BIOLOGICAL ASSESSMENT

AN ASSESSMENT OF POTENTIAL EFFECTS TO FEDERALLY LISTED SPECIES

For

I-26 Widening
From US 25 Near Hendersonville to I-40/I-240 South of Asheville
Henderson and Buncombe Counties, North Carolina

Federal Aid Project No. NHF-26-1(62)23/IMNHF-026-1(86)9
WBS No. 34232.1.1/36030.1.1
S.T.I.P. No. I-4400/I-4700

Prepared for:

Federal Highway Administration
and
North Carolina Department of Transportation

Prepared By:

CALYX Engineers and Consultants, Inc. and Three Oaks Engineering, Inc.

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Contents

List of Tables

List of Appendices

Glossary of Endangered Species Act Definitions:

Action Area - all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The Action Area is typically larger than the footprint of the project and its direct impacts.

Cumulative effects - for purposes of consultation under the Endangered Species Act, the effects of future state or private activities not involving federal activities that are reasonably certain to occur within the Action Area of an action subject to consultation.

Direct effects - effects that are caused by or will result from, and occur contemporaneous with, the proposed action (USFWS 1998a).

Discountable - are those effects that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (USFWS 1998a).

Indirect effects - those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur (50 CFR §402.02).

Informal consultation - an optional process that includes all discussions and correspondence between the Services and a Federal agency or designated non-Federal representative, prior to formal consultation, to determine whether a proposed Federal action may affect listed species or critical habitat. This process allows the Federal agency to utilize the Services' expertise to evaluate the agency's assessment of potential effects or to suggest possible modifications to the proposed action which could avoid potentially adverse effects. If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required (except when the Services concur, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat) (50 CFR §402.02, 50 CFR §402.13).

Insignificant - responses that are incapable of being detected, measured, or evaluated. This analysis relates to the amount or extent of the impact. If the impact will likely be negative, but the consequences are so minute that a person could not measure or detect such responses, then it is appropriate to conclude insignificant effects. (USFWS 1998a).

Interdependent action - actions having no independent utility apart from the proposed action (50 CFR §402.02).

Interrelated action - actions that are part of a larger action and depend on the larger action for their justification (50 CFR §402.02).

Glossary of Freshwater Mussel and Bat Definitions:

Anterior - front or forward

Calcar - spur of cartilage arising from inner side of ankle/heel and running along part of the outer edge of the membrane that stretches between the hind leg bones and the tail bones in bats

Cardinal teeth - teeth located between the lateral teeth in Corbiculidae and Sphaeriidae mussel families

Dorsal - the top or back; in mussels, the hinge area

Gill - a thin plate-like paired structure within the mantel cavity, which serves as a respiratory organ in aquatic mollusks. In female unionids, all or a portion may serve as the marsupium

Glochidia - the bivalve larva of unionids that are generally parasitic on the gills of fish

Gravid - a female mussel that has embryos in the marsupium

Hibernaculum - cave, mine, or other structure where bats spend the winter. Plural form = hibernacula

Hinge ligament - an elastic, elongate, corneous structure that unites the two valves of a mussel dorsally along the hinge plate

Keel - protrusion sometimes present on calcar that projects toward the body of the bat

Marsupium - in unionids, a brood pouch for eggs and developing glochidia, formed by a restricted portion of the outer gill, the complete outer gill, or all four gills

Mantle - soft tissue enclosing the body of a mussel, the principal function of which is to secrete the shell. In some species of the Subfamily Lampsilinae, the posterior portion of the female mantle serves to attract host fish by mimicking the shape and movement of fish or crayfish

Nacre - the interior iridescent, thin layer of a mussel shell

Naiad - formerly a tribe of Mollusca nearly equivalent taxonomically to the family Unionidae, often used as a synonym of unionid

Periostracum - exterior or outside layer of the shell

Posterior - hind or rear

Pseudocardinal teeth - triangular-shaped hinge teeth near the anterior-dorsal margin of the shell

Salvage area - the construction footprint plus an up- and down-stream buffer from which freshwater mussels will be removed prior to construction

Tachytitic - mussels which are short-term breeders (e.g., glochidia are found in the gills of the female only during the summer)

Torpor - a state of lowered physiological activity typically characterized by reduced metabolism, heart rate, respiration, and body temperature that occurs in varying degrees especially in hibernating and estivating animals

Unionid – member of the freshwater mussel family “Unionidae"

Valve - the right or left half of a mussel (or unionid) shell

Ventral - the underside or bottom

Volant - capable of flight

1.0 INTRODUCTION

Federal Highway Administration (FHWA) and North Carolina Department of Transportation (NCDOT) are proposing highway improvements to a 22.2-mile (mi.) segment of Interstate 26 (I-26) in Henderson and Buncombe Counties, NC. The proposed project is included in the 2017–2027 *State Transportation Improvement Program* (STIP) as project numbers I-4400 and I-4700. STIP Project I-4400 begins at US 25 (Exit 54) near Hendersonville and extends along I-26 west to NC 280 (Exit 40), south of Asheville; a distance of 13.6 mi. STIP Project I-4700 extends along I-26 from NC 280 west to the I-40/I-240 interchange; a distance of 8.6 mi. (Appendix A, Figure 1). Reconstruction of a pair of existing rest areas in Henderson County, south of Fanning Bridge Road (SR 3539), and replacement of the Blue Ridge Parkway bridge over I-26 in Buncombe County are included as part of this project.

The purpose of this Biological Assessment (BA) is the evaluation of potential effect of the project on federally listed and proposed species and designated critical habitat in accordance with Section 7 of the Endangered Species Act of 1973 (ESA) (16 United States Code [USC] 1536 (c)). Section 7(a)(2) of the ESA (16 USC 1531-1544 and Section 1536) requires that each Federal agency shall, in consultation with the United States Fish and Wildlife Service (USFWS), ensure that any action authorized, funded, or carried out by such agency, is not likely to jeopardize the continued existence of an endangered or threatened species, or result in the destruction or adverse modification of critical habitat. Since the proposed project includes funding by FHWA, right of access provided by the National Park Service (NPS) for construction staging, and approval by the United States Army Corps of Engineers (USACE) pursuant to the Clean Water Act (CWA), the project is subject to consultation under Section 7 of the ESA.

This BA is provided to satisfy the action agencies' (FHWA, USACE, and NPS) obligations under Section 7 of the ESA (See Glossary on Page viii of this report). FHWA is the lead federal agency for actions under the National Environmental Policy Act (NEPA) and the ESA.

FHWA and NCDOT are evaluating the project under NEPA, as amended (42 USC 4321, et seq.). This BA is primarily based upon information developed for the project, including the Acoustic Survey Report (Appendix B), Structure Survey Report (Appendix C), Freshwater Mussel Survey Report (Appendix D), Indirect Screening Report (NCDOT 2013a) and subsequent update (NCDOT 2017a), Draft Environmental Impact Statement (DEIS) (NCDOT 2016), and other analyses detailed in this report (Appendices E-H). Note that the definitions for Indirect Effects and Cumulative Effects differ between NEPA and ESA.

The federally endangered gray bat (*Myotis grisescens;* MYGR) and Appalachian elktoe (*Alasmidonta raveneliana*), the federally threatened Northern long-eared bat (*Myotis septentrionalis;* MYSE), and the federally threatened (due to similarity of appearance) bog turtle (*Glyptemys muhlenbergii*) are listed by the USFWS for Buncombe and Henderson Counties and are currently known to occur in areas that may be impacted by this project. Indiana bat (*Myotis sodalis*; MYSO) is not listed by USFWS for Buncombe or Henderson County. However, NPS conducted acoustic surveys along the Blue Ridge Parkway, and recorded calls that they believe are attributable to MYSO. Therefore, NCDOT is considering the species to be present in the Action Area. In a letter dated November 2, 2017 to NCDOT, USFWS stated their position that acoustic surveys conducted by NPS in 2016 were not conclusive for MYSO.

1.1 Statutory Authority of Action

The proposed project is included in the NCDOT's STIP as two projects; I-4400 and I-4700. NCDOT is proposing this project with funding from federal sources through FHWA. NCDOT

derives their statutory authority via North Carolina General Statutes (NCGS) 143B-345 and 346 and FHWA derives their statutory authority via 49 USC 104. NCDOT has initiated informal consultation with the USFWS in accordance with the 2002 designation Title 50 Code of Federal Regulations (CFR), Section 402.08 (50 CFR § 402.08), entitled, Designation of Non-Federal Representative, which allows Federal agencies to delegate informal consultation and preparation of biological studies to a non-Federal representative.

In accordance with the requirements of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899, the USACE will review and authorize, as appropriate, the proposed impacts to Waters of the United States (e.g., streams, rivers, most wetlands, lakes, etc.) for this project. NPS provided right-of-way to NCDOT along the Blue Ridge Parkway that will allow for replacement of the bridge over I-26 and associated realignment of the Parkway.

The Department of Interior granted right-of-way to the State Commission of Highways in 1965, so NCDOT, for all intents and purposes, owns the land under the Blue Ridge Parkway bridge. The easement is wide enough to accommodate the proposed eight-lane roadway. However, NPS owns the bridge, and the bridge bents must be moved so the road can be widened. Therefore, the entire bridge must be replaced. NPS will provide right of access to stage construction on NPS property during the bridge replacement.

1.2 Federally Listed Species: Buncombe and Henderson Counties, NC

The USFWS maintains a list of federally protected species for each county in North Carolina, which was most recently accessed on April 9, 2018. The species lists for each county were last updated on March 22, 2018 (USFWS 2018a, USFWS 2018b). There are 19 species listed for the two counties where the Action Area is located. These species are listed in Table 1. The species list is based on the county boundaries and is larger than the Action Area. There is no designated critical habitat within the Action Area for the species listed in Table 1.

