathan Howell, PWS
Education: B.S. Fisheries, Wildlife, and Conservation Biology, North Carolina State University, 2013
M.S. Plant and Microbial Biology, North Carolina State University, 2015
Experience: Environmental Scientist, Three Oaks Engineering, October 2015-Present
Responsibilities: Document preparation and review, terrestrial surveys

Investigator: Byron Levan
Education: B.S. Fisheries, Wildlife, and Conservation Biology; North Carolina State University, 2011
M.F.W. Fisheries, Wildlife, and Conservation Biology, North Carolina State University, 2019
Experience: Environmental Scientist, Three Oaks Engineering, 2021-Present
Junior Environmental Scientist, NV5 Global Inc. 2019-2021
Responsibilities: Document preparation and review, terrestrial surveys

Investigator: James Mason, PWS
Education: B.A. Biology, Colby College, 2000
M.S. Biology/Ecology, UNC-Charlotte, 2004
Experience: Environmental Senior Scientist, Three Oaks Engineering, April 2018-Present
Responsibilities: Document preparation and review, terrestrial surveys



Investigator: Tess Moody
Education: B.S. in Natural Resources Management – Wildlife Biology, University of Tennessee at Martin, 2011
M.S. in Forestry, Wildlife, and Fisheries – Wildlife Health, University of Tennessee, 2013
Experience: Wildlife Research Technician/Assistant, UT Knoxville, May 2011-September 2013
Natural History Interpretive Aide, Charleston County Parks, February 2016-September 2018
Environmental Scientist, Three Oaks Engineering, September 2018–Present
Responsibilities: Terrestrial surveys

Investigator: Joanna Salvucci
Education: B.S. Environmental Geoscience, Bridgewater State University, 2020
Experience: Environmental Scientist, Three Oaks Engineering, March 2021-Present
Responsibilities: Document preparation and review

Investigator: Tim Savidge (Permit No. 21-ES0034)
Education: B.S. Biology, Guilford College, 1987
M.S. Marine Biology/Biological Oceanography, University of North Carolina at Wilmington, 1998
Experience: Environmental Manager & Aquatic Biologist, Three Oaks Engineering, June 2015-present
Environmental Specialist, NCDOT, 1992-2002
Responsibilities: Aquatics surveys and reporting

Investigator: Kate Sevick (Permit No. ES-00485)
Education: M.S. Environmental Sciences, University of Rhode Island, 2004
B.A. Biology, Reed College, 2000
Experience: Environmental Scientist, Three Oaks Engineering, June 2015-present
Environmental Scientist, The Catena Group, November 2004-June 2015
Responsibilities: GIS Mapping, Neuse River Waterdog surveys

Investigator: Lizzy Stokes-Cawley
Education: M.E.M. Water Resources, Duke University, 2016
B.S. Conservation Biology, St. Lawrence University, 2011
Experience: Environmental Scientist, Three Oaks Engineering, April 2017-Present
Responsibilities: Terrestrial and aquatic surveys, aquatics reporting



Appendix C
Aquatic Species Survey Report



Aquatic Species Survey Report

Natural Resources Evaluation of the Raleigh Durham International Airport

Wake County, North Carolina



Brier Creek in Survey Reach

Prepared For:



Landrum & Brown
Raleigh, North Carolina

January 31, 2022
Revised May 24, 2022

Prepared by:



324 Blackwell Street, Suite 1200
Durham, NC 27701

Contact Person:

Tim Savidge
tim.savidge@threeoaksengineering.com
919-732-1300

Table of Contents

1.0	Introduction.....	1
2.0	Waters Impacted	2
2.1	303(d) Classification	2
2.2	NPDES Discharges	2
3.0	Target Species Descriptions.....	3
3.1	Dwarf Wedgemussel (<i>Alasmidonta heterodon</i>)	3
3.1.1	Species Characteristics.....	3
3.1.2	Distribution and Habitat Requirements	3
3.1.3	Threats to Species	4
3.1.4	Designated Critical Habitat.....	5
3.2	Atlantic Pigtoe (<i>Fusconaia masoni</i>).....	6
3.2.1	Species Characteristics.....	6
3.2.2	Distribution and Habitat Requirements	6
3.2.3	Threats to Species	7
3.2.4	Designated Critical Habitat.....	7
3.3	Neuse River Waterdog (<i>Necturus lewisi</i>).....	9
3.3.1	Species Characteristics.....	9
3.3.2	Distribution and Habitat Requirements	9
3.3.3	Threats to Species	10
3.3.4	Designated Critical Habitat.....	10
3.4	Carolina Madtom (<i>Noturus furiosus</i>)	11
3.4.1	Species Characteristics.....	11
3.4.2	Distribution and Habitat Requirements	11
3.4.3	Threats to Species	12
3.4.4	Designated Critical Habitat.....	12
4.0	Other Target Species Descriptions.....	13
4.1	Savannah Lilliput (<i>Toxolasma pullus</i>)	13
4.1.1	Species Characteristics.....	13
4.1.2	Distribution and Habitat Requirements	13
4.1.3	Threats to Species	13
4.1.4	Species Listing.....	13
4.2	Green Floater (<i>Lasmigona subviridis</i>).....	14
4.2.1	Species Characteristics.....	14
4.2.2	Distribution and Habitat Requirements	14
4.2.3	Threats to Species	14
4.2.4	Species Listing.....	14
5.0	Survey Efforts	14
5.1	Impoundment Conditions: Brier Creek Reservoir	15
5.2	Stream Conditions: Brier Creek	15
5.3	Stream Conditions: Stirrup Iron Creek.....	16
5.4	Stream Conditions: Little Brier Creek	16
5.5	Methodology	16
5.5.1	Mussel Surveys.....	16
5.5.2	Neuse River Waterdog Surveys.....	17
5.5.3	Carolina Madtom Surveys	17
6.0	Results.....	18

6.1	Mussel Surveys	18
6.1.1	Brier Creek Reservoir 210929.2tws.....	18
6.1.2	Brier Creek Reservoir 210929.3tws.....	18
6.1.3	Brier Creek Reservoir 210929.4tws.....	19
6.1.4	Brier Creek 210921.2tws	19
6.1.5	Brier Creek 210929.1tws	19
6.1.6	Little Brier Creek 210929.5tws.....	20
6.1.7	Little Brier Creek 210929.6tws.....	20
6.1.8	Stirrup Iron Creek 211101.2tws.....	20
6.1.9	Brier Creek Reservoir 211207.1tws.....	21
6.1.10	Brier Creek Reservoir 211207.2tws.....	21
6.1.11	Brier Creek 211207.3tws	22
6.1.12	Brier Creek Reservoir 211209.1tws.....	22
6.2	Carolina Madtom Surveys.....	22
6.2.1	Brier Creek 210921.1tws	22
6.2.2	Little Brier Creek 211101.1tws.....	23
6.3	Neuse River Waterdog Surveys	23
6.3.1	Little Brier Creek	23
6.3.2	Brier Creek.....	24
6.3.3	Stirrup Iron Creek	25
7.0	Habitat Assessments	26
7.1	Little Brier Creek Reservoir.....	26
8.0	Discussion/Conclusions	26
9.0	Literature Cited	27

Appendix A. Figures:

Figure 1: Project Vicinity & Survey Locations

Figures 2-1 to 2-5: NCNHP Element Occurrences

Figure 3: 303(d) Streams and NPDES Discharge

1.0 INTRODUCTION

Landrum & Brown Inc. (Landrum & Brown) is conducting a natural resource evaluation located at the Raleigh Durham International Airport (RDU) property in Wake County (Figure 1). The project area encompasses multiple named streams in the Neuse River Basin. The Federally Endangered Dwarf Wedgemussel (*Alasmidonta heterodon*, DWM), Tar River Spiny mussel (*Parvaspina steinstansana*), Cape Fear Shiner (*Notropis mekistocholas*), and Carolina Madtom (*Noturus furiosus*) are listed by the U.S. Fish and Wildlife Service (USFWS) for Wake County. The Federally Threatened Neuse River Waterdog (*Necturus lewisi*), Atlantic Pigtoe (*Fusconaia masoni*), and Yellow Lance (*Elliptio lanceolata*), are listed by USFWS for Wake County. The USFWS Information for Planning and Consultation (IPaC) system lists DWM, Atlantic Pigtoe, Neuse River Waterdog, and Carolina Madtom as species that could be affected by activities in this location as of January 17, 2022 (USFWS IPaC 2022a). Because the Cape Fear Shiner is restricted to the Cape Fear River Basin, and the Tar River Spiny mussel and Yellow Lance are not known from this portion of the Neuse River Basin, they are not listed as vulnerable species at this location (USFWS IPaC 2022a); thus, they are not further addressed in this report.

The Green Floater (*Lasmigona subviridis*) is being considered for listing by the USFWS and is known to occur in Wake County. Although the Green Floater was not listed by IPaC in this location, it was added due to a historical record of the species in close proximity to the Detailed Study Area (DSA; Figure 2). The Savannah Lilliput (*Toxolasma pullus*) has no current federal listing status but is listed as endangered in North Carolina and was presumed extirpated (Bogan 2017) from the Neuse River Watershed (USFWS 2016). During surveys of Brier Creek conducted for this project, Three Oaks staff located shells and one live individual.

Table 1 lists the nearest element occurrence (EO) for targeted species in approximate river miles (RM) from Brier Creek at its exit of the study area. Data are from the NC Natural Heritage Program database (NCNHP 2022) most recently updated in January 2022 (Figure 2-1 through 2-5).

Table 1. Element Occurrences

Species Name	EO ID	EO Waterbody	Distance (river miles)	First Observed	Last Observed	EO Status*	Figure Number
Dwarf Wedgemussel	7699	Neuse River	23.5	1951	1951	H	2-1
	13799	Swift Creek/Middle Creek	>50	March 1991	March 2020	C	
Atlantic Pigtoe	14599	Crabtree Creek	5.9	October 1995	May 2003	C	2-2
Neuse River Waterdog	12592	Crabtree Creek	7.8	1979	1979	H	2-3
	40669	Crabtree Creek	16.5	March 2021	March 2021	C	
Carolina Madtom	10676	Neuse River/ Crabtree Creek	22.0	August 1888	August 1902	H	2-4
	3858	Little River	>50	June 1961	July 2005	C	

Species Name	EO ID	EO Waterbody	Distance (river miles)	First Observed	Last Observed	EO Status*	Figure Number
Green Floater	39613	Stirrup Iron Creek	2.0	1960	1960	H	2-5
	28706	Neuse River	23.5	July 2010	May 2018	C	
Savannah Lilliput**	41253	Brier Creek	Within Study Area	September 2021	September 2021	C	N/A

*: C-NCNHP Current; H -NCNHP Historic

** : EO added from this project

As part of the federal permitting process that requires an evaluation of potential project-related effects to federally protected species, Landrum & Brown contracted Three Oaks to conduct surveys targeting the DWM, Atlantic Pigtoe, Neuse River Waterdog, Carolina Madtom, Green Floater, and Savannah Lilliput.

2.0 WATERS IMPACTED

The DSA is located in the Upper Neuse River subbasin (HUC# 03020201) of the Neuse River Basin. Areas within the DSA drain either to Brier Creek or Stirrup Iron Creek before exiting the DSA. Brier Creek flows approximately 1.9 RM to the confluence with Lake Crabtree/ Crabtree Creek. Stirrup Iron Creek flows approximately 2.3 RM from the tailrace of the Stirrup Iron Creek Reservoir to the confluence with Brier Creek just upstream of Lake Crabtree. Crabtree Creek then flows from the tailrace of Lake Crabtree 20.5 RM to its confluence with the Neuse River.

2.1 303(d) Classification

There are several streams within a 5-mile buffer of the DSA area listed on the 2020 303(d) final list of impaired streams (NC Division of Water Resources [NCDWR] 2020). In the study area, Brier Creek and Little Brier Creek are impaired for exceeding criteria for a PCB Fish Tissue Advisory. Crabtree Creek (including Lake Crabtree) and Hare Snipe Creek are impaired for poor bioclassification. Black Creek and Richland Creek are impaired for fair bioclassification (Figure 3).

2.2 NPDES Discharges

The North Carolina Division of Environmental Quality (NCDEQ) lists several active permitted discharges within a 5-mile buffer of the DSA, one of which, the RDU Delivery Facility (NC0081479), is listed as a minor discharger into Brier Creek. The other four discharges within the 5-mile radius occur outside of the DSA. The closest major permitted National Pollutant Discharge Elimination System (NPDES) discharge is the North Cary Water Reclamation Facility (NC0048879), located 3.25 RM downstream of the DSA just downstream of Lake Crabtree. The Triangle Wastewater Treatment Plant (WWTP; NC0026051) is listed as a major discharge but is located in the Cape Fear River Basin. The Hawthorne Subdivision WWTP (NC0049662) and the

Wildwood Green WWTP (NC0063614) are listed as minor discharges and are in a different HUC10 (Middle Falls Lake) than the DSA. (NCDEQ 2020) (Figure 3).

3.0 TARGET SPECIES DESCRIPTIONS

3.1 Dwarf Wedgemussel (*Alasmidonta heterodon*)

3.1.1 Species Characteristics



The DWM was originally described as *Unio heterodon* (Lea 1829). Simpson (1914) subsequently placed it in the genus *Alasmidonta*. Ortmann (1919) placed it in a monotypic subgenus *Prolasmidonta*, based on the unique soft-tissue anatomy and conchology. Fuller (1977) believed the characteristics of *Prolasmidonta* warranted elevation to full generic rank and renamed the species *Prolasmidonta heterodon*. Clarke (1981) retained the genus name *Alasmidonta* and considered *Prolasmidonta* to be a subjective synonym of the subgenus *Pressodonta* (Simpson 1900).

The specific epithet *heterodon* refers to the chief distinguishing characteristic of this species, which is the only North American freshwater mussel that consistently has two lateral teeth on the right valve and only one on the left (Fuller 1977). All other laterally dentate freshwater mussels in North America normally have two lateral teeth on the left valve and one on the right. The DWM is generally small, with a shell length ranging between 25 millimeters (mm) (1.0 inch) and 38 mm (1.5 inches). The largest specimen reported by Clarke (1981) was 56.5 mm (2.2 inches) long, taken from the Ashuelot River in New Hampshire. The periostracum is generally olive green to dark brown; nacre bluish to silvery white, turning to cream or salmon colored towards the umbonal cavities. Sexual dimorphism occurs in DWM, with the females having a swollen region on the posterior slope, and the males are generally flattened. Clarke (1981) provides a detailed description of the species.