Table 1. Federally Protected Species in Buncombe and Henderson Counties

Common Name	**Scientific name**	**Federal Status**	**Listing Status**		**Species Present in Action Area**
			Buncombe	**Henderson**	
Appalachian elktoe	*Alasmidonta raveneliana*	E	Current	Current	Yes
Blue Ridge goldenrod	*Solidago spithamaea*	T	Current	NL	No
Bog turtle	*Glyptemys muhlenbergii*	T (S/A)	Current	Current	Yes
Bunched arrowhead	*Sagittaria fasciculata*	E	Current	Current	No
Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	E	Current	Current	No
Gray bat	*Myotis grisescens*	E	Current	Probable/ Potential	Yes
Indiana bat	*Myotis sodalis*	E	NL	NL	Yes^
Mountain sweet pitcher plant	*Sarracenia rubra ssp. jonesii*	E	Current	Current	No
Northern long-eared bat	*Myotis septentrionalis*	T	Current	Current	Yes
Rock gnome lichen	*Gymnoderma lineare*	E	Current	NL	No

Table 1. Federally Protected Species in Buncombe and Henderson Counties

Common Name	Scientific name	Federal Status	Listing Status		Species Present in Action Area
			Buncombe	Henderson	
Rusty-patched bumble bee*	*Bombus affinis*	E	Historic	Historic	No
Small whorled pogonia	*Isotria medeoloides*	T	NL	Current	No
Spotfin chub (=turquise shiner)	*Erimonax monachus*	T	Historic	NL	No
Spreading avens	*Geum radiatum*	E	Current	NL	No
Spruce-fir moss spider	*Microhexura montivaga*	E	Current	NL	No
Swamp pink	*Helonias bullata*	T	NL	Current	No
Tan riffleshell	*Epioblasma florentina walkeri (=E. walkeri)*	E	Historic and Obscure	NL	No
Virginia spiraea	*Spiraea virginiana*	T	Historic	NL	No
White fringeless orchid	*Platanthera integrilabia*	T	NL	Historic	No
White irisette	*Sisyrinchium dichotomum*	E	NL	Current	No

NL = Not listed for county, E = Endangered, T = Threatened, T(S/A) = Threatened due to similarity of appearance

^ = MYSO does not appear on the USFWS list of protected species for Buncombe or Henderson Counties, but NPS recorded calls they attributed to MYGR on Parkway property
* = USFWS does not and will not require surveys for rusty-patched bumble bee in North Carolina because USFWS assumes the state is unoccupied by rusty-patched bumble bee

Current - the species has been observed in the county within the last 50 years
Historic - the species was last observed in the county more than 50 years ago
Obscure - the date and/or location of observation is uncertain
Probable/Potential - the species is considered likely to occur in this county based on the proximity of known records (in adjacent counties), the presence of potentially suitable habitat, or both

The official species list for this project was based on federally listed species in all of Buncombe and Henderson Counties. The Action Area for the project is a smaller area than the counties' limits. Most species do not occur within the Action Area, and do not require consultation under Section 7 of the ESA. These species are addressed briefly in Section 9 with a "No Effect" determination. Bog turtle is known to occur within the Action Area, but no ESA Section 7 consultation is required for this species due to its federal status. The Appalachian elktoe and MYGR are known to occur within some portion of the Action Area (Table 1) and the potential project-related effects to these species are considered in this BA. MYSE is assumed to occur in the Action Area. Potential project effects to this species are discussed in Section 8. The NPS conducted acoustic surveys on Parkway property and concluded that MYSO is present. However, in a letter dated November 2, 2017, USFWS stated their position that these surveys are inconclusive for MYSO. Therefore, the species does not appear on the list of protected species for Buncombe and Henderson Counties. Potential project effects to this species are also discussed in Section 8.

1.3 Summary of Consultation History

Informal consultation for the I-26 widening project began in 2001. At that time, only the STIP Project Number I-4400 portion of the project was under consideration. An Environmental Assessment (EA) was completed for STIP I-4400 (the 13.6-mi. segment from US 25 to NC 280) in May 2001. Following completion of the Finding of No Significant Impact (FONSI) decision document, in January 2002, the project was advertised as a Design-Build project by NCDOT. A lawsuit and resulting judgment in 2003 found that NCDOT should conduct a broader analysis of the cumulative impacts and logical termini, or project limits, of the overall expansion of the I-26 corridor. The project was reinitiated and included in the Draft NCDOT 2013 – 2023 STIP. To address the 2003 judgment, the NCDOT combined the analysis of STIP I-4400 and STIP I-4700 (the 8.6-mi. segment from NC 280 (Airport Road) to I-40/I-240) into one comprehensive Environmental Impact Statement (EIS). HNTB North Carolina, P.C. (HNTB) has been tasked with preparation of the EIS for the combined I-4400 and I-4700 project. Project purpose and need, study area, and detailed study alternatives were decided during a Merger Team meeting on June 20, 2013 (the Merger Team is a group of federal and state environmental agency partners). These alternatives were studied as part of the analysis presented in the Draft EIS (DEIS), which was approved on August 9, 2016. Subsequently, the least environmentally damaging practicable alternative (LEDPA) was selected on January 18, 2017. The Final Environmental Impact Statement (FEIS) is anticipated in summer 2018.

Informal consultation for MYGR for this project began in August 2016, after the North Carolina Wildlife Resources Commission (NCWRC) discovered MYGR roosting in a bridge near the project in Buncombe County. CALYX Engineers and Consultants, Inc. (CALYX) was contracted by NCDOT in December 2016 to conduct surveys for MYGR and to complete the BA for MYGR. Through acoustic surveys, MYGR was confirmed to be present in several locations along the proposed project corridor. Three Oaks Engineering, Inc. (Three Oaks) was contracted by NCDOT in May 2017 to complete aquatic mussel surveys for the project. Appalachian elktoe was discovered in the main stem of the French Broad River, approximately 2 mi. downstream from the I-26 bridge over the French Broad River, in September 2017. Three Oaks was subsequently hired to complete the portion of this BA pertinent to Appalachian elktoe.

The following information provides a detailed consultation history for the subject project.

- May 3, 2001 – USFWS concurred with a “No Effect” determination for all listed species associated with project I-4400.
- May 18, 2006 – Letter from USFWS to NCDOT providing comments on project scoping information. USFWS’ primary concern was potential impacts to Appalachian elktoe, because more than 5 years had passed since previous surveys for any federally protected species, and particularly since STIP I-4700 was added to the project scope.
- March 17, 2016 – NCDOT submitted a letter to USFWS via email, noting that the proposed action is consistent with the final Section 7 4(d) rule for MYSE.
- April 7-12, 2016 – Series of emails between National Park Service (NPS), NCDOT, and HNTB clarifying that the NPS requested and NCDOT agreed to seasonal tree clearing (August 15 – May 15) on NPS property for MYSE.
- July 19, 2016 – MYGR discovered by NCWRC and USFWS in bridge roost near Action Area.
- September 19, 2016 – Email from NPS to HNTB stating that NPS biologists “found an MYSO during a survey on the night of 9/19/16” on Blue Ridge Parkway property.
- September 22, 2016 – Email between NPS and HNTB requesting a commitment for MYSO on NPS property based on the results of an acoustic survey.

- October 5, 2016 – Letter from USFWS to NCDOT providing comments on the DEIS. USFWS recommended additional surveys for bats and protection of known, occupied habitat for bog turtle, which occurs adjacent to the existing interstate.
- October 11, 2016 – NCDOT emailed USFWS asking if time of year restrictions on bridge construction at the French Broad River and tree clearing would suffice as allowable conservation measures to proceed with the project without a need for formal consultation. A subsequent email from USFWS on October 18, 2016 indicated that more surveys were needed before decisions on consultation could be made.
- October 20, 2016 – Letter from United States Department of the Interior (USDOI) to NCDOT providing comments on the DEIS. USDOI stated that they did not agree with the "No Effect" finding for MYGR since the species had recently been discovered near the project. The letter also mentioned that results of recent acoustic surveys along the Blue Ridge Parkway recorded calls consistent with those of Indiana bat. The letter recommended additional surveys for MYGR and MYSO, as well as protection of known, occupied habitat for bog turtle, which occurs adjacent to the existing interstate.
- November 30, 2016 – Coordination meeting with NCDOT, USFWS, NPS, NCWRC, FHWA to discuss needed surveys for MYGR.
- December 20, 2016 – On-site coordination meeting with NCDOT, USFWS, NPS, NCWRC, FHWA, HNTB, and CALYX to visit areas of concern and discuss needed bat surveys.
- January 30, 2017 – Meeting in Asheville with NCDOT, CALYX, USFWS, NCWRC, and NPS to discuss bat survey specifics.
- March 23, 2017 – USFWS and NCWRC provide comments on proposed scope of work for MYGR surveys.
- March 24, 2017 – Coordination meeting with NCDOT, HNTB, CALYX, FHWA.
- May 9, 2017 through August 15, 2017 – CALYX provided periodic (approximately every 2-3 weeks) updates to USFWS, NCWRC, and NCDOT on results of acoustic surveys.
- May 15, 2017 – Call with CALYX, USFWS and NCWRC to discuss preliminary results of acoustic surveys. The decision was made to keep a detector in place full time at the French Broad River.
- May 22, 2017 – CALYX provided update to USFWS, NCWRC, and NCDOT on status of structure checks via email.
- June 6, 2017 – CALYX provided final results of structure checks to USFWS, NCWRC, and NCDOT via email.
- June 20, 2017 – Call with CALYX, USFWS, NCWRC, NCDOT to discuss status of acoustic surveys and changes to survey plan for the remainder of the survey season.
- July 17, 2017 – Call with CALYX, USFWS, and NCWRC to discuss changes to acoustic detector deployment schedule. It was decided that the detector at the French Broad River bridge would stay in place indefinitely (beyond the time frame of the originally proposed survey period) as a way to try and determine when the MYGR activity ceased for the year. This information was not included in the acoustic survey report, but submitted to USFWS at a later date.
- August 11, 2017 – CALYX submitted structure survey report to USFWS and NCDOT
- September 12, 2017 – CALYX submitted draft acoustic survey report to USFWS, NCWRC, and NCDOT for review.

- September 25, 2017 – Coordination call/meeting with CALYX, USFWS, NCWRC, NCDOT, and HNTB to discuss status of acoustic surveys and progress on BA. Changes to the acoustic survey report were made per USFWS and NCWRC comments.
- September 29, 2017 – USFWS and Three Oaks conducted surveys downstream from the I-26 crossing over the French Broad River and found a previously undocumented occurrence of Appalachian elktoe.
- October 11, 2017 – Merger Team Concurrence Point 4A Meeting. USFWS states that they will not expect formal consultation for MYSO. Potential stormwater and sediment and erosion control measures specific to minimizing impacts to MYGR and elktoe were also discussed. USFWS suggested additional conservation measures including a revegetation plan, minimization of impacts to surface waters, and minimization of tree clearing, especially around the bridge over the French Broad River.
- October 23, 2017 – NCDOT had a phone call with USFWS to get clarification on appropriate language for MYSO and MYSE in the BA due to the fact that neither species is listed for Buncombe or Henderson County, yet NCDOT has agreed to conditions for these species on NPS property. The following were also discussed as potential conservation measures: MYGR research project, the use of DSSW, the use of (and commitment to, where feasible and practical) post-construction stormwater controls for any streams draining directly to the French Broad River.
- October 26, 2017 – NCDOT email to USFWS proposing 3-year MYGR research project as a conservation measure for multiple STIP Projects in the French Broad River basin to assist USFWS in a future programmatic consultation.
- October 26, 2017 – NCDOT sent a map to USFWS documenting the areas surveyed for and included the locations where Appalachian elktoe were found during those surveys.
- November 2, 2017 – Letter from USFWS to NCDOT stating their position that acoustic surveys conducted by NPS in 2016 were not conclusive for MYSO.
- November 3, 2017 – USFWS email to NCDOT agreeing to conservation measure proposal for MYGR.
- November 10, 2017 – CALYX submitted final acoustic survey report to USFWS, NCWRC, and NCDOT.
- November 20, 2017 - Call with USFWS, FHWA, NCDOT, and CALYX to discuss potential revision of project Action Area. It was decided that the Action Area should include the study area used for the DEIS and potentially an area extending downstream from the I-26 crossing over the French Broad River to the study area associated with the STIP I-2513 (Asheville Connector).
- November 21, 2017 – Call between NCDOT, Three Oaks, and USFWS. USFWS Species Recovery Biologist presented current research and projects as examples for appropriate conservation for Appalachian elktoe in the French Broad River basin. NCDOT requested a written proposal.
- December 6, 2017 – NCDOT provided written justification via email for extension of the Action Area to USFWS.
- December 7, 2017 – USFWS emailed the “French Broad River Conservation Plan Outline” for Appalachian elktoe to those who participated in the November 21, 2017 call.
- December 12, 2017 – USFWS approved revised Action Area (needed for Appalachian elktoe) via email.

- February 1, 2018 - Coordination call/meeting with CALYX, USFWS, FHWA, NCDOT, and HNTB to discuss USFWS and FHWA comments on draft version of BA. Updates will be made to the document based on agency comments.
- February 7, 2018 – Call/meeting between CALYX, USFWS, FHWA, NCDOT, North Carolina Division of Water Resources (NCDWR), USACE, and HNTB to discuss bridge replacement over the French Broad River. USFWS, NCDWR, and USACE expressed concern over safety of river users, size of causeways, length of time causeways will be in place, and size of river channel opening while causeways need to be in place. CALYX, NCDOT, and HNTB agreed to work together to address these concerns.
- February 27, 2018 – Call between NCDOT and USFWS to discuss implementation of safety measures for river users and potential impacts to MYGR and elktoe.
- March 5, 2018 -Revised plan for replacement of bridges over the French Broad River distributed to attendees of February 7, 2018 meeting.
- March 23, 2018 – Meeting between CALYX, USFWS, FHWA, NCDOT, NCDWR, USACE, and HNTB to discuss updates to plan for bridge replacement over the French Broad River and project conservation measures. The agencies, USACE, USFWS, and NCDWR, agreed that the new Stage 4 causeway and working in the wet was something that they would permit with the understanding that additional precautions would be taken. See Section 7.3.4 and Appendix E for these precautions.
- June 5, 2018 – NCDOT submitted draft BA to USFWS, USACE, NPS, FHWA, and NCDWR for review and comment.
- June 15, 2018 – Call between NCDOT, USFWS, and FHWA regarding draft BA.
- June 20, 2018 – Call between NCDOT, USFWS, FHWA, CALYX, and Three Oaks to review comments on draft BA.
- June 22, 2018 – Call between NCDOT and USFWS to discuss addition of access roads at French Broad River needed to safely allow construction vehicles to ingress, egress from construction zone.
- June 28, 2018 – Call between NCDOT and USFWS to discuss addition of access roads at Blue Ridge Parkway. USFWS requested maps depicting the difference in clearing limits between proposed access roads and required clearing limits for roadway widening only.
- July 23, 2018 – Call between NCDOT and USFWS. USFWS sent comments and requested changes on Final BA to NCDOT and FHWA.
- July 26, 2018 – Call between NCDOT and USFWS. USFWS requested via email that NCDOT make a commitment to install causeway material in the French Broad River between October and April.
- July 30, 2018 – Call between NCDOT and USFWS regarding requested changes and comments on Final BA.
- August 7, 2018 – NCDOT followed up with USFWS on the request for an additional commitment.
- August 13, 2018 – Based on correspondence from FHWA on August 9, 2018, NCDOT provided responses and changes to the draft BA to USFWS.

2.0 Project Description and Action Area

2.1 General Information

The proposed project lies in the Southern Blue Ridge Mountain physiographic region of North Carolina, in Henderson and Buncombe Counties, North Carolina. Topography in the project

vicinity ranges from very steep, rolling intermountain hills and narrow valleys to wide valleys and stream floodplains associated with the French Broad River. Elevations in the area range from approximately 2,000 to 2,310 feet (ft.) above mean sea level (NCDOT 2016) (Appendix A, Figure 2).

The preferred alternative will widen the existing two-lane section of I-26 to three lanes in each direction for roughly 13.6 mi. between US 25 (Exit 54) and the US 25 (Asheville Highway; Exit 44) interchange, and widen I-26 to four lanes in each direction for roughly 8.6 mi. from the US 25 (Asheville Highway; Exit 44) to the I-40/I-240 interchange. This alternative will be designed to best fit within the existing right of way limits, mainly utilizing the existing median. However, some additional right of way is needed in some locations (NCDOT 2016).

As part of this project, the Blue Ridge Parkway bridge over I-26 will be replaced on new location with the approaches realigned accordingly; in addition, a new parking pull off will be constructed east of I-26, on the south side of the Parkway.

As part of this project, the Blue Ridge Parkway bridge over I-26 will be replaced on new location, south of the existing bridge, with the approaches reconstructed on new alignment, approximately 0.25 mi. on east and west of I-26, for a total reconstructed length of approximately 0.5 mi. In addition, a new parking pull off will be constructed east of I-26, on the south side of the Parkway. The new Parkway bridge will be a concrete segmental structure constructed using a balanced cantilever approach. It is expected that the concrete segments for the bridge and piers will be pre-cast, hauled to the site, and assembled on-site. The bridge abutments and bents will be constructed along with the Parkway approaches. Once the bents and temporary supports are in place the segments will be placed accordingly. The existing bridge will be demolished once traffic is shifted onto the new Parkway bridge. Demolition will take approximately one month. Traffic on I-26 and the Parkway will be maintained throughout construction and demolition of the Parkway bridges. Replacement of the Parkway bridge is anticipated to take approximately 2-3 years.

To reach the construction area, there are three options: travel the Parkway from NC 191 (Brevard Road), approximately 3 mi.; travel the Parkway from US 25 (Asheville Highway), approximately 5 mi.; or construct access roads from I-26 and use the existing Parkway bridge to traverse from one side to the other. Enjoyment of park resources is part of the fundamental purpose of all national parks. Using the Parkway as a mass haul road for construction equipment and/or materials would infringe on the visitor experience of the Parkway. Using access roads to minimize this infringement as much as possible is preferred by the NPS. Therefore, at least one, and possibly two access roads will be installed on the south side of the Parkway to facilitate hauling of materials between the Parkway and the Interstate.

The rest areas along I-26, south of Fanning Bridge Road (SR 3539) overpass in Henderson County, will be reconstructed as part this project. The rest areas are currently undersized for the amount of use they receive and the ramps need to be brought to current interstate standards. The renovations will include the reconfiguration and expansion of the site, parking areas, and primary building site. The direct environmental impacts will be contained within the existing property, but will include grading, vegetation and tree removal, and expanded impermeable areas. Mitigation of these impacts will include, but are not limited to, contained site stormwater runoff, erosion control (during construction), the inclusion of permanent bio-retention and hazardous spill basins, re-establishment of vegetative buffers, and the development of site landscaping that will include landscape trees, turf, and recreational/sitting areas (for the traveling public). The facility, once complete, will have continued maintenance to monitor the improved storm water controls, sustained growth of the vegetative buffers, and matured development of the landscape.