Nearly all freshwater mussel species have similar reproductive strategies; a larval stage (glochidium) becomes a temporary obligatory parasite on a fish. Many mussel species have specific fish hosts, which must be present to complete their life cycle. Based upon laboratory infestation experiments, Michaelson and Neves (1995) determined that potential fish hosts for the DWM in North Carolina include the Tessellated Darter (*Etheostoma olmstedi*) and the Johnny Darter (*E. nigrum*). McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

3.1.2 Distribution and Habitat Requirements

The historic range of the DWM is confined to Atlantic slope drainages from the Peticodiac River in New Brunswick, Canada, south to the Neuse River, North Carolina. Occurrence records exist from at least 70 locations, encompassing 15 major drainages, in 11 states and one Canadian Province (USFWS 1993). When the recovery plan for this species was written, the DWM was

believed to have been extirpated from all but 36 localities, 14 of them in North Carolina (USFWS 1993). The most recent assessment (2013 5-Year Review) indicates that the DWM is currently found in 16 major drainages, comprising approximately 75 "sites" (one site may have multiple occurrences). At least 45 of these sites are based on less than five individuals or solely on relict shells. It appears that the populations in North Carolina, Virginia, and Maryland are declining as evidenced by low densities, lack of reproduction, or inability to relocate any individuals in follow-up surveys. Populations in New Hampshire, Massachusetts, and Connecticut appear to be stable, while the status of populations in the Delaware River watershed affected by the multiple flood events between 2004 and 2006 are still being studied (USFWS 2013).

Strayer et al. (1996) conducted range-wide assessments of remaining DWM populations and assigned a population status to each of the populations. The status rating is based on range size, number of individuals and evidence of reproduction. Seven of the 20 populations assessed were considered "poor," and two others are considered "poor to fair" and "fair to poor," respectively. In North Carolina, populations are found in portions of the Neuse and Tar River basins; however, the species is believed to have been extirpated from the main stem of the Neuse River.

The DWM inhabits creeks and rivers of varying sizes (down to approximately two meters wide), with slow to moderate flow. A variety of preferred substrates have been described that range from coarse sand, to firm muddy sand, to gravel (USFWS 1993). In North Carolina, DWM often occurs within submerged root mats along stable streambanks. The wide range of substrate types used by this species suggests that the stability of the substrate is likely as important as the composition.

3.1.3 Threats to Species

The cumulative effects of several factors, including sedimentation, point and non-point discharge, stream modifications (impoundments, channelization, etc.) have contributed to the decline of this species throughout its range. Except for the Neversink River population in New York, which has an estimated population of over 80,000 DWM individuals, all the other populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity (Strayer et al. 1996). Catastrophic events may consist of natural events such as flooding or drought, as well as human influenced events such as toxic spills associated with highways, railroads, or industrial-municipal complexes.

Siltation resulting from substandard land-use practices associated with activities such as agriculture, forestry, and land development has been recognized as a major contributing factor to degradation of mussel populations. Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than one inch have been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of the DWM because of accelerated sedimentation and erosion (Smith 1981).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations may not occur for up to two miles below points of chlorinated sewage effluent.

The impact of impoundments on freshwater mussels has been well documented (USFWS 1992a, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes in aquatic community composition. The changes associated with inundation adversely affect both adult and juvenile mussels, as well as fish community structure, which could eliminate possible fish hosts for upstream transport of glochidia. Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for naiads (mussels) in the world, is now at the bottom of Wilson Reservoir and covered with 19 feet of muck (USFWS 1992b). Large portions of all the river basins within the DWM's range have been impounded; this is believed to be a major factor contributing to the decline of the species (Master 1986).

The introduction of exotic species such as the Asian Clam (*Corbicula fluminea*) and Zebra Mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The Asian Clam is now established in most of the major river systems in the United States (Fuller and Powell 1973), including those streams still supporting surviving populations of the DWM. Concern has been raised over competitive interactions for space, food and oxygen with this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987, Alderman 1995). The Zebra Mussel, native to the drainage basins of the Black, Caspian, and Aral Seas, is an exotic freshwater mussel that was introduced into the Great Lakes in the 1980s and has rapidly expanded its range into the surrounding river basins, including those of the South Atlantic slope (O'Neill and MacNeill 1991). This species competes for food resources and space with native mussels and is expected to contribute to the extinction of at least 20 freshwater mussel species if it becomes established throughout most of the eastern United States (USFWS 1992b). The Zebra Mussel is not currently known to be present in any river supporting DWM population.

3.1.4 *Designated Critical Habitat*

The DWM has no official designated critical habitat.

3.2 Atlantic Pigtoe (*Fusconaia masoni*)

3.2.1 Species Characteristics



The Atlantic Pigtoe was described by Conrad (1834) from the Savannah River in Augusta, Georgia. Although larger specimens exist, the Atlantic Pigtoe seldom exceeds 50 mm (2 inches) in length. This species is tall relative to its length, except in headwater stream reaches where specimens may be elongated. The hinge ligament is relatively short and prominent. The periostracum is normally brownish, has a parchment texture, and young individuals may have greenish rays across the entire shell surface. The posterior ridge is biangulate. The interdentum in the left valve is broad and flat. The anterior half of the valve is thickened compared with the posterior half, and, when fresh, nacre in the anterior half of the shell tends to be salmon colored, while nacre in the posterior half tends to be more iridescent. The shell has full dentation. In addition to simple papillae, branched and arborescent papillae are often seen on the incurrent aperture. In females, salmon colored demibranchs are often seen during the spawning season. When fully gravid, females use all four demibranchs to brood glochidia (VDGIF 2014).

The Atlantic Pigtoe is a tachytictic (short-term) breeder, brooding young in early spring and releasing glochidia in early summer. The Bluegill (*Lepomis macrochirus*) and Shield Darter (*Percina peltata*) have been identified as potential fish hosts for this species (O'Dee and Waters 2000). Additional research has found Rosefin Shiner (*Lythrurus ardens*), Creek Chub (*Semotilus atromaculatus*), and Longnose Dace (*Rhynchithys cataractae*) are also suitable hosts (Wolf 2012). Eads and Levine (2012) found White Shiner (*Luxilus albeolus*), Satinfish Shiner (*Cyprinella analostana*), Bluehead Chub (*Nocomis leptoccephalus*), Rosyside Dace (*Clinostomus funduloides*), Pinewoods Shiner (*Lythrurus matutinus*), Swallowtail Shiner (*Notropis procne*), and Mountain Redbelly Dace (*Chrosomus oreas*) to also be suitable hosts for Atlantic Pigtoe.

3.2.2 Distribution and Habitat Requirements

Johnson (1970) reported the range of the Atlantic Pigtoe extended from the Ogeechee River Basin in Georgia north to the James River Basin in Virginia; however, recent curation of the H. D. Athearn collection uncovered valid specimens from the Altamaha River in Georgia (USFWS 2021a). In addition, USFWS (2021a) citing Alderman and Alderman (2014) reported two shells from the 1880's that also documented the historical occurrence in the Altamaha River Basin. It is presumed extirpated from the Catawba River Basin in North and South Carolina south to the Altamaha River Basin (USFWS 2021a, USFWS 2021b). The general pattern of its current distribution indicates that the species is currently limited to headwater areas of drainages and most populations are represented by few individuals. In North Carolina, aside from the Waccamaw River, it was once found in every Atlantic Slope River basin. Except for the Tar River, it is no longer found in the mainstem of the rivers within its historic range (Savidge et al. 2011). It is listed as Endangered in Georgia, South Carolina, and North Carolina, and as Threatened in Virginia. It has a NatureServe rank of G2 (imperiled).

The Atlantic Pigtoe has been found in multiple physiographic provinces, from the foothills of the Appalachian Mountains, through the Piedmont and into the Coastal Plain, in streams less than one meter wide to large rivers. The preferred habitat is a substrate composed of gravel and coarse sand, usually at the base of riffles; however, it can be found in a variety of other substrates and lotic habitat conditions.

3.2.3 *Threats to Species*

Threats to the Atlantic Pigtoe are similar to those described for the DWM and have contributed to the decline of this species throughout its range. Atlantic Pigtoe appears to be particularly sensitive to pollutants and requires clean, oxygen-rich water for all stages of life. All the remaining Atlantic Pigtoe populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event.

3.2.4 *Designated Critical Habitat*

As mentioned in Section 1.0, the Atlantic Pigtoe is listed as a Federally Threatened Species under the Endangered Species Act (ESA) with Section 4(d) Rule and Critical Habitat Designation. In accordance with Section 4 of the ESA, Critical Habitat for listed species consists of:

- (1) The specific areas within the geographical area occupied by the species at the time it is listed, in which are found those physical or biological features (constituent elements) that are:
 - a. essential to the conservation of the species, and
 - b. which may require special management considerations or protection
- (2) Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the Act, upon a determination by the Secretary that such areas are “essential for the conservation of the species.”

On November 16, 2021, USFWS listed the Atlantic Pigtoe as a Threatened species under the ESA. Critical habitat was revised with the listing (86 FR 64000) and consists of the following (USFWS 2021b):

- Unit 1 (JR1) - 29 river mi (46.7 river km) of Craig Creek in Craig and Botetourt Counties, Virginia
- Unit 2 (JR2) - 1 mile (1.6-km) of Mill Creek in Bath County, Virginia
- Unit 3 (CR1) - 4 miles (6.6 km) of Sappony Creek in the Chowan River Basin in Dinwiddie County, Virginia

- Unit 4 (CR2) - 64 river miles (103 river km) of the Nottoway River and a portion of Sturgeon Creek in Nottoway, Lunenburg, Brunswick, Dinwiddie, and Greenville Counties, Virginia
- Unit 5 (CR3) - 5 miles (8 km) of the Meherrin River in Brunswick County, Virginia
- Unit 6 (RR1) - 14 miles (22.5 km) of the Dan River in Pittsylvania County, Virginia and Rockingham County, North Carolina
- Unit 7 (RR2) - 12 miles (19.3 km) of Aarons Creek in Granville County, North Carolina and along the Mecklenburg County-Halifax County line in Virginia and North Carolina
- Unit 8 (RR3) - 3 miles (4.8 km) of Little Grassy Creek in the Roanoke River Basin in Granville County, North Carolina
- Unit 9 (TR1) - 91 miles (146.5 km) of the mainstem of the upper and middle Tar River as well as several tributaries (Bear Swamp Creek, Crooked Creek, Cub Creek, and Shelton Creek), in Granville, Vance, Franklin, and Nash Counties, North Carolina.
- Unit 10 (TR2) - 50 miles (80.5km) of Sandy/Swift Creek in Granville, Vance, Franklin, and Nash Counties, North Carolina
- Unit 11 (TR3) - 85 miles (136.8 km) in Fishing Creek, Little Fishing Creek, Shocco Creek, and Maple Branch located in Warren, Halifax, Franklin, and Nash Counties, North Carolina
- Unit 12 (TR4) - 30 miles (48.3 km) of the Lower Tar River, lower Swift Creek and lower Fishing Creek in Edgecombe County, North Carolina
- Unit 13 (NR1) - 60 river miles (95 river km) in four subunits including Flat River, Little River, Eno River, and the Upper Eno River in Person, Durham, and Orange Counties, North Carolina
- Unit 14 (NR2) - 61 river miles (98.2 river km) in five subunits including Swift Creek, Middle Creek, Upper Little River, Middle Little River, and Contentnea Creek in Wake, Johnston, and Wilson Counties, North Carolina
- Unit 15 (CF1) - 4 miles (6.4 km) of habitat in the New Hope Creek in Orange County, North Carolina
- Unit 16 (CF2) - 10 river miles (16.1 river km) of Deep River in Randolph County, North Carolina, including the mainstem as well as Richland Creek and Brush Creek
- Unit 17 (YR1) - 40 miles (64.4 km) of Little River in Randolph and Montgomery Counties, North Carolina

*JR, CR, RR, TR, NR, CF and YR denote James River, Chowan River, Roanoke River, Tar River, Neuse River, Cape Fear River and Yadkin River Basins, respectively.

Brier Creek does not occur within or drain directly to any of the Critical Habitat Units. It is more than 50 RM upstream of proposed Critical Habitat Unit 14 (NR2) (specifically the subunit located in Swift Creek (Figure 2-2)).

3.3 Neuse River Waterdog (*Necturus lewisi*)

3.3.1 Species Characteristics



The Neuse River Waterdog, a fully aquatic salamander, was first described by C.S. Brimley in 1924, as a subspecies of the Common Mudpuppy (*N. maculosus*); it was elevated to species status in 1937 by Percy Viosca, Jr.

The Neuse River Waterdog ranges in size from 6-9 inches (15.24 – 22.86 cm) in length; record length is 11 inches (27.94 cm). It has a somewhat stocky, cylindrical body with smooth skin, a rather flattened, elongate head with a squared-off nose, and small limbs. The tail is vertically flattened with fins on both the top and bottom. Distinct from most salamanders, the Neuse River Waterdog and other *Necturus* species, have four toes on each foot. The Neuse River Waterdog is a rusty brown color on the dorsal side and dull brown or slate colored on the ventral side. Both dorsal and ventral sides are strongly spotted but the ventral side tends to have fewer and smaller markings; spots are dark bluish to black. They also have a dark line running through the eye. Adults are neotenuous and retain three bushy, dark red external gills usually seen in larval amphibians. Both male and female are similar in appearance and can be distinguished only through differences in the shape and structure of the cloaca (Beane and Newman 1996; Conant and Collins 1998; EDGE of Existence 2016).

Individuals become sexually mature at approximately 5-6 years of age. Breeding normally occurs in the spring. The male deposits a gelatinous spermatophore that is picked up by the female and used to fertilize between 30-50 eggs. The fertilized eggs are attached to the underside of flat rocks or other submerged objects and guarded by the female until they hatch in June or July (Conant and Collins 1998; EDGE of Existence 2016).

3.3.2 Distribution and Habitat Requirements

The Neuse River Waterdog is found only in the Neuse and Tar River basins of North Carolina (AmphibiaWeb 2006; Beane and Newman 1996; Frost 2016).

Neuse River Waterdogs inhabit rivers and larger streams, where they prefer leaf beds in quiet waters. They need high levels of dissolved oxygen and good water quality. The Neuse River Waterdog is generally found in backwaters off the main current, in areas with sandy or muddy substrate. Adults construct retreats on the downstream side of rocks or in the stream bank where they remain during the day. They are active during the night, leaving these retreats to feed. Neuse River Waterdogs are carnivorous, feeding on invertebrates, small vertebrates, and carrion. Neuse River Waterdogs are most active during winter months even when temperatures are below freezing. During summer months, they will burrow into deep leaf beds and are rarely found. It has been suggested that this inactivity in summer may be an adaptation to avoid fish predators, which are more active at these times. In addition, Neuse River Waterdogs produce a defensive, toxic skin secretion that is assumed to be distasteful to predators (AmphibiaWeb 2006; Beane

and Newman 1996; Conant and Collins 1998; EDGE of Existence 2016; NatureServe Explorer 2016).

3.3.3 *Threats to Species*

Any factors that reduce water quality are threats to the Neuse River Waterdog. These can include changes that result in siltation and pollution reducing habitat quality (e.g., channelization, agricultural runoff, and industrial and urban development). Impoundments are also a threat to the dispersal of the species as it is unable to cross upland habitat; Neuse River Waterdogs do not climb and are unlikely to use fish passages (NatureServe Explorer 2016).