Project construction is anticipated to begin approximately 2 months after the contract is let, and will continue for approximately 60 months (5 years). Construction activities associated with the proposed widening project may include, but are not limited to clearing, grubbing, grading, installation of base material, installation of pavement, striping, signs, and lighting. Extensions of existing culverts and replacement of some existing bridges and overpasses will also be necessary. Earth moving and road building equipment of various kinds and sizes will be utilized to complete the project construction.

There is a sewer line adjacent to the French Broad River that is a major line for southern Asheville and must be maintained. The line is a 42-inch (in.) pipe branching to 36-in. and 24-in. sections. NCDOT will leave the line in place (no relocation). Utility lines in the Action Area are mostly limited to I-26 interchanges, as opposed to parallel services. There will also be a need for utility relocations at the reconstructed rest areas. The places where utility relocations are necessary are small in size and located relatively far from the French Broad River.

Two locations will require additional permanent lighting: the I-26 and US 25 (Asheville Highway) interchange and the reconstructed rest areas. All three interchanges along the I-26 corridor within the project limits of I-4700 have existing lighting. No additional lighting will be required at two of these interchanges. Additional lighting is warranted and justified at the I-26/US 25 (Asheville Highway) interchange and the rest areas. The site lighting for the interchange includes approximately six 45-ft. single-arm light poles with a cobrahead style LED light fixture for the ramp terminal area on US 25 Business, eight 45-ft. median twin-arm light poles with two cobrahead style LED light fixtures each for ramp tie-in onto I-26 and for I-26 travel lanes, and six 100-ft. high mast light poles with six high mast LED light fixtures each in the gore areas to provide lighting on US 25 Business (Asheville Highway) and for the I-26 travel lanes. The site lighting for each rest area will include approximately 35 cobrahead style lights for the parking area and 20 post top lights for the sidewalks. Lighting relocation plans will be included in the project to resolve conflicts with proposed roadway work (NCDOT 2001).

Additional information can be found on the project website:
https://www.ncdot.gov/projects/i26Widening/.

2.1.1 Bridge Replacement over the French Broad River

The existing pair of two-lane bridges that carry I-26 over the French Broad River will be replaced with one new structure that will provide a total of eight travel lanes. NCDOT evaluated the various constraints associated with the bridge replacements, conducted preliminary coordination with USACE, USFWS, FHWA, NCWRC, and NCDWR and accelerated the design process to better determine potential impacts to protected species within the Action Area. NCDOT's preferred replacement structure is a three-span bridge, which will take approximately three to four years to build. Although the three-span bridge is NCDOT's preferred option, the preliminary design that was used to determine potential impacts is considered a worst-case scenario and will be refined as design progresses. A detailed description of the proposed bridge, the replacement process, including preliminary causeway design, preliminary impacts to surface waters, construction staging and techniques, and summary of hydraulic analysis are included in Appendix E. Demolition of the existing bridges and construction of the new bridge is anticipated to take approximately 3 to 4 years.

The proposed three-span structure maintains the existing vertical clearance over Old River Road and the river's water surface, but the new I-26 centerline will be shifted approximately 12.5 ft. to the south of the existing centerline. The three spans for this design are anticipated to have lengths of approximately 151 ft., 170 ft., and 143 ft. from east to west, and will require two bents in the

river. Each bent will require ten drilled shafts. Assuming ten, 5-foot diameter shafts for each bent, the drilled shaft area is approximately 200 square feet (sq. ft.), per bent, for a total of 400 sq. ft. for both bents. The unequal span arrangement avoids all existing foundations, including the center bent. This design reduces impacts to the river by using fewer bents than the four-span arrangement; maximizes the hydraulic opening with smaller causeways; and speeds construction. The center span length exceeds the standard concrete girder length typically utilized by NCDOT, so it is likely that final design specifications will call for steel girders. Currently, drainage from the deck of the existing structure flows directly into the river. The proposed design for the bridge over the French Broad River will include shoulders sufficient to convey runoff into adjacent stormwater control devices and eliminate direct discharge into the river.

To build the bridge, access roads and causeways will be used. Access roads are required to transport materials and construction equipment to the worksite. The access roads will be built parallel to I-26, one in each quadrant. The access roads parallel to I-26 westbound in the northeast and southeast quadrants are within 10 and 30 feet of jurisdictional streams SFG and SEE, as identified in the Natural Resources Technical Report [NRTR] (NCDOT 2014a), respectively. These streams are identified as Environmentally Sensitive Areas and thus require a 50-foot buffer zone according to NCDOT policy. To avoid sedimentation and erosion of the streams, as well as to stay within the NCDOT right of way and off Biltmore Estate property, a National Historic Landmark, NCDOT shall temporarily pipe streams SEE and SFG during bridge construction and demolition. USFWS and USACE will have the opportunity to review the design of the SEC measures for Streams SEE and SFG. A revegetation and stream monitoring plan shall be developed for Streams SEE and SFG, to observe vegetation success and stream stability. The revegetation and stream monitoring plan shall be approved the USACE and will commence once the bridge construction and demolition are complete and the pipe is removed.

Due to insufficient area between the toe of slope and the top of bank to allow construction vehicle passage under the bridge and the location of the interior bents within the river, a causeway is required to provide construction access. The size, width, and length into the river of the causeways varies from stage to stage depending on the work being performed.

Between 51 and 67 percent of the river will remain free-flowing depending upon the causeway stage. The bridge is anticipated to be built in four stages. Demolition of the existing bridge, including the superstructure and interior bents and the top of the center bent will occur in conjunction with construction of the new bridge. The first stage of construction comprises building the bridge to the west of the existing bridge. In the second stage, the existing eastbound I-26 bridge will be demolished and construction will then continue, adding four lanes to the new bridge structure. The third stage will demolish the westbound bridge and then build the remainder of the structure. In the fourth stage the two center bents will be removed. This approach minimizes the restriction of the river created by the causeway.

The French Broad River was modeled using the USACE Hydrologic Engineering Center's River Analysis System (HEC-RAS). The modeling was conducted for two scenarios, the first with the causeway that is anticipated to be in place for the entire construction time, shown as Stages 1A, 2A, and 3A in the causeway sketches (Appendix E). The second scenario used the 'L' causeway extension (Stage 4) that will be in place for approximately four weeks at the end of construction. The modeling shows a rise in the water surface elevation (WSE) during a mean rain event and during a 100-year storm event for both scenarios. The rise in WSE under the mean event for the Stage 1A, 2A, and 3A causeway is approximately 8.5 in. at approximately 0.02 mi. (106 ft.) upstream of the causeway, and returns to 0 in., or no difference, 0.6 mile upstream. During a 100-year storm event a WSE rise of approximately 1.5 ft. to 2.5 in. may occur between the

causeway and approximately 2.1 mi. upstream of the bridge before returning to a normal WSE for a 100-year flood event. Similar results were found for the Stage 4, 'L' causeway.

During demolition, removal of the bents will be accomplished by tipping them over and removing the entire bent, or by cutting the bent off at stream bed elevation or, if the bent is on land, 1 foot below ground elevation. Because the base of the remaining bent in the stream is at stream elevation, no material will be put back over the remaining bent. The method of removal will be dependent on the foundation conditions present at the site. According to existing bridge plans, the structure is supported by spread footings (no piles underneath). The new structure will place the bents directly adjacent to the existing bents. No loose portion of the existing bents can remain in the streambed.

As part of its evaluation, NCDOT also took into consideration the time of day when construction and demolition may take place. It was determined that some work would likely need to be completed at night. These activities may include causeway installation, setting girders, drilling shafts, concrete pours, deck concrete pours, beam setting, construction material(s) stockpiling, and traffic shifts. The amount and type of lighting for all activities will be minimized to the maximum extent possible.

Additional measures to protect the French Broad River during construction will be taken and are summarized in the conservation measures (Section 7).

Because the French Broad River is regularly used for recreation, it cannot be closed to navigation for the duration of construction. There are no options for portage due to the location of the bridge. NCDOT will commit to providing a safe passage lane for river users. To do so, NCDOT will employ safety measures, including a catchment device on the overhead structure to prevent material from falling on river users, equestrians or bicyclists on Old River Road, or in the water. In addition, a floating navigational aid will be installed to guide river users to the safe passage lane and away from the causeways/construction zone. Steady-state, red lighting will be used at night to alert river users to the presence of the causeways. Certain activities, such as setting girders, will require temporary river closure to ensure the safety of river users. Most of these activities are anticipated to occur at night. NCDOT has developed a Communication Plan specific to the construction/demolition of the I-26 bridge over the French Broad River and will work with river users, businesses, and recreational river and civic groups to insure public notification of the temporary closures.

2.1.2 Removal of Woody Vegetation

The project includes limited clearing of woody vegetation to accommodate additional travel lanes and interchange expansions. Clearing will likely begin almost immediately after the project is let for construction, and may continue for a period of up to two years. Clearing may occur at different locations along the length of the project, depending on construction timing/phasing. Clearing activities will take place during daylight hours, but may occur during any time of year, with the exception of the area on Blue Ridge Parkway property (see Section 7.1.2) where tree clearing will occur between August 15 and May 15. The amount of tree clearing that may occur in conjunction with the replacement of the Blue Ridge Parkway is uncertain at this time, depending on the use of one versus two access roads. Clearing will total approximately 3.9 ac. on the southwest side of the Parkway bridge and approximately 7.3 ac on the southeast side of the Parkway bridge. Clearing in this area may extend beyond the minimum extent necessary to accommodate the completed roadway.

The 3.3-mi. long section of the project that extends from just north of the Blue Ridge Parkway to NC 191 (Brevard Road) is heavily wooded. For this reason, because of its proximity to the French Broad River, and because it is the largest contiguously forested area within the Action Area, clearing in this section will be minimized. Clearing will not extend beyond areas that will become part of the permanent project footprint. NCDOT developed a preliminary design that utilizes retaining walls whenever practicable for this section of the project. Based on the slope stake limits associated with preliminary design and the tree line presented in the final survey, approximately 3.8 ac. of trees will be cleared along this section of the project.

Under current conditions, in the heavily wooded section mentioned above, bats are flying approximately 181 ft. across the four-lane roadway in areas that are not bifurcated. In the bifurcated section, bats attempting to fly across the road are crossing two openings that are each approximately 112 ft. wide (two, two-lane crossings). Based on current preliminary design, on average, bats will need to fly an additional 25 ft. to cross each set of lanes in the proposed bifurcated section (two, four-lane crossings), and an additional 35 ft. to cross the proposed eight-lane sections (Table 2).

Table 2: Average Width across I-26 between Blue Ridge Parkway and Brevard Road (NC 191) Based on Existing Tree Line and Post-Construction Tree Line

Bifurcated Section Tree Line Width (Feet)			Contiguous Section Tree Line Width (Feet)		
Existing 2-lane crossings (each)	Proposed 4-lane crossings (each)	Increased Width (each)	Existing 4-lane crossing (total)	Proposed 8-lane crossing (total)	Increased Width (total)
112	137	25	181	216	35

Clearing at the French Broad River will be minimized as much as practicable. Four access roads will be utilized, one in each quadrant, to reach the causeways. Retaining walls will be used to minimize the amount of necessary clearing. Access roads will require approximately 3.75 ac. beyond the current slope stake limits for the project. However, these areas would need to be cleared as part of the typical construction process for this project.

Table 3 provides information on existing and proposed breaks in the riparian vegetation associated with the I-26 crossing of the river. On the northwest bank of the river, there is currently a gap in the canopy that spans approximately 134 ft. Clearing that is necessary to widen the roadway (and accommodate the temporary access roads) will result in an additional 175 ft. of open space. On the southeast side of the river, the riparian vegetation in this location is already fragmented by Old River Road. The current break in the canopy is approximately 195 ft. Additional clearing in this area adds a minimum of 45 ft. to the existing break in the canopy. The extent of tree clearing on this side of the river will ultimately be determined by the clearing necessary to incorporate an access road and an appropriate sediment and erosion control (SEC) device in this location, which will be completed in association with the temporary piping of streams SEE and SFG. As mentioned in the previous section, the access road design will use DSSW to mitigate the amount of sediment and erosion material that enters the French Broad River. Streams SEE and SFG have been identified as Environmentally Sensitive Areas that require special procedures be used for construction activities within a 50-foot zone on both sides of the streams measured from top of bank. However, the proposed access roads at the southeast and northeast quadrants are within 30 and 10 ft., respectively, of streams SEE and SFG. Therefore, to reduce sediment and erosion caused by the access roads, NCDOT shall temporarily pipe streams SEE and SFG. It should be noted that any clearing that must occur to accommodate the

sediment basin associated with SEE and/or SFG that lies outside the minimum roadway width needed for the completed widening will be revegetated with native species (discussed further in Section 7).

Table 3. Approximate Width across I-26 at the French Broad River Crossing Based on Existing Tree Line and Post-Construction Tree Line

Northwest Bank Tree Line Width (Feet)			Southeast Bank Tree Line Width (Feet)		
Existing 4-lane section	Proposed 8-lane section	Increased Width	Existing 4-lane section	Proposed 8-lane section	Increased Width
134	309	175	195	240	45

At the time of writing this document, detailed design is not available for clearing associated with the rest area reconstruction. So, assuming total take of the rest area trees, based on the aerial and final survey file, the westbound rest area will take approximately 4 ac. and the eastbound will take approximately 5 ac.

There are few utility relocations planned as part of this project, and those relocations will occur primarily in areas that are already in a disturbed/maintained state.

Additional measures will be taken to replace native, woody vegetation in as many areas as possible following construction, and these measures are summarized in the conservation measures (Section 7).

2.2 Description of Action Area

The Action Area as defined in 50 CFR 402.02 includes all areas in which federally listed species will be affected directly and indirectly by the Proposed Action. The "effects of the action" to be analyzed in the BA are defined as the direct and indirect effects of the action, together with the effects of other activities that are interrelated or interdependent with that action.

The Action Area for the project includes the immediate project footprint, including work areas, staging areas, and access areas, as well as areas immediately adjacent to areas affected directly by project activities. For example, noise and vibrations from project activities could potentially result in indirect effects in immediately adjacent areas. With implementation of avoidance and minimization measures as appropriate, such indirect effects will be temporary and localized, but the Action Area is nonetheless expanded beyond the immediate footprint of project activities to include such areas.

The I-4400/I-4700 Action Area (Appendix A, Figure 3) includes the I-4400/I-4700 study area (as it was defined in the DEIS; NCDOT 2016), which extends 22.2 mi. and consists generally of a 1,400 ft.-wide corridor that follows I-26 from US 25 in Henderson County north to I-40/I-240 in Buncombe County, with expanded areas at interchanges, rest areas, and the Blue Ridge Parkway bridge. In addition, the Action Area incorporates some tributaries and portions of the French Broad River including:

- sections of the French Broad River within 0.5 mi. (downstream) of tributary impacts,
- French Broad River tributaries impacted within 0.5 mi. of occupied Appalachian elktoe habitat, and
- the French Broad River from the I-26 crossing downstream (north) to I-40, specifically to the I-26 Connector (I-2513) study area.

2.3 Conservation Measures

Conservation measures are actions to benefit or promote the recovery of listed species that are included as an integral part of the proposed action. These actions serve to minimize or compensate for project effects on the species under review (USFWS 1998a). NCDOT will implement measures help minimize impacts to listed species from the project and promote conserve of MYGR and Appalachian elktoe A summary of these conservation measures is included below, and detailed information on species-specific avoidance and minimization and conservation measures is included in Section 7.

2.3.1 Project Design Modifications for Avoidance and Minimization

The Hybrid 6/8-lane widening alternative was chosen by the project Merger Team as the Least Environmentally Damaging Practicable Alternative (LEDPA) for this project, since it meets level of service (LOS) D for the design year and will result in fewer impacts to environmental features than the 8-lane widening alternative.

The proposed project minimizes impacts to resources to the extent practicable based on current information and design. However, it is not feasible to completely avoid impacts to all resources, including federally protected species. NCDOT is proposing a best fit widening that includes widening into the median to the maximum extent practicable, which results in avoidance and minimization of impacts and results in a reduced footprint for the overall project. By widening into the median, opportunities for vertical and horizontal changes and alignment shifts are limited and were determined not to be practicable. NCDOT has also reduced slope stake limits from the standard 4:1 to 2:1 to further avoid and minimize impacts. Further, NCDOT selected a diverging diamond interchange design for the US 25 interchange, which has fewer impacts than the partial cloverleaf B interchange design and synchronized interchange design that were also under consideration (NCDOT 2016).

The following is a summary of reductions to impacts to jurisdictional resources to date. It should be noted that reductions to impacts are the difference between current design with 4:1 slope stake limits plus 40 ft. for additional clearing and current design with 2:1 slope stake limits plus 25 ft. for additional clearing. A copy of the Concurrence Point 4A (Avoidance and Minimization) Merger Team meeting summary, which provides detailed information on the reduction of impacts at each jurisdictional feature, is included in Appendix F.

By reducing the slope stake limits from 4:1 to 2:1, NCDOT:

- minimized impacts to streams by approximately 10,000 ft.,
- avoided impacts to 19 wetlands (approximately 1.2 ac.),
- minimized impacts to wetlands by approximately 9.6 ac., including approximately 2.6 ac. to wetland WCH (Biltmore Bog) (as identified in the NRTR; NCDOT 2014a), and
- avoided impacts to two ponds (>0.1 ac.).

By selecting the diverging diamond interchange design at US 25 (Asheville Highway) instead of the partial cloverleaf design, NCDOT:

- minimized approximately 890 ft. of stream impacts, and
- minimized approximately 0.2 ac. of wetland impacts.

It should also be noted that the rest area reconstruction was not originally included as part of the project. Therefore, jurisdictional impacts associated with reconstruction were not included in impact calculations presented at the Concurrence Point 4A meeting, but will be included in the

impact calculations when the Merger Team revisits CP 4A. One jurisdictional stream is located within the study area associated with the project adjacent to the rest areas. At the time of writing this document, detailed designs for the rest area reconstruction are not available. Using the preliminary design of the rest area, impacts to the jurisdictional stream associated with the westbound rest area would be approximately 114 ft.

NCDOT will continue to identify avoidance and minimization measures to all Waters of the U.S. and ensure that major hydraulic structures associated with the project are designed and installed to minimize negative impacts to stream stability (and therefore, water quality) to the greatest extent practicable. As part of this process, NCDOT will continue to coordinate with the Merger Team to identify avoidance and minimization measures and ensure that project impacts are minimized to every practicable extent, including impacts to federally protected species.