3.3.4 *Designated Critical Habitat*

As mentioned in Section 1.0, the Neuse River Waterdog is listed under the ESA as a Threatened Species with Section 4(d) Rule and Critical Habitat Designation. Critical habitat designation (CFR Vol. 86 No. 109) consists of the following (USFWS 2021c):

- Unit 1 - 12.3 river mi (13.8 river km) of the Upper Tar River in Granville County
- Unit 2 - 10.5 river mi (16.9 river km) of Upper Fishing Creek in Warren County
- Unit 3 - 2 river mi (3.2 river km) of Bens Creek in Warren County
- Unit 4 - 82.8 river mi (133 river km) of lower Little Fishing Creek in Halifax, Nash, Warren and Edgecombe Counties.
- Unit 5 - 72.5-river-mi (116.8-river-km) segment of Sandy Creek and Red Bud Creek in Franklin, and Nash Counties
- Unit 6 - 111-river-mi (179-river-km) segment of the Middle Tar River in Franklin, Nash, and Edgecombe Counties
- Unit 7 - 59.9 river mi (96.3 river km) in the Lower Tar River Subbasin including portions of Town Creek, Otter Creek, and Tyson Creek in Edgecombe and Pitt Counties
- Unit 8 - 43.9 river mi (70.6 river km) of the Eno River in Orange and Durham Counties
- Unit 9 - 15.2-river-mi (24.5-river-km) segment of the Flat River in Person and Durham Counties
- Unit 10 - 30.8-river-mi (49.6-river-km) stretch of Middle Creek in Wake and Johnston Counties
- Unit 11 - 24-river-mi (38.6-river-km) stretch of Swift Creek in Johnston County
- Unit 12 - 90.8-river-mi (146.1-river-km) segment of the Little River including Buffalo Creek in Franklin, Wake, Johnston, and Wayne Counties
- Unit 13 - 20.8-river-mi (33.5-river-km) segment of Mill Creek in Johnston and Wayne Counties
- Unit 14 - 43.2 river-mi (69.5 river-km) segment of Middle Neuse River in Wayne County
- Unit 15 - 114.8 river-mi (184.8 river-km) segments of Contentnea Creek, Nahunta Swamp and the Neuse River in Craven, Green, Lenoir, Pitt, Wayne, and Wilson Counties

- Unit 16 – 10.3 river-mi (16.5 river-km) segment of Swift Creek in Craven County
- Unit 17 – 32.5 river-mi (52.4 river-km) segments of Beaver Creek and Trent River in Jones County
- Unit 18 – 2 river-mi (3.2 km) segment of Tuckahoe Swamp in Jones County

Critical Habitat Unit 11 is located 31.1 RM downstream of where Crabtree Creek enters the Neuse River and is located in Swift Creek (Figure 2-3).

3.4 Carolina Madtom (*Noturus furiosus*)

3.4.1 Species Characteristics



The Carolina Madtom, a small catfish, was described at Milburnie, near Raleigh, NC in the Neuse River by Jordan (Jordan 1889). The Carolina Madtom reaches a maximum size of 132 mm (5.2 inches). Compared to other madtoms within its range, it has a relatively short stout body and a distinctive color pattern of three to four dark saddles along its back that connect a long black stripe on the side running from the

snout to the tail. The adipose fin is mostly dark, making it appear that the fish has a fourth saddle. The Madtom is tan on the rest of its body and yellow to tan between the saddles. The adipose fin and caudal fin are fused together, a distinguishing characteristic from other members of the catfish family (Ictaluridae). There are no speckles on the Madtom's belly, and the tail has two brown bands that follow the curve of the tail. The Carolina Madtom, like other catfishes, has serrae on its pectoral fins and is thought to have the most potent venom of any of the catfish species (NCWRC 2010).

3.4.2 Distribution and Habitat Requirements

The Carolina Madtom is endemic to the Piedmont/Inner Coastal Plain portion of the Tar/Pamlico and Neuse River basins. It occurs in creeks and small rivers in habitats generally consisting of very shallow riffles with little current over coarse sand and gravel substrate (Lee et al. 1980). Burr et al. (1989) found most records came from medium to large streams, i.e., mainstem Neuse and Tar Rivers and their major tributaries. The population in the Trent River system (part of the Neuse River basin) is isolated from the rest of the Neuse River basin by salinity levels, so it is therefore considered a separate population, though it has not been detected in Trent River in the last five years (Sarah McRae, USFWS, personal communication). In the lower portions of these rivers, Carolina Madtom is usually found over debris piles in sandy areas. During nesting season, which is from May to July, Madtoms prefer areas with plenty of cover to build their nests with shells, rocks, sticks, bottles, and cans, being suitable cover types. Males guard the nests, in which females may lay between 80 and 300 eggs.

Carolina Madtom is found in water that ranges from clear to tannin-rich, which is usually free-flowing. It is generally rare throughout its range and is apparently in decline. The Tar River

population has historically been more robust than the Neuse River population (Burr et al. 1989), which has shown declines in recent years (Midway 2008). The Little River of the Neuse River Basin has the largest population of Carolina Madtom in the Neuse River Basin, with records from 2016 indicating it is present (Sarah McRae, USFWS, personal communication). A few specimens have been collected from Swift Creek of the Neuse River Basin. Fishing Creek and Swift Creek of the Tar River Basin are also productive systems in regard to Carolina Madtom populations, with around 14 specimens collected in the mid-1980s from Swift Creek (water levels in Fishing Creek prevented sampling during that study). In 2016, a total of 17 individuals were recorded in Swift Creek and a total of four individuals were recorded in Fishing Creek (Sarah McRae, USFWS, personal communication). The Carolina Madtom has been observed in at least 36 localities (Burr et al 1989).

Carolina Madtom has a lifespan of about four years, with sexual maturity being reached around two years in females and three years in males. Sampling for Carolina Madtom is most effective at dawn and dusk when they are most active and feeding (Mayden and Burr 1981). Their diet consists mostly of benthic macroinvertebrates, which they collect by scavenging for food on the bottom of the stream.

3.4.3 Threats to Species

Identified threats to the species include water pollution and construction of impoundments (Burr et al. 1989). Carolina Madtom is susceptible to threats due to its limited range and low population densities (Angermeier 1995, Burr and Stoekel 1999). As a bottom-dwelling fish, Carolina Madtom is susceptible to habitat loss when stream bottoms are impacted by urbanization, impoundments, deforestation, etc.

3.4.4 Designated Critical Habitat

As mentioned in Section 1.0, the Carolina Madtom is listed under the ESA as an Endangered Species with Section 4(d) Rule and Critical Habitat Designation. Critical habitat designation (CFR Vol. 86 No. 109) consists of the following (USFWS 2021c):

- Unit 1 – 26 river miles (42 river km) of Tar River in Franklin, Granville, and Vance Counties
- Unit 2 – 66 river miles (106 km) of Sandy/Swift Creek in Edgecombe, Franklin, Halifax, Nash, and Warren Counties
- Unit 3 – 86 river miles (138 km) of the Fishing Creek Subbasin in Edgecombe, Franklin, Halifax, Nash, and Warren Counties
- Unit 4 – 20 river miles (32 km) of the Upper Neuse River Subbasin (Eno River) in Durham and Orange Counties
- Unit 5 – 28 river miles (45 km) of the Little River in Johnston County
- Unit 6 – 15 river miles (24 km) of Contentnea Creek in Wilson County
- Unit 7 – 15 river miles (24 km) of the Trent River in Jones County

Critical Habitat Unit 4 is located greater than 50 RM upstream of where Crabtree Creek reaches the Neuse River and is located in the Eno River (Figure 2-4).

4.0 OTHER TARGET SPECIES DESCRIPTIONS

4.1 *Savannah Lilliput (Toxolasma pullus)*

4.1.1 *Species Characteristics*



The Savannah Lilliput was described by Conrad (1838) from the Wateree River in South Carolina. This small species of mussel has a semi-inflated ovular/elliptical shell, only reaching approximately 35mm in length. Shells are blackish with fine rays that are not visible on all individuals. The Savannah Lilliput is sexually dimorphic, females typically have a broader more truncated posterior end; males have a narrower and more rounded posterior end (USFWS, 2016). The *Toxolasma pullus* from the lower Savannah River are characterized by slightly difference shell morphology and were at once described as a separate species but have since been synonymized with *T. pullus*.

4.1.2 *Distribution and Habitat Requirements*

The Savannah Lilliput occurs along the southern Atlantic Slope with a historic range from the Altamaha River Basin in Georgia to the Neuse River Basin in North Carolina. It was presumed extirpated in the Neuse and Waccamaw River Basins (USFWS 2016, Bogan 2017); however, Three Oaks found an individual in Lake Waccamaw in 2017 and these efforts reestablished extant presence in the Neuse Basin. Historic records show specimens collected in Wake County in the Neuse River, but it has not been recorded more recently in the mainstem Neuse River (Johnson 1970). It is believed to be declining throughout its range (Adams et al. 1990, Price 2005). The Savannah Lilliput prefers shallow waters of creeks, rivers, and impounded lakes, tending to inhabit sandy/silty or muddy banks in relatively still water (NCWRC 2022).

4.1.3 *Threats to Species*

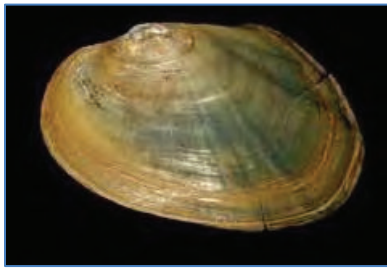
Threats to the Savannah Lilliput are similar to those of the above mussel species. Additionally, given its preference for shallow water in impounded habitats, this species is especially susceptible to fluctuations in water levels, off-road recreational vehicle traffic, and drought. In North Carolina, known populations are generally restricted to short reaches and in isolation, with many populations considered highly vulnerable (NCWRC 2022). Predation by muskrats and raccoons may be an important source of mortality in lake populations (Hanlon and Levine 2004).

4.1.4 *Species Listing*

The Savannah Lilliput is State Endangered in North Carolina (NCWRC, 2022). The USFWS petitioned to add the Savannah Lilliput for federal listing in 2010 and 2011 and published a 90-day finding the listing may be warranted, however listing has not been granted at this time (USFWS 2016).

4.2 *Green Floater (Lasmigona subviridis)*

4.2.1 *Species Characteristics*



The Green Floater was described by Conrad (1835) from the Schuylkill River in Lancaster County, Pennsylvania. This small mussel species has a thin, slightly inflated, subovate shell that is narrower in front and higher behind. The dorsal margin forms a blunt angle with the posterior margin. The shell is dull yellow or tan to brownish green, usually with concentrations of dark green rays.

4.2.2 *Distribution and Habitat Requirements*

The Green Floater occurs along the Atlantic Slope from the Savannah River in Georgia north to the Hudson River in New York, as well as in the “interior” basins (New, Kanawha, and Watauga Rivers) of the Tennessee River basin. It has experienced major declines throughout its entire range. Based on preliminary genetics research, the southern populations of the Green Floater (Tar-Pamlico, Neuse, and Yadkin/Pee Dee River Basins) appear to be genetically distinct from populations from the Roanoke River to the north and west (Morgan Railey and Arthur Bogan, North Carolina Museum of Natural Sciences, 2007 Personal Communication). Further research is needed to determine if these differences warrant classification of the southern populations as a distinct species. It occurs in small size streams to large rivers, in quiet waters such as pools, or eddies, with gravel and sand substrates.

4.2.3 *Threats to Species*

Threats to the Green Floater are similar to those described for the above mussel species and have contributed to the decline of this species throughout its range. Remaining Green Floater populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event.

4.2.4 *Species Listing*

This species was petitioned for federal listing under the Endangered Species Act of 1973, as amended (ESA) within the 2010 Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States by the Center for Biological Diversity (CBD) (CBD 2010). The listing status as of January 31, 2022, is considered under review (USFWS 2022b).

5.0 SURVEY EFFORTS

Mussel surveys for the project were conducted in Brier Creek, Brier Creek Reservoir, Little Brier Creek, and Stirrup Iron Creek by Tim Savidge (Permit # 21-ES0034), Lizzy Stokes-Cawley, and Trevor Hall on September 22, 2021, and September 29, 2021. Additional shoreline mussel

surveys were completed in Brier Creek Reservoir by Tim Savidge and Lizzy Stokes-Cawley on December 7-9, 2021.

Trapping surveys for Neuse River Waterdog were conducted in Stirrup Iron Creek, Brier Creek, and Little Brier Creek by Three Oaks personnel Tim Savidge, Kate Sevick (Permit # ES-00485), Trevor Hall, and Lizzy Stokes-Cawley on November 15-19, 2021.

Electro-fishing surveys for the Carolina Madtom were conducted in Brier Creek by Tim Savidge, Lizzy Stokes-Cawley, and Trevor Hall on September 22, 2021, and in Little Brier Creek by Tim Savidge, Lizzy Stokes-Cawley, and Trevor Hall on November 1, 2021.

The following provide general stream condition descriptions for each stream area visited. Separate conditions are listed for the impounded areas included for the shoreline mussel surveys in the Stirrup Iron Creek and Brier Creek reservoirs. These streams were visited on multiple occasions as detailed in the results section.

5.1 Impoundment Conditions: Brier Creek Reservoir

The shoreline of the Brier Creek Reservoir varied from marsh-wetland areas to steep wooded slopes with several small intermittent/ephemeral stream systems. The shoreline is shallow in most areas, ranging from 0.25-1m in depth. Substrate consisted primarily of sand and gravel, with silt accumulations throughout. Banks were generally stable with moderate scour, ranging from one to three feet. Water was slightly turbid during the time of surveys, but water clarity was not an issue. In drought conditions, the shoreline became exposed, allowing staff biologists to walk the uncovered substrate.

5.2 Stream Conditions: Brier Creek

Habitat in Brier Creek varied highly below the tailrace of the Brier Creek reservoir. Active construction of a new road approximately 100m upstream of the Airport Blvd. stream crossing was ongoing during the mussel surveys. The area downstream of the new road crossing consisted of a sequence of straightened shallow, primarily run and riffle habitat, with small pools present throughout the reach caused by sediment buildup and scour. Erosion/sediment controls were in place; however, sediment was observed entering the stream following a rain event after mussel surveys had been completed. Overall, the channel ranged from 15-20 feet wide with banks four to six feet high that were generally unstable and scoured, as well as lined with rip-rap in sections. Water was slightly turbid during the time of surveys; however, there were no issues with water clarity. Substrates consisted of sand, gravel, cobble, and silt. A narrow natural wooded vegetation buffer was present in this section.

The area upstream of the new crossing construction consisted of similar habitat, with a more sinuous channel throughout. Channel ranged from 20-25 feet wide with banks six to eight feet high that were unstable and eroded. Water was clear in this section during the time of survey, with substrate consisting mainly of gravel and cobble, with sand/silt deposits in the margins and pools. A moderate to wide natural vegetation buffer was present along the right descending bank,

while a buffer less than 100 feet occurs along the left descending bank between the channel and Airport Blvd.