2.3.2 Bridge Design Modifications for Avoidance and Minimization

As previously mentioned, the pair of bridges over the French Broad River will be replaced as part of the proposed project. Although project planning and the associated Merger process has not progressed to the point where bridge design would typically occur, NCDOT evaluated the various constraints associated with the bridge replacement, conducted preliminary coordination with USACE, USFWS, FHWA, NCWRC, and DWR and accelerated the design process to better determine potential impacts on protected species within the Action Area.

As stated in the proposed construction and demolition document (Appendix E), NCDOT considered two options for the bridge replacement. Alternative One is a pair of four-span bridges. This symmetrical design requires drilling through an existing footing and bedrock, and is not ideal due to the amount of time, cost, and difficulty. In addition, very large causeways on both sides of the river would be necessary, reducing the open river channel to 56 ft. For these reasons, NCDOT prefers to utilize Alternative Two, a three-span bridge scenario.

The three-span option results in the following avoidance and minimization of effects to the French Broad River:

- Fewer bents are required, and the unequal span arrangement eliminates the need for a center bent
- Reduces the number of spans and, therefore, eliminates one additional bent in the center of the river
- No direct discharge of bridge deck drainage; design will direct discharge to stormwater structures
- Maximizes the hydraulic opening with smaller causeways
- Reduces time to construct

Wetland and stream impacts adjacent and/or draining to the French Broad River (wetlands WEA, WDA and WFG; streams SFH and SEF, as identified in the NRTR (NCDOT 2014a)) are being avoided/minimized in the design of temporary access roads to the French Broad River Bridge. See figure for proposed access roads in Appendix E.

2.3.3 Species Specific Avoidance and Minimization Measures

NCDOT developed a variety of avoidance and minimization measures specifically for MYGR and Appalachian elktoe. Some of these measures directly benefit one species or the other, but many are beneficial to both species. Whenever possible, these measures are categorized below per the species that may derive the most benefit from the measure. These measures have been further categorized by three types of activity associated with this project; road construction, bridge

replacement, and road operation. More detailed information about avoidance and minimization measures can be found in Section 7.

2.3.3.1 Measures to Avoid/Minimize Effects to Gray Bat during Road Construction

Minimization of Tree Clearing:

- In the area between the Blue Ridge Parkway and NC 191 (Brevard Road), no trees will be cleared beyond what will be necessary to establish the permanent project footprint, to temporarily pipe streams SEE and SFG and establish associated SEC devices, and to create access roads at the Blue Ridge Parkway.

Time of Year Restriction for Tree Clearing on NPS Property:

- No tree clearing will occur on NPS land between May 15 and August 15 to avoid potential impacts to MYSE.
- Emergence and/or acoustic surveys are required prior to any tree clearing that must occur between April 1 and May 1 or August 15 and November 15 to avoid potential impacts to MYSO.
- No significant tree removal within 5 mi. of known MYSO hibernacula can occur between April 1 and November 15.
- In the event that any MYSE roost trees are documented within 0.25 mi. of the project area, regardless of the time of year, the NPS will seek consultation with the USFWS before work proceeds.

Roadway Construction Lighting:

- Due to MYGR activity on the landscape between April 15 and August 15, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the French Broad River during this time. Therefore, construction-related lighting will be indirect in nature, and will not project into adjacent wooded areas or over the water surface of the river whenever practicable. This restriction will apply to locations between Brevard Road (NC 191) and Glenn Bridge Road (SR 3495) with the exceptions of the construction area associated with the access roads at the Blue Ridge Parkway and the existing brightly lit area associated with the Long Shoals Road (NC 146) interchange.

2.3.3.2 Measures to Avoid/Minimize Effects to Gray Bat during Bridge Replacement

Night Time Construction Activities at French Broad River:

- To minimize potential impacts to lactating females and their pups, between June 1 and August 1, NCDOT shall commit to restrict the construction contractor to no more than 28 total nights of work, and no more than four consecutive nights within a two-week period. Lighting used for construction will be limited to whatever is necessary to maintain safety standards, and will only be directed toward active work areas.

Red Safety Lighting:

- NCDOT shall place solar-powered, steady-state, red, safety lights on the causeways for river user safety. Generators will not be used to provide power, so as to avoid additional noise that may disturb bats flying through the work zone.

2.3.3.3 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Road Construction and Bridge Replacement

Erosion Control Measures:

- The sedimentation and erosion control plans (SECP) shall adhere to the DSSW, where practicable, within the existing and proposed right of way for the following areas:
  - From the Blue Ridge Parkway bridge to the northern project terminus.
  - For portions of the project within 1 mi. and draining directly to streams that are identified as NCDEQ and/or NCWRC designated trout streams.
  - For portions of the project within 1 mi. and draining directly to streams where aquatic threatened or endangered species are present.

- Environmentally Sensitive Areas will be demarcated within the Action Area and will be defined by a 50-foot buffer zone on both sides of jurisdictional streams measured from top of streambank, in which the following shall apply:
  - The Contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations.
  - Once grading operations begin, work shall progress in a continuous manner until complete.
  - Erosion control devices shall be installed immediately following the clearing operation.
  - Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment.
  - Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 ft. in height measured along the slope, or greater than 2 ac. in area, whichever is less.
  - All SEC measures, throughout the project limits, must be cleaned out when half full of sediment, when applicable, to ensure proper function of the measures.

- Contract language regarding erosion control will include the following, or similar language as appropriate:
  - "The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor's operations in writing."
  - "In the event that the Contractor's operations are suspended in violation of the above provisions or it is determined the Contractor is not deemed to be pursuing the work in a continuous manner in accordance with his submitted and approved schedule, the sum of $1000.00 per day will be charged to the Contractor for each and every calendar day that such suspension takes place. The said amount is hereby agreed upon as liquidated damages due to extra engineering and maintenance costs and due to increased public hazard resulting from a suspension of the work. Liquidated damages chargeable due to suspension of the work will be additional to any liquidated damages that may become chargeable due to failure to complete the work on time."

Monitoring of Effectiveness of SEC Devices:

- Two Construction Project Inspectors, one for I-4400 and one for I-4700, will monitor SEC devices for the life of the project.

- Inspections of erosion control devices will be done daily for construction associated with the French Broad River bridge replacement. For the remainder of the project, the standard inspection schedule (weekly, or after a rainfall event of one-half in. or greater) will apply.
- NCDOT will install a rainfall data logger at the river to continuously monitor and record rainfall events.
- NCDOT will self-report to USFWS any SEC device failures that result from excessive rainfall events (exceeding a 25-year storm event). The NCDOT inspector will report any failures to the Division Environmental Officer, who will contact the agency within 24 hours. If there are any failures in SEC measures, NCDOT will meet with resource agencies and work to adaptively manage SEC devices for further storm events while construction continues.

Agency Coordination:
- NCDOT will invite representatives from USFWS, USACE, and the NCWRC to the pre-construction meeting for the proposed project, as well as to all subsequent field inspections prior to construction, to insure compliance with all special project commitments.
- NCDOT shall provide USFWS with the SECP and allow 15 days for review.
- NCDOT shall provide USFWS with the French Broad River bridge demolition plan and allow 15 days for review.
- All resource agencies will be invited to review the demolition plan and will be notified prior to start of demolition so they may have a representative on site.
- NCDOT will invite USFWS and USACE to review the design of the SEC measures for streams SEE and SFG, as well as the revegetation and monitoring plan.
- NCDOT will contact USFWS if new information about MYGR is discovered, as it relates to the project.
- NCDOT will report any dead bats found on the construction sites to USFWS.

French Broad River Bridge Replacement:
- NCDOT will install temporary retaining walls on the outer edges of the access roads to reduce impacts to adjacent forested land and jurisdictional features.
- The footprint for the access roads will not extend beyond the permanent project footprint.
- Activities in the floodplain will be limited to those needed to construct the proposed bridge and remove the existing bridges.
- Streams SEE and SFG will be temporarily piped during bridge construction and demolition. A revegetation and stream monitoring plan shall be developed for Streams SEE and SFG. The revegetation and stream monitoring plan shall be approved by the USACE and will commence once the bridge construction and demolition are complete and the pipe is removed. Monitoring, to observe vegetation success and stream stability, will take place for a minimum of three years after construction.
- Causeways will be used instead of multiple work bridges which would require drilled piles and take longer to install. The use of causeways also means that work bridge support piers will not be present, thereby eliminating obstacles in the flight path of bats foraging and commuting through the work zone.
- Causeways will have 1:1 slopes to minimize their size.
- NCDOT will require the contractor to use clean rock (free of debris and pollutants) for the construction of the causeways to minimize unnecessary sediment input into the river.
- Causeway material will be removed to the extent practicable and either disposed of off-site or used in areas that require permanent stone protection after project completion.

NCDOT will also require that concrete barriers (barrier rail) be placed along the downstream edge of each causeway to limit the downstream movement of causeway material during high flow events.

- Causeway material will be added/removed as needed for each stage to minimize the causeway footprint over the length of the project.
- The Stage 4 causeway extension will be sloped to allow water to flow over the top, reducing overall impact to channel flow (Appendix E).
- To minimize disturbance to the riverbed, all readily detectible causeway material will be removed to the extent practicable, while removing as little of the original riverbed as possible.
- Construction fabric will not be used under the causeway material, as it has a tendency to tear into tiny pieces and float downstream during removal.
- Any equipment that is placed on the causeways will be removed any time throughout a work day when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, they must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded.
- NCDOT will require the contractor to use new or steam-cleaned equipment to access causeways that are under water if these causeways are utilized for removal of existing bents in under-water conditions.
- NCDOT will commit to requiring its contractor to have clean, non-leaking equipment, diapers on-site for each causeway, and spill kits located at each causeway.
- With the exceptions noted below for the drill rig and crane, all construction equipment shall be refueled outside the 100-year floodplain or at least 200 ft. from all water bodies (whichever distance is greater) and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 ft. from all water bodies (whichever distance is greater), and not in a Water of the U.S. Areas used for borrow or construction by-products will not be located within wetlands or the 100-year floodplain.
- When constructing drilled piers for the French Broad River bridge, a containment system will be developed so that material does not enter the river. Material by-product will be pumped out of the shaft to an upland disposal area to the extent practicable and treated through a proper stilling basin or silt bag.
- The erosion-control plan will be in place prior to any ground disturbance for the French Broad River bridge replacement. When needed, combinations of erosion-control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- Construction of the new bridge will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river.
- The causeway design has been refined to allow for a maximum free flow area of the French Broad River. The original design provided for only a 28 percent free flow area of the river at the causeway's largest size. The design was refined and now allows a 51 percent minimum free flow area when the causeway is at its greatest extent.
- Removal of the existing bridge shall be performed so as not to allow debris to fall into the water. If debris is dropped in river, it will be immediately removed.

- The current barrier on the bridge is a one bar metal rail on concrete parapet with retrofitted guardrail. It will be replaced with concrete barrier rail, a 42-in. solid, concrete "Jersey barrier" style guard wall.

2.3.3.4 Measures to Avoid/Minimize Effects to Gray Bat during Roadway Operation

Minimal Additional Roadway Lighting:

- NCDOT has determined that minimal additional permanent lighting will be required for this project. Lighting at interchanges may be relocated, to allow for reconfiguration or expansion of the interchanges, but new lighting will only be required at the US 25 (Asheville Highway) interchange and the rest areas.

2.3.3.5 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Roadway Operation

Stormwater Control Measures:

- NCDOT has developed stormwater commitment guidance, which will apply at crossings of the French Broad River and any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the river within the NCDOT right of way (Appendix H).
- NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater best management practices (BMPs) to the maximum extent practical, which is consistent with the Department's National Pollutant Discharge Elimination System (NPDES) Post-Construction Stormwater Program.
- When preparing the SMP, NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients, and heavy metals.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:
    - Bioswales
    - Bioembankments
    - Biofiltration conveyances
    - Soil improvement to maximize infiltration
- The NCDOT hydraulics engineer will consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP.

2.3.4 Conservation Measures

NCDOT has developed conservations measures to benefit the MYGR and Appalachian elktoe. Whenever possible, these measures are categorized below per the species that may derive the most benefit from the activity. More detailed information about conservation measures can be found in Sections 7.6, 7.7, and 7.8

2.3.4.1 Conservation Measures to Benefit Gray Bat

Monitoring for MYGR Return and Activity:

- Acoustic surveys for MYGR began at the French Broad River bridges in April 2017. Therefore, it is unknown when MYGR became active at this location earlier in the spring of that year. NCDOT deployed an acoustic detector at the French Broad River bridge on March 1, 2018 and determined that MYGR activity was first detected in mid-March. NCDOT will leave an acoustic detector in place through the fall of 2018 when MYGR activity trails off for the season. NCDOT will share this information with USFWS and

NCWRC. The information should be helpful in understanding MYGR activity in construction areas for use on future projects.

- NCDOT will conduct acoustic monitoring for MYGR immediately prior to and during construction at the French Broad River bridge. Acoustic data may provide valuable information on bat activity in general, and MYGR activity, in particular, as it relates to project construction.
- To determine whether MYGR avoid the active construction zone, NCDOT will investigate the use of night-vision video recordings, or other methods, in an attempt to monitor bat activity at the bridge while active night time construction is underway.

NCDOT-Sponsored MYGR Research Project:

- NCDOT, with the cooperation of the USFWS and NCWRC, committed to a three year study on MYGR within the French Broad River Basin. This study will serve as a conservation measure for NCDOT projects within the Divisions 13 and 14 for a limited time. NCDOT will provide $900,000 in funding Indiana State University to conduct the research project, which will aid in the recovery and conservation of MYGR. The end goal is to gather the information needed to allow NCDOT and USFWS to enter into a programmatic consultation to cover MYGR for NCDOT Divisions 13 and 14, as well as help to develop species-specific avoidance and minimization measures.

2.3.4.2 Conservation Measures to Benefit Appalachian elktoe

French Broad River Conservation Funding:

- NCDOT will provide $500,000 in funding to the North Carolina Nongame Aquatic Projects Fund for the French Broad River Conservation Plan (FBRCP) proposed by USFWS, which will aid in the recovery and conservation of Appalachian elktoe. The funding will be held by the NCWRC. A multi-agency/organization group of mussel species experts, including USFWS and NCDOT, will determine how to expend the funds, which may include the following: species reintroduction, early warning and emergency production capacity, genetic management program, and other appropriate activities as described in the FBRCP.

French Broad River Geomorphology Monitoring:

- To ensure bridge construction at the French Broad River crossing will not result in substantial changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel monitoring at the I-26 bridge construction site to document the morphological condition at the French Broad River bridge site and to evaluate the impacts of construction and temporary causeways on river habitat. Monitoring activities will consist of the following:
    - Surveying the French Broad River channel bathymetry and riverbanks before and during the construction of the I-26 crossing (approximately 3.5 years). Mapping will occur before construction and then every quarter during construction, with one final survey after the causeways are all removed, and will cover at least 100 ft. upstream and 250 ft. downstream of the causeway locations.
    - A complete digital terrain model (DTM) of the stream bed and banks from each survey conducted will be prepared. NCDOT will retain an experienced firm or staff members to analyze the DTM and compile a final report to be submitted to USFWS.
    - If monitoring at the French Broad River reveals excessive bank erosion, bank instability, or sedimentation associated with the bridge replacement, NCDOT will

work to identify the cause and will make improvements to address the problems in a timely manner.

2.3.4.3 Conservation Measures to Offset Effects to Gray Bat and Appalachian Elktoe

Reforestation and Monitoring Plan:

- Eastern Federal Lands Highway Division (EFLHD) of FHWA will develop a re-vegetation/landscaping plan to re-establish native vegetation and provide for a continuous visual experience for Blue Ridge Parkway and Mountains to Sea Trail users.
- For the portion of the project from the Blue Ridge Parkway overpass to the northern terminus of the project, NCDOT will develop a revegetation plan that incorporates native woody and/or shrubby vegetation, as appropriate, for areas outside of the final slope stake limits disturbed during construction. The monitoring shall be conducted annually for a minimum of three years after final planting. Photo documentation shall be utilized to document the success of the vegetation and a report shall be submitted to the USFWS within sixty (60 days) post monitoring.
- Plantings associated with the rest areas will include re-establishment of vegetative buffers, and the development of site landscaping that will include landscape trees (1:1 in-kind replacement with native species), turf, and recreational/sitting areas (for the traveling public). The facility, once complete, will have continued maintenance to monitor the sustained growth of the vegetative buffers and matured development of the landscape.
- NCDOT will develop a revegetation and monitoring plan for Streams SEE and SFG to commence once the bridge construction and demolition are complete and the temporary pipes are removed, which will likely be similar to the structure presented above for the area between the Blue Ridge Parkway overpass and the northern project terminus.

2.4 Potential Effects of the Action

Effects of the Action (as defined in Section 2.1) refer to the direct and indirect effects on the species and/or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, which will alter the environmental baseline. Direct effects are caused by the proposed action and generally occur at the same time and place as the project. Indirect effects are those that are caused by the proposed action and are later in time or distance, but still are reasonably certain to occur (50 CFR 402.02). These types of effects can include natural responses to the proposed action's direct effects or can include human induced effects associated with the proposed action (50 CFR 402.02).

Interrelated actions are defined as actions that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Interrelated/Interdependent actions include project-associated utility relocations, as well as construction borrow pits, haul roads, staging areas, and human development and patterns induced by the action.

Preliminary roadway designs are in progress at the time of this BA submittal. Right of way requirements for I-26 within the project study area vary between approximately 240 ft. and 430 ft. Very little additional right of way will be acquired to meet the needs of the proposed project. Additional easements may also be required for drainage, utilities, and construction. The proposed typical section for the six-lane section, from US 25 to NC 280 (Airport Road), of the Preferred Alternative consists of three 12-ft. travel lanes in each direction, with a 26-ft. median that includes a median barrier wall. The typical width for the inside paved shoulder is 12 ft.; however, under existing bridges the shoulder widths are reduced to 9 ft.. The outside paved shoulder width is 12 ft., with an additional 2 ft. of graded shoulder. The areas of construction effects will encompass:

- the I-26 widening roadway footprint;
- adjacent areas impacted for permanent fixtures (ROW fences, lighting, etc.);
- associated utility relocations;
- haul/access roads;
- staging/storage areas;
- a crossing of the French Broad River, including a portion of the river downstream from that crossing;
- access road(s) at the Blue Ridge Parkway;
- streams and wetlands; and
- other ground disturbing activities directly associated with the project.

Cumulative effects are those of future state or private activities, not involving federal activities, which are reasonably certain to occur within the Action Area of the proposed federal action. In addition to highway improvements, other infrastructure projects such as water and sewer service have the potential to stimulate land development and directly or indirectly result in effects within the Action Area. However, these other types of infrastructure will likely require some type of federal authorization, such as a CWA Section 404 permit, and would therefore, have their own ESA Section 7 consultation and not be considered a cumulative effect under the ESA for this Action. Thus, most anticipated cumulative effects are likely to be localized and small in scale, but when these effects are added to other effects, they may further affect the species in question.