5.3 *Stream Conditions: Stirrup Iron Creek*

Habitat in Stirrup Iron Creek consisted of long deep run habitat, with pools present throughout the reach caused by woody debris and scour. Overall, the channel ranged from 25 to 35 feet wide with banks six to 10 feet high that were generally unstable and highly eroded. Water was slightly turbid during time of survey. Substrates consisted primarily of unconsolidated sand with silt, clay, and occasional gravel present in riffle areas. A natural wooded vegetation buffer was wide on the right descending bank and moderate on the left descending bank bordered on the left descending bank by a large clear-cut vegetated area. The lower reach of the survey entered a highly developed area with little to no riparian buffer, several roads/parking lots, and industrial buildings near both banks.

5.4 *Stream Conditions: Little Brier Creek*

Habitat in the lower surveyed portion of Little Brier Creek consisted of a sluggish run/pool associated with the backwaters of Little Brier Creek Reservoir in the vicinity of the Globe Road. Water depths ranged from one to three feet and the substrate was dominated by sand and silt. Approximately 300 feet above the road crossing, the channel transitioned to shallow, primarily riffle and run habitat, with pools present throughout the reach caused by woody debris and scour. Overall, the channel ranged from 24 to 34 feet wide with banks six to 10 feet high that were generally unstable and highly eroded. Water was clear during time of survey. Substrates consisted primarily of unconsolidated sand with silt, clay, and occasional gravel present in riffle areas. A natural wooded vegetation buffer was wide on the left descending bank and moderate on the right descending bank bordered on the right descending bank by several parking lots and industrial buildings.

5.5 *Methodology*

5.5.1 *Mussel Surveys*

Mussel surveys were conducted in variable lengths as depicted on Figure 1, covering both streams and impoundments in the study area. Areas of appropriate habitat were searched, concentrating on the habitats preferred by the target species. The survey team spread out across the creek into survey lanes or separated along the shoreline in the case of the impoundment surveys. Visual surveys were conducted using glass bottom view buckets (bathyscopes) and snorkel/mask. Tactile methods were employed, particularly in streambanks under submerged rootmats. All freshwater bivalves were recorded and returned to the substrate. Timed survey efforts provided Catch Per Unit Effort (CPUE) data for each species. Relative abundance for freshwater snails and freshwater clam species were estimated using the following criteria:

- (VA) Very abundant > 30 per square meter
- (A) Abundant 16-30 per square meter
- (C) Common 6-15 per square meter

- (U) Uncommon 3-5 per square meter
- (R) Rare 1-2 per square meter
- (P-) Ancillary adjective “Patchy” indicates an uneven distribution of the species within the sampled site.

While conducting the mussel surveys, searches were also conducted for Carolina Madtom by overturning logs, rocks, and other debris on the stream bottom which are often used for cover by madtom species. These techniques can also incidentally locate Neuse River Waterdog, although standard presence/absence methods involve four consecutive days of trapping during winter months using baited minnow traps upstream and downstream of a project area.

5.5.2 *Neuse River Waterdog Surveys*

Methods were developed by Three Oaks in consultation with the USFWS and NCWRC and were designed to replicate winter trapping efforts conducted as part of the recent species status assessment undertaken by these agencies and collaborators. A total of ten baited traps were set for four soak nights within the respective survey reaches. Trap sites were selected based on habitat conditions and accessibility. Undercut banks, with some accumulation of leaf pack, as well as back eddy areas within runs were the primary microhabitats selected; however, all of the microhabitats (pool, riffle, run, etc.) occurring at a site were sampled with at least one trap. Traps were baited with a combination of chicken livers and hot dogs and allowed to soak overnight. The traps were checked daily, all species found within the traps were recorded, and the traps were rebaited. If the targeted Neuse River Waterdog was found at a site, trapping efforts were to be discontinued. In addition, dip net sweeps through leaf packs and underneath submerged rootmats were conducted to supplement the trapping efforts.

5.5.3 *Carolina Madtom Surveys*

During the mussel and waterdog efforts, the presence of preferred habitats for the Carolina Madtom were assessed and, if conditions were appropriate, targeted visual surveys were conducted by overturning rocks and debris in these areas. The species was not observed during these surveys; however, based on habitat observations, further surveys using active collection methods was determined to be warranted. Fish community surveys were completed in Brier Creek and Little Brier Creek. The fish surveys were conducted within the depicted reaches using two Smith Root LR-24 backpack electrofishing unit and dip nets. All habitat types in the survey reach (riffle, run, pool, slack-water, etc.) were sampled. Stunned fish were placed into buckets and were identified, counted, assigned a relative abundance, and released live onsite.

Relative abundance reported was estimated using the following criteria:

- (VA) Very abundant: > 30 collected at survey reach
- (A) Abundant: 16-30 collected at survey reach
- (C) Common: 6-15 collected at survey reach
- (U) Uncommon: 3-5 collected at survey reach
- (R) Rare: 1-2 collected at survey reach

- (P-) Ancillary adjective “Patchy” indicates an uneven distribution of the species within the sampled site.

It should be noted that relative abundances of particular species can be affected by survey methodologies and site conditions. Thus, some species, particularly those that are found in deeper pools and runs and those that can seek cover quickly may be under-represented or not detected within the respective survey reach.

6.0 RESULTS

6.1 Mussel Surveys

Mussel surveys and or habitat evaluations were conducted in the following reaches as depicted in Figure 1. Surveys are listed below in chronological order. Sites were named using the following naming convention: YYMMDD.Xzzz where year is YY, month is MM, day is DD, site number is X, and initials of survey lead are zzz. Across all sites, a total of three mussel species, Savannah Lilliput (*Toxolasma pullus*), Eastern Elliptio (*Elliptio complanata*), and Paper Pondshell (*Utterbackia imbecillis*) were found.

6.1.1 Brier Creek Reservoir 210929.2tws

The shoreline of Brier Creek Reservoir was evaluated in several areas for a total of 1.14 person hours, during which the Paper Pondshell was located. Other mollusk species, the Asian Clam and Banded Mystery Snail, were also located (Table 2).

Table 2. CPUE for Freshwater Mussels in Brier Creek 210929.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell	15	common	13.15/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~		C
<i>Viviparus georgianus</i>	Banded Mystery Snail	~		PC

6.1.2 Brier Creek Reservoir 210929.3tws

This reach was surveyed for a total of 0.66 person hours, during which the Paper Pondshell was located. One other mollusk species, the Asian Clam, was also located (Table 3).

Table 3. CPUE for Freshwater Mussels in Brier Creek 210929.3tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell	24	common	16/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~		C

6.1.3 Brier Creek Reservoir 210929.4tws

This reach was surveyed for a total of 0.74 person hours, during which the Paper Pondshell was located. Other mollusk species, the Asian Clam and Banded Mystery Snail, were also located (Table 4).

Table 4. CPUE for Freshwater Mussels in Brier Creek 210929.4tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell	41	common	55.4/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	A
<i>Viviparus georgianus</i>	Banded Mystery Snail		~	C

6.1.4 Brier Creek 210921.2tws

Two reaches of Brier Creek were evaluated during this study. This reach was surveyed for a total of 9.0 person hours, during which two live species of freshwater mussel, the Eastern Elliptio and Paper Pondshell, were located. Other mollusk species, the Pointed Campeloma and Asian Clam, were also located. Shells of the Savannah Lilliput were discovered in this reach (Table 5).

Table 5. CPUE for Freshwater Mussels in Brier Creek 210921.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Elliptio complanata</i>	Eastern Elliptio	974	common	324.33/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	3	2	1/hr
<i>Toxolasma pullus</i>	Savannah Lilliput	0	7	0/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	A
<i>Campeloma decisum</i>	Pointed Campeloma		~	PU

Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.5 Brier Creek 210929.1tws

This reach was surveyed for a total of 7.34 person hours, during which three live species of freshwater mussel, the Eastern Elliptio, Paper Pondshell, and Savannah Lilliput, were located. Other mollusk species, the Pointed Campeloma and Asian Clam, were also located. Shells of the Savannah Lilliput were also discovered in this reach (Table 6).

Table 6. CPUE for Freshwater Mussels in Brier Creek 210922.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Elliptio complanata</i>	Eastern Elliptio	578	common	78.75/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	7	1	.95/hr
<i>Toxolasma pullus</i>	Savannah Lilliput	1	4	.14/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	A
<i>Campeloma decisum</i>	Pointed Campeloma		~	PU

Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.6 Little Brier Creek 210929.5tws

Two reaches of Little Brier Creek were evaluated during this study. This reach, which occurred in the backwaters of the Little Brier Creek Reservoir, was surveyed for a total of 1.54 person hours, during which one live species of freshwater mussel, the Paper Pondshell, was located. One other mollusk species, the Asian Clam, was also located (Table 7).

Table 7. CPUE for Freshwater Mussels in Brier Creek 210922.5tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell	16	~	10.39/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	C

Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.7 Little Brier Creek 210929.6tws

This reach was surveyed for a total of 1.26 person hours, during which only the Asian Clam was located. Habitat for Carolina Madtom and Neuse River Waterdog were assessed and surveyed visually during mussel survey efforts, however, neither species were observed.

6.1.8 Stirrup Iron Creek 211101.2tws

This reach of Stirrup Iron Creek was surveyed for a total of 1.2 person hours, during which one live species of freshwater mussel, the Paper Pondshell, was located. Three other mollusk species, the Pointed Campeloma, Japanese Mystery Snail, and Asian Clam, were also located (Table 8).

Table 8. CPUE for Freshwater Mussels in Stirrup Iron Creek 211101.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell	3	2	2.5/hr
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~		C
<i>Campeloma decisum</i>	Pointed Campeloma	~		R
<i>Cipangopaludina japonica</i>	Japanese Mystery Snail	~		C

6.1.9 Brier Creek Reservoir 211207.1tws

This reach consisted of exposed reservoir shoreline and was surveyed for a total of 2.0 person hours. The purpose of these surveys was to uncover relict shells of mussels that were exposed due to lower water levels. Shells of the Paper Pondshell were common. Actual in water surveys for mussels were not conducted; however, a few live Paper Pondshell individuals were observed. One other mollusk species, the Asian Clam was also found. Additionally, one Banded Mystery Snail shell was observed (Table 9).

Table 9. CPUE for Freshwater Mussels in Brier Creek Reservoir 211207.1tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell		~	C
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	C
<i>Viviparus georgianus</i>	Banded Mystery Snail	~	1	R

6.1.10 Brier Creek Reservoir 211207.2tws

This reach consisted of exposed reservoir shoreline and was surveyed for a total of 2.0 person hours. The purpose of these surveys was to uncover relict shells of mussels that were exposed due to lower water levels. Shells of the Paper Pondshell were common. Actual in water surveys for mussels were not conducted; however, a few live Paper Pondshell individuals were observed. The Asian Clam was also abundant. One Banded Mystery Snail shell was also located (Table 10).

Table 10. CPUE for Freshwater Mussels in Brier Creek Reservoir 211207.2tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell		~	A
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	A
<i>Viviparus georgianus</i>	Banded Mystery Snail	~	1	R

6.1.11 Brier Creek 211207.3tws

This reach was surveyed for a total of 1.5 person hours, during which no freshwater mussels were located. Asian Clams were common with a patchy distribution (CP).

6.1.12 Brier Creek Reservoir 211209.1tws

This reach consisted of the shoreline of the Little Brier Creek arm of the reservoir and was surveyed for a total of 1.0 person hour. The purpose of these surveys was to uncover relict shells of mussels that were exposed due to lower water levels. Shells of the Paper Pondshell were common. Actual in water surveys for mussels were not conducted; however, a few live Paper Pondshell individuals were observed. The Asian Clam was common and Japanese Mystery Snails were located in low numbers (Table 11).

Table 11. CPUE for Freshwater Mussels in Brier Creek Reservoir 211209.1tws

Scientific Name	Common Name	# Live	# Shells	Abundance / CPUE
Freshwater Mussels				CPUE
<i>Utterbackia imbecillis</i>	Paper Pondshell		~	C
Freshwater Snails and Clams				Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam		~	C
<i>Cipangopaludina japonica</i>	Japanese Mystery Snail		~	UC

6.2 Carolina Madtom Surveys

6.2.1 Brier Creek 210921.1tws

A total of 20 fish species were found in Brier Creek during a total of 1,968 seconds of electrofishing time (Table 12).

Table 12. Fish Survey Results: Brier Creek 210921.1tws

Scientific Name	Common Name	Relative Abundance
<i>Ameiurus brunneus</i>	Snail Bullhead	C
<i>Ameiurus nebulosus</i>	Brown Bullhead	R
<i>Ameiurus platycephalus</i>	Flat Bullhead	C
<i>Cyprinella analostana</i>	Satinfin Shiner	A
<i>Dorosoma cepedianum</i>	Gizzard Shad	C
<i>Etheostoma nigrum</i>	Johnny Darter	A
<i>Gambusia holbrooki</i>	Eastern Mosquitofish	A
<i>Ictalurus punctatus</i>	Channel Catfish	C
<i>Lepomis auritus</i>	Redbreast Sunfish	C
<i>Lepomis cyanellus</i>	Green Sunfish	A
<i>Lepomis gibbosus</i>	Pumpkinseed	R
<i>Lepomis gulosus</i>	Warmouth	R
<i>Lepomis macrochirus</i>	Bluegill	A

Scientific Name	Common Name	Relative Abundance
<i>Micropterus salmoides</i>	Largemouth Bass	R
<i>Notemigonus crysoleucas</i>	Golden Shiner	R
<i>Notropis altipinnis</i>	Highfin Shiner	A
<i>Notropis hudsonius</i>	Spottail Shiner	C
<i>Notropis procne</i>	Swallowtail Shiner	A
<i>Noturus insignis</i>	Margined Madtom	U
<i>Pomoxis nigromaculatus</i>	Black Crappie	C

6.2.2 Little Brier Creek 211101.1tws

A total of 9 fish species were found in Little Brier Creek during a total of 1,426 seconds of electrofishing time (Table 13).

Table 13. Fish Survey Results: Little Brier Creek 211101.1tws

Scientific Name	Common Name	Relative Abundance
<i>Ameiurus brunneus</i>	Snail Bullhead	C
<i>Ameiurus natalis</i>	Yellow Bullhead	C
<i>Dorosoma cepedianum</i>	Gizzard Shad	C
<i>Lepomis auritus</i>	Redbreast Sunfish	C
<i>Lepomis cyanellus</i>	Green Sunfish	A
<i>Lepomis gibbosus</i>	Pumpkinseed	R
<i>Lepomis macrochirus</i>	Bluegill	A
<i>Lepomis microlophus</i>	Redear Sunfish	U
<i>Pomoxis nigromaculatus</i>	Black Crappie	C

6.3 Neuse River Waterdog Surveys

The Neuse River Waterdog was not captured during Waterdog trapping efforts; however, 16 fish species, consisting of Yellow Bullhead, Snail Bullhead, Brown Bullhead, Green Sunfish, Bluegill, Redear Sunfish, Redbreast Sunfish, Margined Madtom (*Noturus insignis*), White Shiner (*Luxilus albeolus*), Spottail Shiner, Highfin Shiner, Satinfin Shiner, Black Crappie, Channel Catfish (*Ictalurus punctatus*), Eastern Mosquitofish, and Johnny Darter, were captured (this inventory is separate from what was captured during fish surveys). Two crayfish species, the White River Crayfish (*Procambarus acutus*) and the Variable Crayfish (*Cambarus latimanus*) were also captured during the survey efforts (Tables 14-16).

6.3.1 Little Brier Creek

The Neuse River Waterdog was not captured during Waterdog trapping efforts at Little Brier Creek; however, seven fish species, consisting of Yellow Bullhead, Snail Bullhead, Brown Bullhead, Green Sunfish, Bluegill, Redear Sunfish and Redbreast Sunfish, were captured. The Variable Crayfish was also captured during the effort (Table 14).

Table 14 Little Brier Creek Trapping Surveys Species Found

Trap #	Day 1	Day 2	Day 3	Day 4
1	Snail Bullhead (1)	~	Snail Bullhead (2)	Brown Bullhead (1)
2	White River Crayfish (1)	Redbreast Sunfish (2), Bluegill (1)	Bluegill (5), Redbreast Sunfish (2)	Yellow Bullhead (2), Redbreast Sunfish (1)
3	~	~	Yellow Bullhead (2)	Yellow Bullhead (2), Redbreast Sunfish (1)
4	Yellow Bullhead (1)	~	Yellow Bullhead (3)	Yellow Bullhead (3)
5	~	Green Sunfish (1), Variable Crayfish (1)	Yellow Bullhead (1)	Yellow Bullhead (2), Variable Crayfish (1)
6	~	Yellow Bullhead (2), Brown Bullhead (1), Variable Crayfish (1)	Yellow Bullhead (1)	Yellow Bullhead (1), Variable Crayfish (1)
7	~	~	Yellow Bullhead (3), Snail Bullhead (1)	Yellow Bullhead (1)
8	Yellow Bullhead (1), Brown Bullhead (1)	Yellow Bullhead (2)	Yellow Bullhead (1)	Yellow Bullhead (2)
9	White River Crayfish (3)	Brown Bullhead (2)	Snail Bullhead (1), Variable Crayfish (2)	Brown Bullhead (1), <i>Cambarus latimanus</i> (1)
10	Yellow Bullhead (1), Green Sunfish (1)	~	Yellow Bullhead (3), Variable Crayfish (3)	Redear Sunfish (1)

6.3.2 Brier Creek

The Neuse River Waterdog was not captured during Waterdog trapping efforts at Brier Creek; however, 15 fish species, consisting of Yellow Bullhead, Snail Bullhead, Brown Bullhead, Green Sunfish, Bluegill, Redear Sunfish, Redbreast Sunfish, Margined Madtom, White Shiner, Spottail Shiner, Highfin Shiner, Black Crappie, Channel Catfish, Eastern Mosquitofish, and Johnny Darter, were captured. Two crayfish species, the White River Crayfish and the Variable Crayfish were also captured during the effort (Table 15).

Table 15. Brier Creek Trapping Surveys Species Found

Trap #	Day 1	Day 2	Day 3	Day 4
1	Green Sunfish (1)	Yellow Bullhead (1)	White River Crayfish (1)	Green Sunfish (1)
2	~	Snail Bullhead (1), Green Sunfish (2)	Variable Crayfish (2)	Snail Bullhead (2), Variable Crayfish (1)

Trap #	Day 1	Day 2	Day 3	Day 4
3	~	Margined Madtom (1), White Shiner (1)	Spottail Shiner (3)	Black Crappie (1), Highfin Shiner (4), Johnny Darter (1)
4	~	~	Johnny Darter (1), Highfin Shiner (1), Variable Crayfish (1)	White River Crayfish (1)
5	Variable Crayfish (1)	Eastern Mosquitofish (6)	~	Highfin Shiner (1)
6	White Shiner (2), Highfin Shiner (1)	Channel Catfish (2)	Highfin Shiner (4)	White River Crayfish (1), Variable Crayfish (1)
7	Satinfin Shiner (8), Highfin Shiner (32), Johnny Darter (1)	~	~	~
8	~	Bluegill (1)	Bluegill (1)	~
9	Snail Bullhead (1), Highfin Shiner (6), Redbreast Sunfish (2), Bluegill (6), Green Sunfish (1)	Black Crappie (1), Eastern Mosquitofish (4), Yellow Bullhead (1)	~	Eastern Mosquitofish (1), Bluegill (1)
10	~	Black Crappie (1), Satinfin Shiner (1)	~	~

6.3.3 Stirrup Iron Creek

The Neuse River Waterdog was not captured during Waterdog trapping efforts at Stirrup Iron Creek; however, five fish species, consisting of Snail Bullhead, Bluegill, Channel Catfish, Satinfin Shiner, and Highfin Shiner, were captured (Table 16).

Table 16. Stirrup Iron Creek Trapping Surveys Species Found

Trap #	Day 1	Day 2	Day 3	Day 4
1	~	Satinfin Shiner (1)	Highfin Shiner (1)	~
2	Bluegill (1)	Highfin Shiner (1)	~	~
3	Snail Bullhead (1)	~	~	~
4	~	~	~	~
5	~	~	Channel Catfish (1)	~
6	~	~	~	~
7	~	Snail Bullhead (1)	~	~
8	~	~	~	Bluegill (1), Highfin Shiner (1)
9	~	~	~	~
10	~	~	~	~

7.0 HABITAT ASSESSMENTS

7.1 *Little Brier Creek Reservoir*

A habitat assessment was completed in the backwaters of Little Brier Creek Reservoir downstream of Globe Road at 35.887699, -78.800179. The habitat here consisted of a channel ranging from 40-50 ft wide, with steep clay/mud banks. The riparian area was made up of a maintained powerline ROW. The water was slow moving and turbid during the evaluation and was at least 4-6 feet deep.

8.0 DISCUSSION/CONCLUSIONS

The results indicate that three streams and two impoundments within the study area support freshwater mussel species. The widespread and common Eastern Elliptio and Paper Pondshell occur within the surveyed portion of Brier Creek, along with the Savannah Lilliput, which was previously presumed to be extirpated from the Neuse River Basin. The Paper Pondshell was the only mussel species found in the reservoir; it was also found in Little Brier Creek in the backwaters of the reservoir. The other targeted protected mussel species were not found during this effort; in recent years, they have only been documented a considerable distance from the project area and are separated by Lake Crabtree (Section 1.0).

The Neuse River Waterdog and Carolina Madtom were not detected during these efforts and suitable habitat was sparse throughout the study area. While other species were not found during these surveys, appropriate habitat is present; thus, there is the potential for additional species across the three taxa surveyed to occur within the study area.

Based on these survey results, adverse effects to any of the species listed in Section 1.0 are unlikely to occur in the study area. However, strict adherence to erosion control standards should minimize the potential for any adverse impacts to aquatic resources.

9.0 LITERATURE CITED

- Adams, W. F., J. M. Alderman, R. G. Biggins, A. G. Gerberich, E. P. Keferl, H. J. Porter, and A. S. VanDevender. 1990. A report on the conservation status of North Carolina's freshwater and terrestrial molluscan fauna. N.C. Wildl. Resourc. Comm., Raleigh. 246 p., Appendix A: 37.
- Alderman, J. M. 1995. Monitoring the Swift Creek Freshwater mussel community. Unpublished report presented at the UMRCC symposium on the Conservation and Management of Freshwater Mussels II Initiative for the Future. Rock Island, IL, UMRCC.
- AmphibiaWeb: Information on amphibian biology and conservation [web application]. 2006. Berkeley, California: AmphibiaWeb. Accessed: March 22, 2016. <http://amphibiaweb.org/index.html>.
- Angermeier, P. L. 1995. Ecological attributes of extinction-prone species: loss of freshwater fishes of Virginia. *Conservation Biology* 9:143–158.
- Beane, J. and Newman, J. T. 1996. North Carolina Wildlife Profiles – Neuse River waterdog. Division of Conservation Education, North Carolina Wildlife Resources Commission.
- Bogan, A.E. 2017. Workbook and key to the freshwater bivalves of North Carolina. North Carolina Freshwater Mussel Conservation Partnership, Raleigh, NC 115 pp.
- Brimley, C. S. 1924. The waterdogs (Necturus) of North Carolina. *Journal of the Elisha Mitchell Scientific Society* 40: 166–168.
- Burr, B. M., B.R. Kuhajda, W.W. Dimmick and J.M. Grady. 1989. Distribution, biology, and conservation status of the Carolina madtom (*Noturus furiosus*, an endemic North Carolina catfish. *Brimleyana* 15:57-86.
- Burr, B. M., and J. N. Stoeckel. 1999. The natural history of madtoms (genus *Noturus*), North America's diminutive catfishes. Pages 51–101 in E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. J. Schramm, and T. Coon, editors. *Catfish 2000: Proceedings of the International Ictalurid Symposium*. Symposium 24. American Fisheries Society, Bethesda, Maryland.
- Center for Biological Diversity (CBD). 2010. Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States as Threatened or Endangered Under the Endangered Species Act. April 20, 2010, 1,145 pp. Available online at: http://sero.nmfs.noaa.gov/pr/esa/Candidate%20Spp/SE_Petition.pdf.
- Clarke, A. H. 1981. The Tribe Alasmidontini (Unionidae: Anodontinae), Part I: Pegias, Alasmidonta, and Arcidens. *Smithsonian Contributions to Zoology*, No. 326. 101 pp.

- Conant, R. and Collins, J.T. 1998. A Field Guide to the Reptiles and Amphibians of Eastern and Central North America. Third Edition, Expanded. Houghton Mifflin Company. Boston, Massachusetts.
- Conrad, T.A. 1834. New freshwater shells of the United States, with coloured illustrations; and a monograph of the genus *Anculotus* of Say; also a synopsis of the American naiades. J. Dobson, 108 Chestnut Street, Philadelphia, Pennsylvania. 1-76, 8 pls.
- Conrad, T.A. 1835. Monography of the Family Unionidae, or naiades of Lamarck, (freshwater bivalve shells) of North America, illustrated by figures drawn on stone from nature. J. Dobson, 108 Chestnut Street, Philadelphia, Pennsylvania. 1:1-12, plates 1-5.
- Conrad, T. A. (1835-1838). Monography of the family Unionidae, or naiades of Lamarck, (freshwater bivalve shells), of North America, illustrated by figures drawn on stone from nature. Philadelphia, Pennsylvania. 11: 95-102, plates 95-102
- Eads, C.B. and J.F. Levine. 2011. Refinement of Growout Techniques for Four Freshwater Mussel Species. Final Report submitted to NC Wildlife Resources Commission, Raleigh, NC. 15pp.
- EDGE of Existence website. "165. Neuse River Waterdog (*Necturus lewisi*)". Accessed: March 22, 2016. http://www.edgeofexistence.org/amphibians/species_info.php?id=1361.
- Ellis, M. M. 1936. Erosion Silt as a Factor in Aquatic Environments. *Ecology* 17: 29-42.
- Fuller, S. L. H. and C. E. Powell. 1973. Range extensions of *Corbicula manilensis* (Philippi) in the Atlantic drainage of the United States. *Nautilus* 87(2): 59.
- Fuller, S. L. H. 1977. Freshwater and terrestrial mollusks. In: John E. Cooper, Sarah S. Robinson, John B. Fundeburg (eds.) *Endangered and Threatened Plants and Animals of North Carolina*. North Carolina State Museum of Natural History, Raleigh.
- Frost, Darrel R. 2016. *Amphibian Species of the World: an Online Reference*. Version 6.0 (March 22, 2016). Electronic Database accessible at <http://research.amnh.org/herpetology/amphibia/index.html>. American Museum of Natural History, New York, USA.
- Goudreau, S. E., R. J. Neves, and R. J. Sheehan. 1988. Effects of Sewage Treatment Effluents on Mollusks and Fish of the Clinch River in Tazewell County, Virginia. USFWS: 128 pp.
- Johnson, R.I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the southern Atlantic slope region. *Bulletin of the Museum of Comparative Zoology*. 140: 263-449, 369-371

- Jordan, D.S. 1889. Descriptions of fourteen species of freshwater fishes collected by the U.S. Fish Commission in the summer of 1888. Proceedings of the United States National Museum 11:351-362.
- Lea, I. 1829. Description of a new genus of the family of naiades, including eight species, four of which are new; also the description of eleven new species of the genus *Unio* from the rivers of the United States: with observations on some of the characters of the naiades. Transactions of the American Philosophical Society 3[New Series]:403–457, pls. 7–14.
- Lee, D.S., C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer. 1980. Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh.
- Marking, L.L., and T.D. Bills. 1979. Acute effects of silt and sand sedimentation on freshwater mussels. Pp. 204-211 in J.L. Rasmussen, ed. Proc. of the UMRCC symposium on the Upper Mississippi River bivalve mollusks. UMRCC. Rock Island IL. 270 pp.
- Master, L. 1986. *Alasmidonta heterodon*: results of a global status survey and proposal to list as an endangered species. A report submitted to Region 5 of the U.S. Fish and Wildlife Service. 10 pp. and appendices.
- Mayden, R.L. and B.M. Burr. 1981. Life history of the slender madtom, *Noturus exilis*, in southern Illinois (Pisces: Ictaluridae), Occas. Pap. Mus. Nat. Hist. Univ. Kans. 93:1-64
- McRae, Sarah. United State Fish and Wildlife, Personal communication.
- McMahon, R. F. and A. E. Bogan. 2001. Mollusca: Bivalvia. Pp. 331-429. IN: J.H. Thorpe and A.P. Covich. Ecology and classification of North American freshwater invertebrates. 2nd edition. Academic Press.
- Michaelson, D.L. and R.J. Neves. 1995. Life history and habitat of the endangered dwarf wedgemussel *Alasmidonta heterodon* (Bivalvia: Unionidae). Journal of the North American Benthological Society 14(2):324-340.
- Midway, S.R. 2008. Habitat Ecology of the Carolina Madtom, *Noturus furiosus*, an Imperiled Endemic Stream Fish. M.S. Thesis. North Carolina State University, Raleigh, NC. 74 pp.
- NatureServe. 2016. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://explorer.natureserve.org>. (Accessed: May 23, 2016). Species Accessed: *Necturus lewisi*
- Neves, R.J. 1993. A state of the Unionids address. Pp. 1-10 in K.S. Cummings, A.C. Buchanan, and L.M. Kooch, eds. Proc. of the UMRCC symposium on the Conservation and Management of Freshwater Mussels. UMRCC. Rock Island IL. 189 pp.

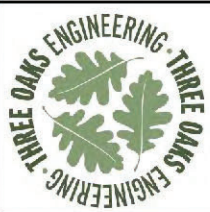
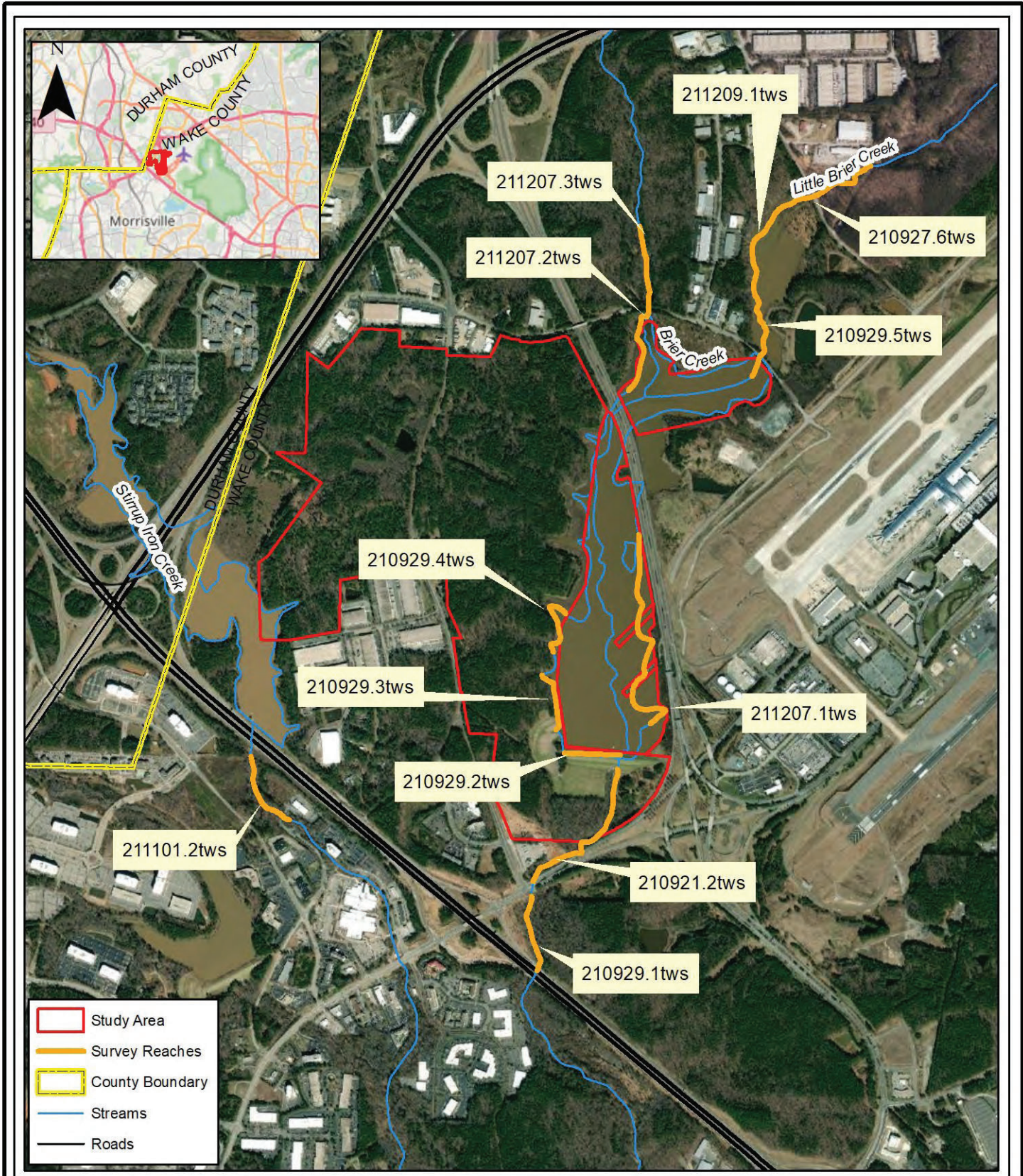
- Neves, R. J. and J. C. Widlak. 1987. Habitat Ecology of Juvenile Freshwater Mussels (Bivalvia: Unionidae) in a Headwater Stream in Virginia. *American Malacological Bulletin* 1(5): 1-7.
- North Carolina Division of Water Resources (NCDWR). 2021. 2021 North Carolina 303(d) List. <https://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/303d/303d-files>
- North Carolina Natural Heritage Program (NCNHP). 2021. nheo-2021-08. Natural Heritage Element Occurrence polygon shapefile. July 2021 version.
- North Carolina Wildlife Resource Commission (NCWRC). 2010. NCpedia profile for Carolina Madtom (*Noturus furiosus*) [web application]. By Brian Watson, updated by Chris Wood. June 14, 2010. <http://ncpedia.org/wildlife/carolina-madtom> Accessed November 4, 2016.
- North Carolina Wildlife Resource Commission (NCWRC). Species Profile Savannah Lilliput. Accessed January 2022. <https://www.ncwildlife.org/Learning/Species/Mollusks/Savannah-Lilliput>
- O'Dee, S.H., and G.T. Waters. 2000. New or confirmed host identification for ten freshwater mussels. Pp. 77-82 in R.A. Tankersley, D.I. Warmolts, G.T. Waters, B.J. Armitage, P.D. Johnson, and R.S. Butler (eds.). *Freshwater Mollusk Symposia Proceedings Part I. Proceedings of the Conservation, Captive Care and Propagation of Freshwater Mussels Symposium*. Ohio Biological Survey Special Publication, Columbus.
- O'Neill, C. R., Jr., and D. B. MacNeill. 1991. The zebra mussel (*Dreissena polymorpha*): an unwelcome North American invader. Sea Grant, Coastal Resources Fact Sheet. New York Sea Grant Extension. 12 pp.
- Ortmann, A.E. 1919. A monograph of the naiades of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8(1): xvi-384, 21 pls.
- Pennak, R. W. 1989. *Fresh-water Invertebrates of the United States, Protozoa to Mollusca*. New York, John Wiley & Sons, Inc.
- Price, Jennifer (SC DNR). 2005. Savannah Lilliput (*Toxolasma pullus*). Accessed January 2022. <https://www.dnr.sc.gov/cwcs/pdf/SavannahLilliput.pdf>
- Railey, Morgan and Arthur Bogan, North Carolina Museum of Natural Sciences, 2007 Personal Communication
- Savidge, T. W., J. M. Alderman, A. E. Bogan, W. G. Cope, T. E. Dickinson, C. B. Eads, S. J. Fraley, J. Fridell, M. M. Gangloff, R. J. Heise, J. F. Levine, S. E. McRae, R.B. Nichols, A. J. Rodgers, A. Van Devender, J. L. Williams and L. L. Zimmerman. 2011. 2010 Reevaluation of Status Listings for Jeopardized Freshwater and Terrestrial Mollusks in

- North Carolina. Unpublished report of the Scientific Council on Freshwater and Terrestrial Mollusks. 177pp.
- Simpson, C.T. 1900. Synopsis of the naiades, or pearly fresh-water mussels. Proceedings of the United States National Museum 22(1205):501–1044.
- Simpson, C.T. 1914. A descriptive catalogue of the naiades, or pearly fresh-water mussels. Parts I–III. Bryant Walker, Detroit, Michigan, xii + 1540 pp.
- Strayer, D. L., S. J. Sprague and S. Claypool, 1996. A range-wide assessment of populations of *Alasmidonta heterodon*, an endangered freshwater mussel (Bivalvia: Unionidae). J.N. Am. Benthol. Soc., 15(3):308-317.
- United States Fish and Wildlife Service (USFWS). 1992a. Special report on the status of freshwater mussels.
- United States Fish and Wildlife Service (USFWS). 1992b. Endangered and Threatened species of the southeast United States (The Red Book). FWS, Ecological Services, Div. of Endangered Species, Southeast Region. Govt Printing Office, Wash, DC: 1,070.
- United States Fish and Wildlife Service (USFWS). 1993. Dwarf Wedgemussel (*Alasmidonta heterodon*) Recovery Plan. Hadley, Massachusetts. 527 pp.
- United States Fish and Wildlife Service (USFWS). 2013. Dwarf Wedgemussel *Alasmidonta heterodon* 5-Year Review: Summary and Evaluation, Susi von Oettingen, FWS, Concord, NH.
- United States Fish and Wildlife Service (USFWS). 2016. Savannah Lilliput Fact Sheet. Accessed December 2021.
https://www.fws.gov/charleston/pdf/ARS%20fact%20sheets%20for%20web/savannah%20lilliput%20fact%20sheet_SC_2016.pdf
- United States Fish and Wildlife Service (USFWS). April 2021a. Species Status Assessment Report for the Atlantic Pigtoe (*Fusconaia masoni*) Version 1.4
- United States Fish and Wildlife Service (USFWS). 2021b. Endangered and Threatened Wildlife and Plants: Threatened Species Status with Section 4(d) Rule and Designation of Critical Habitat. 50 CFR 17:86 FR 64000, 64000-64053. Docket Nos. FWS-R4-ES-2018-0046FF09E21000 FXES1111090FEDR 223.
- United State Fish and Wildlife Service (USFWS). 2021c. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Neuse River Waterdog, Endangered Species Status for Carolina Madtom, and Designations of Critical Habitat. 50 CFR 17:86 FR 30688, 30688-30751. Docket No. FWS-R4-ES-2018-0092.

- U.S. Fish and Wildlife Service (USFWS). 2022a. USFWS Information for Planning and Conservation (IPAC). Accessed January 2022. <https://ipac.ecosphere.fws.gov/>
- U.S. Fish and Wildlife Service (USFWS). 2022b. Green Floater (*Lasmigona subviridis*). Accessed January 2022. <https://ecos.fws.gov/ecp/species/7541>
- Viosca, P., Jr. 1937. A tentative revision of the genus *Necturus*, with descriptions of three new species from the southern Gulf drainage area. *Copeia* 1937:120-138.
- Virginia Department of Game and Inland Fisheries (VDGIF). 2014. Atlantic Pigtoe Conservation Plan. Bureau of Wildlife Resources. VDGIF, Richmond, VA. 31 pp.
- Wolf, E.D. 2012. Propagation, Culture, and Recovery of Species at Risk Atlantic Pigtoe. Virginia Tech Conservation Management Institute, Project No. 11-108. 55pp.

APPENDIX A

Figures



Prepared For:

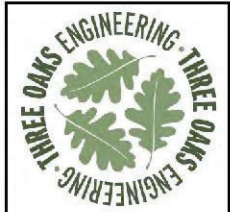
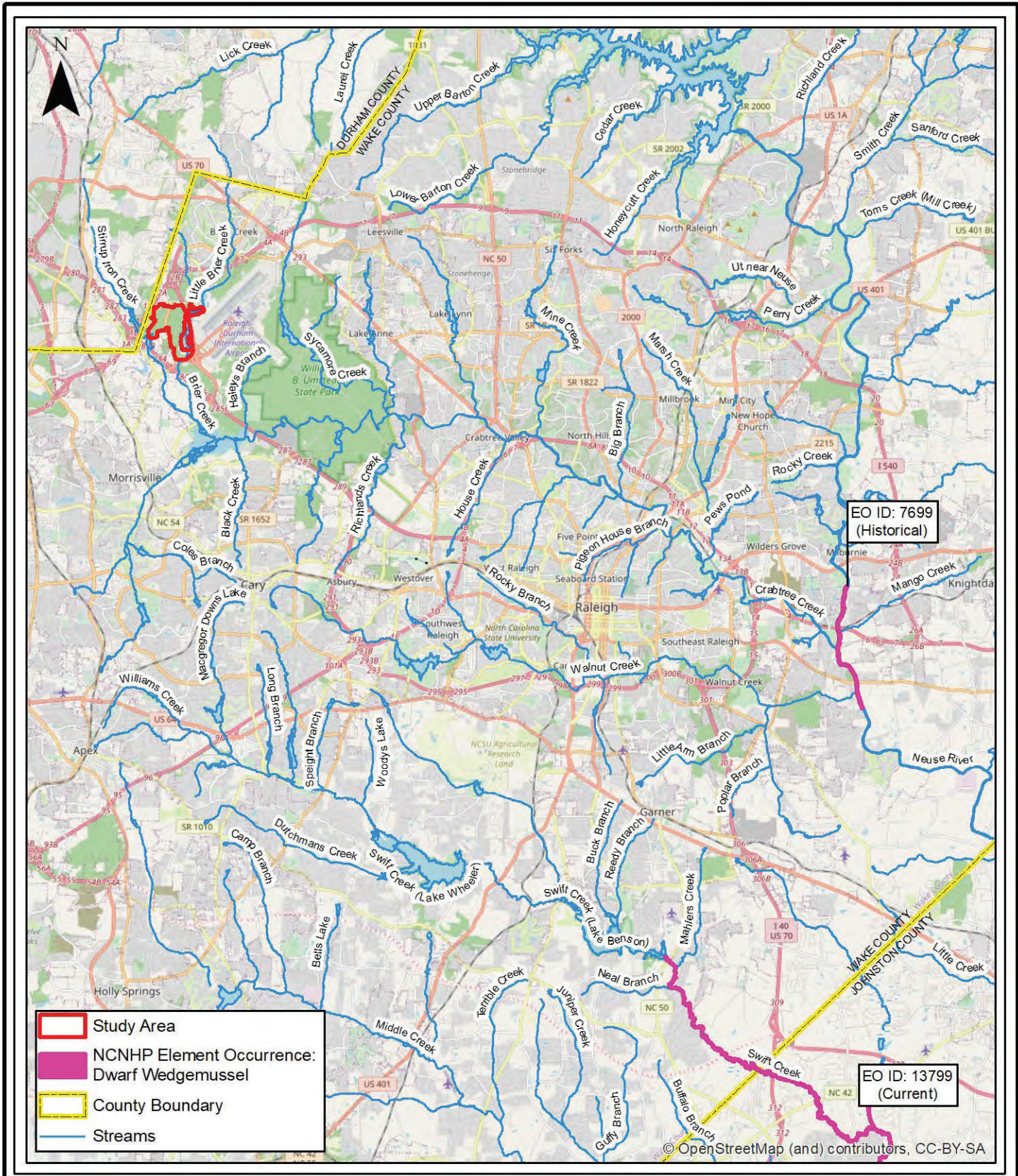


Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 Vicinity Map
 Wake County, North Carolina

Date: January 2022
 Scale: 0 500 1,000 Feet
 Job No.: 19-018
 Drawn By: TDH Checked By: TED

Figure

1



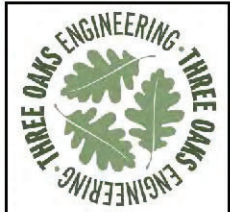
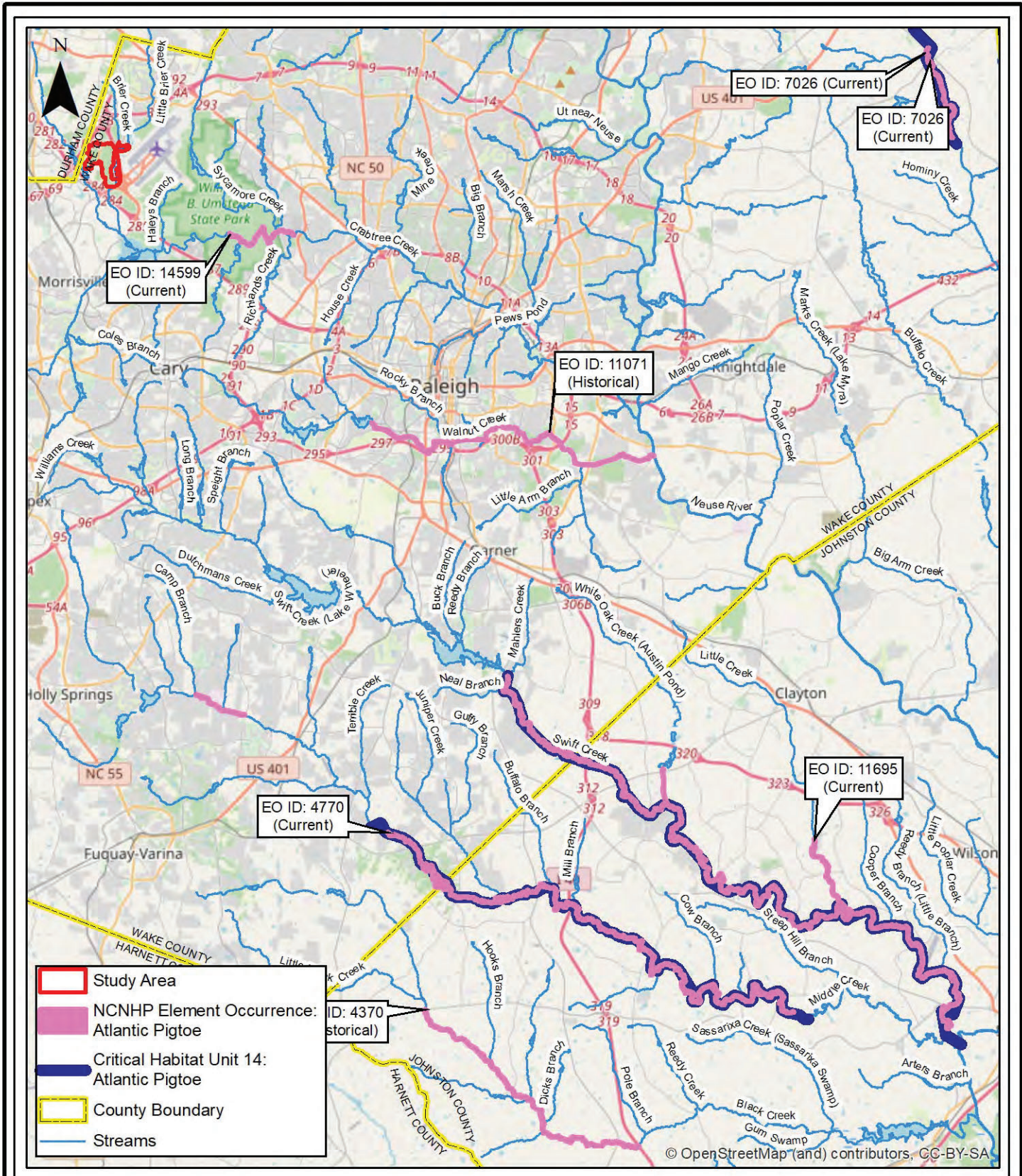
Prepared For:



Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 NCNHP Element Occurrences:
 Dwarf Wedgemussel
 Wake County, North Carolina

Date: January 2022
 Scale: 0 1 2 Miles
 Job No.: 19-018
 Drawn By: TDH Checked By: TED

Figure
2-1



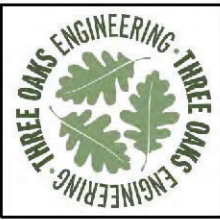
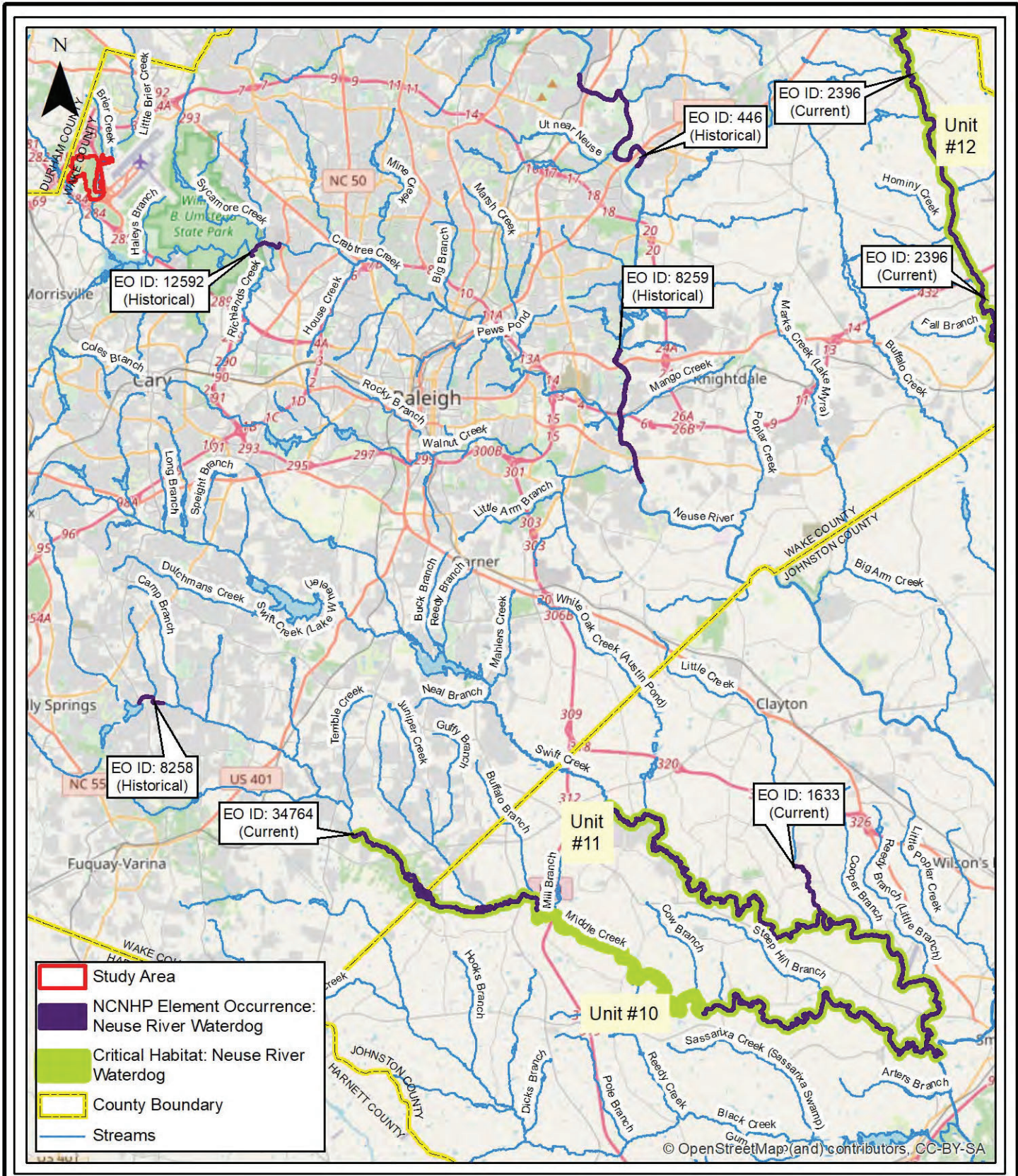
Prepared For:



Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 NCNHP Element Occurrences:
 Atlantic Pigtoe
 Wake County, North Carolina

Date: January 2022
 Scale: 0 1 2 Miles
 Job No.: 19-018
 Drawn By: TDH
 Checked By: TED

Figure
2-2

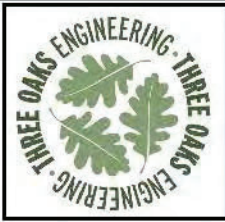
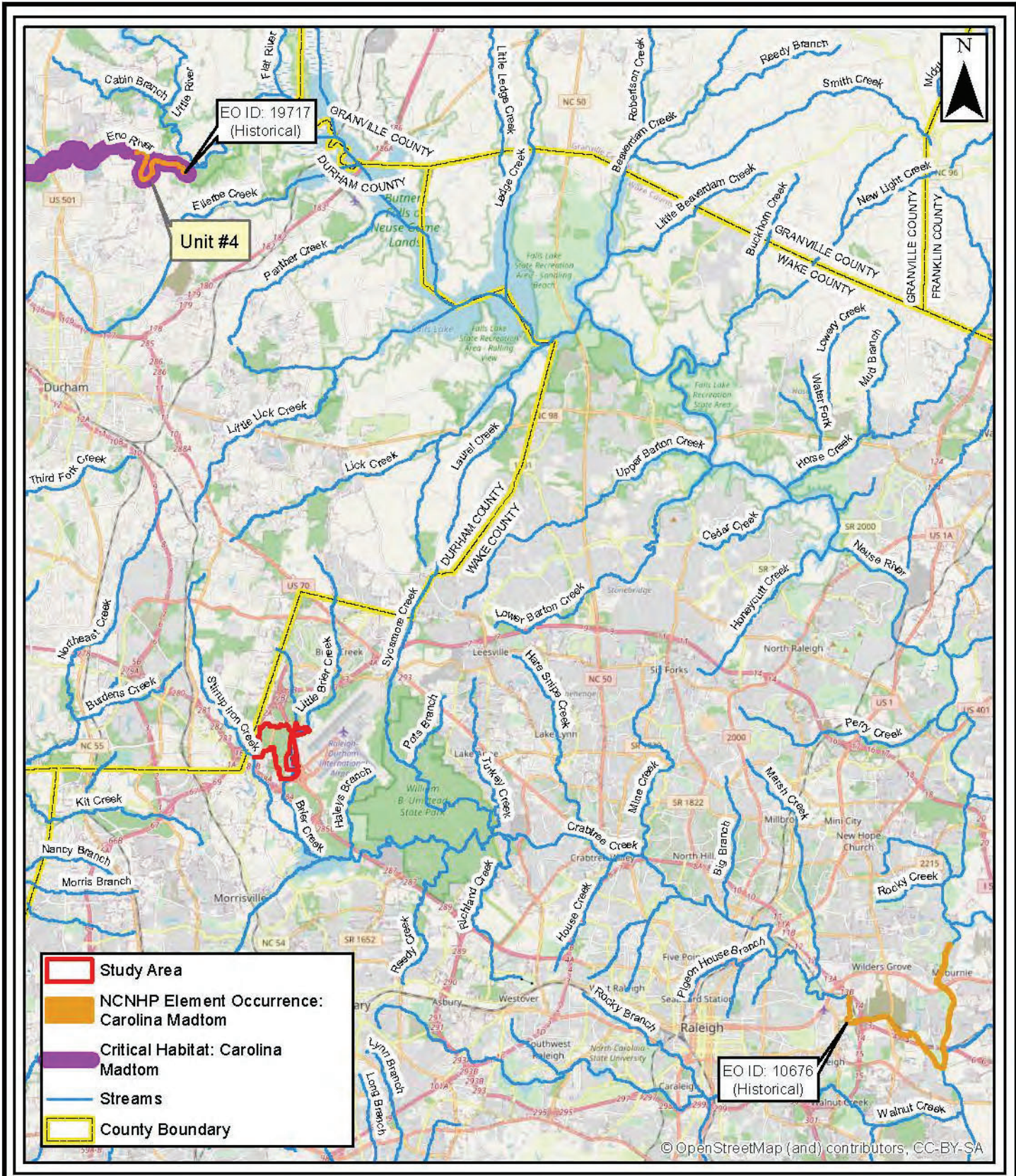


Prepared For:

Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 NCNHP Element Occurrences:
 Neuse River Waterdog
 Wake County, North Carolina

Date: January 2022
 Scale: 0 1 2 Miles
 Job No.: 19-018
 Drawn By: TDH Checked By: TED

Figure
2-3



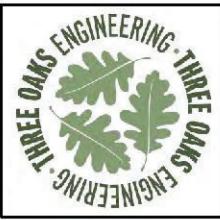
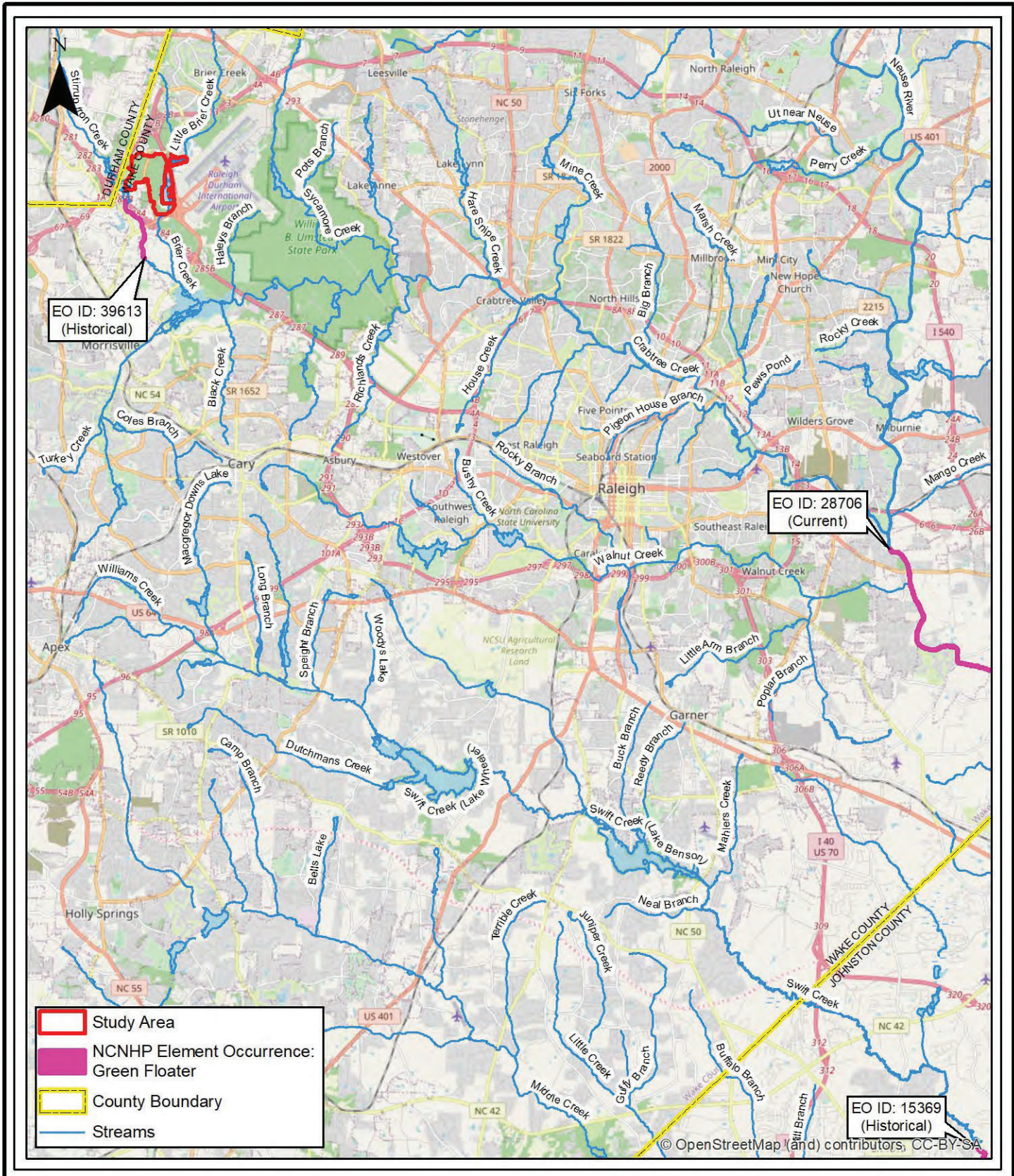
Prepared For:



Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 NCNHP Element Occurrences:
 Carolina Madtom
 Wake County, North Carolina

Date: **January 2022**
 Scale: 0 1 2 Miles
 Job No.: **19-018**
 Drawn By: **TDH** Checked By: **TED**

Figure
2-4

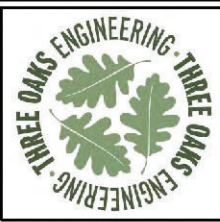
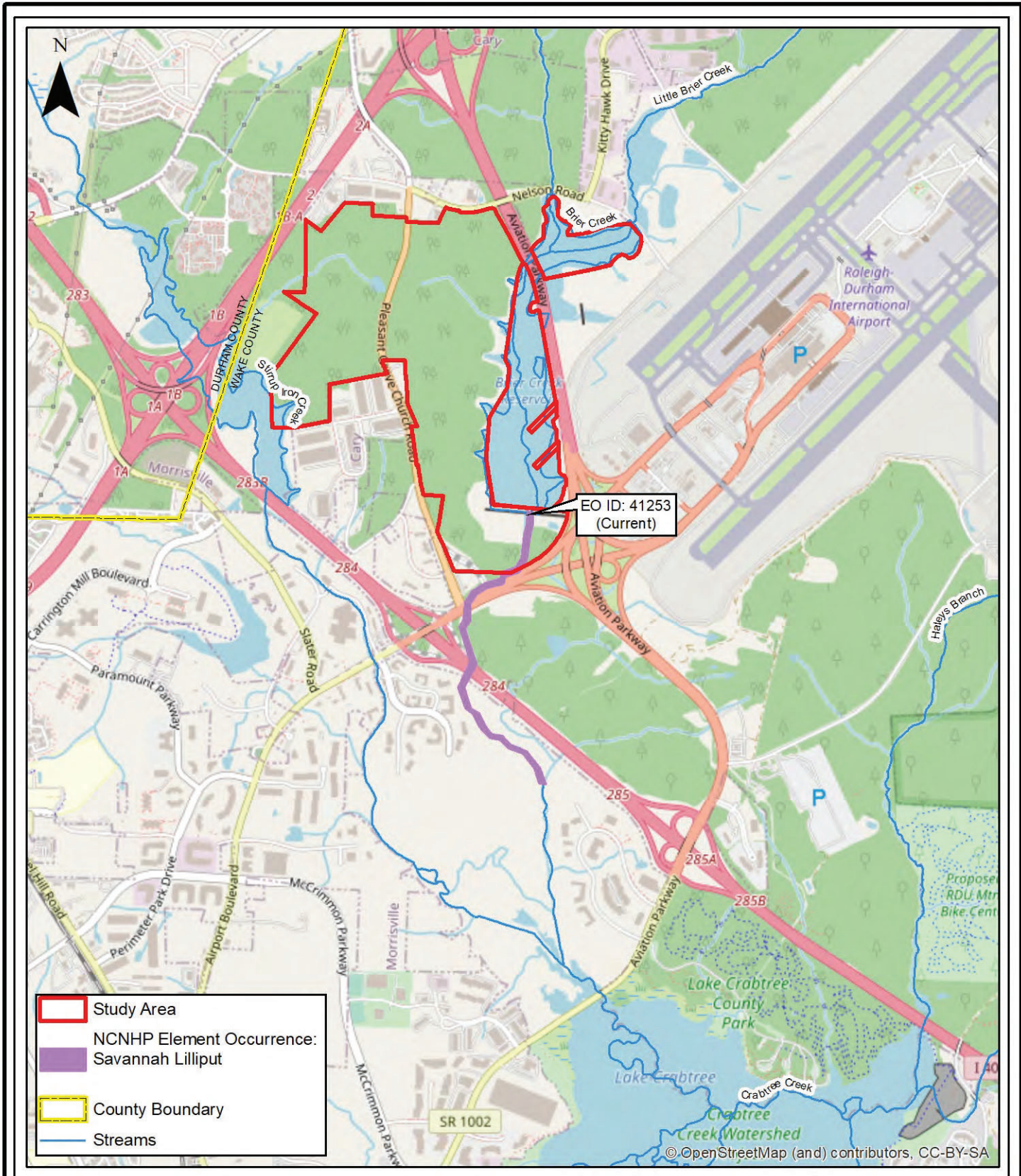


Prepared For:

Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 NCNHP Element Occurrences:
 Green Floater
 Wake County, North Carolina

Date: January 2022
 Scale: 0 1 2 Miles
 Job No.: 19-018
 Drawn By: TDH Checked By: TED

Figure
2-5

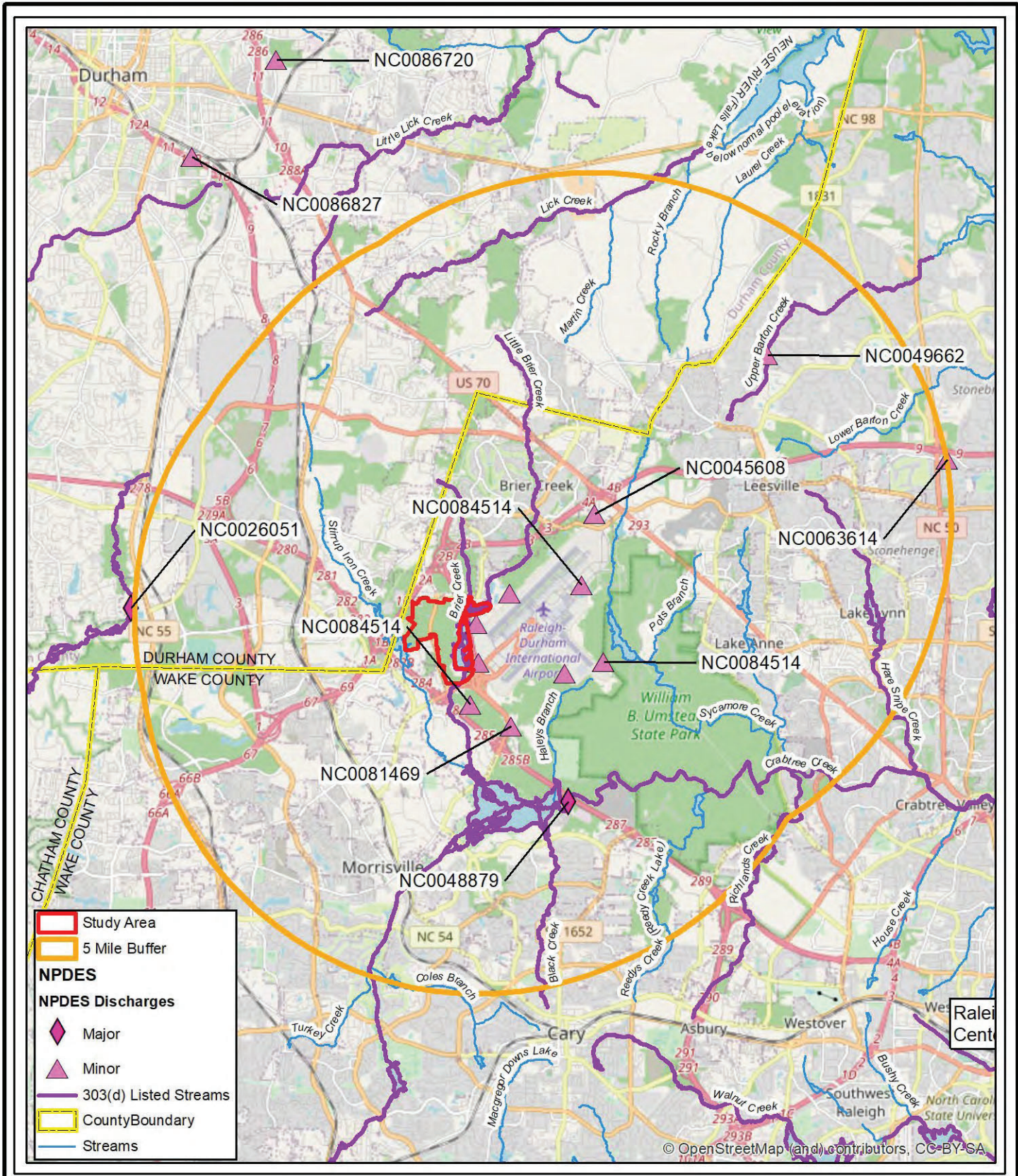


Prepared For:

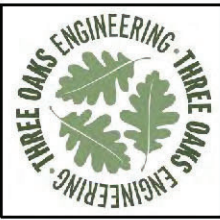
Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 NCNHP Element Occurrences:
 Savannah Lilliput
 Wake County, North Carolina

Date: January 2022
 Scale: 0 0.1 0.2 Miles
 Job No.: 19-018
 Drawn By: TDH
 Checked By: TED

Figure
2-6



© OpenStreetMap (and) contributors, CC-BY-SA



Prepared For:


Aquatic Species Surveys
 Landrum & Brown
 RDU International Airport
 303(d) and NPDES
 Wake County, North Carolina

Date: January 2022
 Scale: 0 0.5 1 Miles
 Job No.: 19-018
 Drawn By: TDH Checked By: TED

Figure
3

Appendix D
USFWS Concurrence Letter





United States Department of the Interior

FISH AND WILDLIFE SERVICE

Raleigh ES Field Office

Post Office Box 33726

Raleigh, North Carolina 27636-3726

November 15, 2022

Tommy L. Dupree, Manager
Memphis Airports District Office
2600 Thousand Oaks Blvd., Suite 2250
Memphis, TN 38118-2486

**Subject: Proposed Runway 5L/23R Replacement Project; Raleigh-Durham International Airport
Wake County, North Carolina**

Dear Mr. Dupree:

This letter is in response to your October 19, 2022 request for informal consultation and concurrence concerning federally listed species at the Raleigh-Durham International Airport (RDU), located in Wake County, North Carolina. The U.S. Fish and Wildlife Service (Service) has reviewed your letter and the October 7, 2022 Biological Resources Assessment (BRA) for the project. According to the submitted information, the project site has been identified for the construction of a replacement runway. The Service participated in a field meeting at the site on June 15, 2022. Our comments are provided in accordance with the Endangered Species Act of 1973, as amended, (ESA) and the Bald and Golden Eagle Act (BGEPA).

The Federal Aviation Administration (FAA) has made a determination of impacts to federally-listed species. Based on the results of species surveys conducted by Three Oaks Engineering, Inc., the Service concurs with the species determinations provided in your letter. We believe that the requirements of section 7 (a)(2) of the ESA have been satisfied for this project. Please remember that obligations under the ESA must be reconsidered if: (1) new information identifies impacts of this action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

Please note that the Service published its decision to list the tricolored bat (*Perimyotis subflavus*) (TCB) as endangered on September 14, 2022 (87 FR 56381–56393). This small bat species is known to occur in Wake County. It is an insectivore, and forages and roosts in forests and on the edges of forests. A final listing decision may come as soon as September, 2023. If the FAA would like to conference on this proposed species prior to listing, please let us know.

The October 19, 2022 letter and BRA state that there is one active bald eagle (*Haliaeetus leucocephalus*) nest, located approximately 1,900 feet from the existing runway. The FAA commits to providing a 660 – foot buffer around the nest during the bald eagle breeding season. In addition, preliminary noise modeling indicates that the nest would receive an increase of 2.6 dBA (weighted decibel level) from the project by 2033 when the proposed project would be fully operational. If the FAA commits to a buffer protecting the area within 660 feet of the bald eagle

nest from construction activities from December 1 to July 15 of any year, the Service agrees that the project is not likely to disturb nesting bald eagles. We recommend that the FAA consider the implementation of other recommendations in the National Bald Eagle Management Guidelines for the benefit of the bald eagle. The guidelines may be found here: <https://www.fws.gov/media/national-bald-eagle-management-guidelines>.

As we stated in the June 15, 2022 field meeting, the Service remains concerned about concerned about deforestation and the removal or fragmentation of contiguous forest. This area appears to provide a wildlife corridor between Umstead State Park and other areas to the northwest. Loss of the forested areas may push wildlife onto adjacent road rights-of-way and other areas that could pose a safety concern for humans and wildlife.

Further, tree removal may affect the TCB. During the spring, summer, and fall, TCB primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees (Veilleux et al. 2003; Perry and Thill 2007; Thames 2020). In addition, TCB have been observed roosting during summer among pine needles, eastern red cedar, within artificial roosts (e.g., barns, beneath porch roofs, bridges, concrete bunkers), and rarely within caves (Perry and Thill 2007; Thames 2020; Jones and Pagels 1968; Barbour and Davis 1969; Jones and Suttkus 1973; Hamilton and Whitaker 1979; Mumford and Whitaker 1982; Whitaker 1998; Feldhamer et al. 2003; Ferrara and Leberg 2005; Smith 2020, pers. comm; Humphrey et al. 1976; Briggler and Prather 2003; Damm and Geluso 2008). Female TCB exhibit high site fidelity, returning year after year to the same summer roosting locations (Allen 1921; Veilleux and Veilleux 2004a). Female TCB form maternity colonies and switch roost trees regularly (Veilleux and Veilleux 2004a; Quinn and Broders 2007; Poissant et al. 2010). Males roost singly (Perry and Thill 2007; Poissant et al. 2010). Effects to TCB from tree removal include potential injury or mortality of individuals roosting in trees that are removed, and loss of foraging, commuting, and roosting habitat. TCB may be injured or killed while fleeing disturbance during daylight hours due to an increased likelihood of predation. Indirect effects may include reduced fitness of TCB individuals through additional energy expenditure while searching for a new roost site, or a shift in home range. Replanting of tree species on the site would help restore foraging and roosting habitat for the TCB. The amount of mortality would not be determinable since dead TCBs would likely go unnoticed, and estimating such mortality is difficult since TCB density data is not available. Although mortality could potentially occur at any time of the year, it is assumed that mortality would be highest during the maternity season if maternity roost trees are felled.

We appreciate the opportunity to comment on this project. If you have any questions concerning these comments, please contact Kathy Matthews by e-mail at kathryn_matthews@fws.gov.

Sincerely,

Pete Benjamin
Field Supervisor



cc (via email):

**Gabriela Garrison, NCWRC
Lyle Phillips, USACE**