2.5 Other Consultations in the Action Area

No previous consultations under Section 7 of the ESA with USFWS have been completed for other projects within the I-26 Widening Action Area (as defined in Section 2.4).

There have not been any formal consultations for MYGR in the USFWS Southeast Region to date. One consultation was completed in the Midwest Region in 2015. This consultation assumed presence of MYGR for an industrial development project in Missouri.

There have been multiple formal consultations for Appalachian elktoe in North Carolina in the recent past. Some recent consultations include the following NCDOT projects:

- 2005 - Bridge Replacement Projects on the North Toe River, Yancey and Mitchell Counties (STIP B-1443 and B-2848)
- 2005 - Natural Resource Conservation Service (NRCS) Stream Restoration Efforts in the Nolichucky River Basin, Yancey and Mitchell Counties.
- 2007 - US 19 and US 19E Widening, Madison, Yancey, and Mitchell Counties (STIP R-2518, R-2519A, R-2519B)
- 2013 - Bridge No. 134 over Cane River on SR 1379, Yancey County (17BP.13.R.107)
- 2014 - Bridge No. 172 Replacement over Little Tennessee River on SR 1456, Macon County (STIP No. B-3868)
- 2017 - Replacement of Bridge No.12 on SR 1538 over Hogsed Creek, Transylvania County (STIP B-4823)

3.0 GRAY BAT SPECIES INFORMATION

A detailed description of characteristics and habitat requirements for the federally endangered MYGR is provided below.

Gray bat (*Myotis grisescens*) (A. H. Howell 1909)

Status: Endangered
Family: Vespertilionidae
Listing Date: April 28, 1976
Critical Habitat: None designated

3.1 Physical Characteristics

MYGR is one of the largest species in the genus *Myotis* in eastern North America, with a forearm length of 40 to 46 millimeters (mm), a weight of 7 to 16 grams (g) (usually 8 to 11g), and a wingspan of 27.4 to 30 centimeters (cm) (Barbour and Davis 1969). MYGR can most readily be distinguished from other *Myotis* by their wooly, unicolored dorsal fur, which may seem paler on the bats' belly. The fur appears gray after the mid-summer molt, becoming chestnut brown or bright russet leading to the next molt (Gore 1992). Another important characteristic is that the wing membrane, which is also gray in color, connects to the foot at the ankle, rather than at the base of the toes (Barbour and Davis 1969, Gore 1992). The nails on the feet are notched and the calcar is unkeeled (Harvey et al. 1981, Sealander 1979).

3.2 Distribution

MYGR is known to occur in 14 southeastern and midwestern states including Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia. There is little variation between summer and winter ranges (NatureServe 2017) and population densities are highest in the limestone karst region (Hall and Wilson 1966, Barbour and Davis 1969, Tuttle 1976a, Decher and Choate 1995, Harvey et al. 1981, Mitchell 1998).

North Carolina Natural Heritage Program (NCNHP) records (most recently updated July 2018, and viewed on August 10, 2018) confirm presence in six western North Carolina counties: Buncombe, Haywood, Madison, Swain, Transylvania, and Yancey. The approximate locations of these records are presented in Appendix A, Figure 4, along with other occurrences that have not yet been incorporated into the NCNHP database.

Buncombe County contains six occurrences in total; one historic (1968) and five current (2003, 2016, 2017, and 2018). The historic record represents a capture from a residence in the Asheville area. In 2003, a juvenile male was caught by mist netting near South Hominy Creek, and in 2016 a juvenile female was captured while roosting at a bridge over the French Broad River, approximately 1 mi. west of the Action Area. Since then, this roost site has been monitored, and has been determined to be a maternity colony, supporting up to an estimated 800 individuals (Katherine Caldwell, NCWRC, personal communication). It is important to note that, prior to the identification of this roost; there were no documented maternity roosts for this species in North Carolina. Another adult male was captured in a mist net during the summer of 2017 in the Bent Creek area, approximately 1.5 mi. from the Action Area (Katherine Caldwell, NCWRC, personal communication). In addition, CALYX biologists discovered a MYGR roost inside a concrete box culvert in Asheville in August 2017 approximately 4 mi. north of the Action Area. More surveys are needed to determine the sexes, ages, and numbers of individuals using this roost. In April 2018, one male MYGR was discovered in a building along the French Broad River less than 1 mi. south of the culvert roost in Asheville (Joey Weber, Indiana State University, personal communication). These discoveries represent the first culvert and building roosts for this species in North Carolina.

The current records in Haywood County (2015) describe three juvenile males caught in mist nets near the Pigeon River, and two adult males and one adult female captured by the same method on a separate night. Three more individuals were captured at this site during the summer of 2017

(Katherine Caldwell, NCWRC, personal communication). In addition, two MYGR were discovered roosting under a bridge over Richland Creek in April 2018 (Katherine Caldwell, NCWRC, personal communication).

Madison County also has current records. Bats were documented in 2016 through roosting observations on bridges, and numbers vary from a single individual at one site to a group of 700 individuals of mixed ages and sexes at another location (Katherine Caldwell, NCWRC, personal communication). One of the bridge roosts represents a maternity colony. Additionally, a female MYGR was found in April 2018 in a building near downtown Marshall (Joey Weber, Indiana State University, personal communication).

One MYGR was found roosting in a bridge on US 74/US 28, NC 19 over Fontana Lake in Swain County in 2017 (Katherine Caldwell, NCWRC, personal communication). A current record (2014) exists for Transylvania County, where one adult male bat was caught via mist netting along the Davidson River. Finally, one current record (2016) exists from Yancey County; an individual roosting on a bridge over the Cane River (NCNHP 2018).

There are no known MYGR hibernacula located in North Carolina. The closest MYGR hibernaculum is a cave located in Cocke County, Tennessee, approximately 72 mi. northwest of the Action Area (Sue Cameron, USFWS, personal communication).

MYGR are known to occur in the Action Area. The results of recent surveys for MYGR are discussed in Section 3.10.

3.3 Population Trends

In the late 1970s, Tuttle (1979) estimated the total population of MYGR to be approximately 2.25 million. The population was estimated at only 1.6 million in the early 1980s (Brady et al. 1982) and fell to 1.5 million within the next 10 years (Harvey 1992). By 2001, the population increased to 2.3 million (Mitchell and Martin 2002), and again to 2.5 million in 2003 (Harvey et al. 2004). This is a net increase in population size of 11.1 percent between the 1970's and 2003, and an increase of 66.7 percent from the smallest population estimate. In 2007, a study was conducted examining MYGR hibernacula and maternity roosts across the established range to ascertain the effectiveness of current conservation steps and suggest future actions. At that time, it was observed that populations had increased nearly 104 percent since 1982 (Martin 2007).

3.4 Roost Habitats

MYGR is a cave obligate species, roosting almost exclusively in warmer caves during summer, and hibernating in cold caves in winter (Hall and Wilson 1966, Barbour and Davis 1969, Tuttle 1976a, Martin 2007), although roosts in mines have been occasionally documented (Sealander 1979, Thom 1981, Brack et al. 1984, Harvey and McDaniel 1988). Due to specific requirement needs for roost and habitat, such as temperature ranges between 57.2 and 77 ˚F, only a small portion of caves (fewer than 5 percent) provide a suitable environment (Tuttle 1979). MYGR exhibit pronounced philopatry to specific summering and wintering sites, commonly returning to the same caves each season (Tuttle 1976a, Tuttle 1979, Tuttle and Kennedy 2005, Martin 2007).

Preferred winter roosting caves are deep and vertical, providing cold air pockets. Trapped air affords a cool environment with mean annual temperatures of 42.8 °F below the above-ground mean annual temperature (Tuttle 1979). Temperatures between 41 and 48.2 °F (Tuttle and Kennedy 2005) often occur in hibernation sites as they offer multiple entrances with good air flow (Martin 2007). Caves for summer dwelling are almost always located within 0.62 mi. of a body of water, such as a stream or reservoir, and are especially important for a maternity colony (Tuttle

1796b). Summer roosts typically contain temperatures ranging between 57.2 and 77 °F, with maternity caves being the warmest within the range (Brady et al. 1982). Tuttle (1976a) documented significant movement between caves within summer ranges (up to six different sites), but comparatively little variation in winter roosts during hibernation.

Summer cave roosts selected as maternity roosts serve as holding areas for pockets of warm air created by the presence of a large group of bats (Tuttle 1975, Tuttle and Stevenson 1978), while males and pre-reproductive females appear to be less particular when choosing roost sites throughout the year. During the transient periods of spring and fall, MYGR are less selective about which caves sites to use (Tuttle 1976b).

There are a few exceptions to this cave-specific roosting strategy. Many bat species have been documented using bridges as roost sites (Keeley and Tuttle 1999) and MYGR are no exception. Bridges provide a warm thermal refuge for individuals foraging far from their primary daytime roosts and have been documented as night roosts for MYGR in northwest Georgia (Johnson et al. 2002). MYGR maternity colonies have been found in storm drains (i.e. culverts) in Arkansas (Harvey and McDaniel 1988, Timmerman and McDaniel 1992), Kentucky (Hays and Bingham 1964, and Kansas (Decher and Choate 1988). Culvert conditions can mimic those found in natural caves in terms of high levels of humidity and clear running water. Maternity colonies have also turned up in more unusual places, such as a barn in Missouri (Gunier and Elder 1971) and the gate room of a large dam in Tennessee (Lamb 2000).

In North Carolina, MYGR have been documented using bridges as both day and night roosts during the summer months, with at least one of these bridges serving as a maternity roost (NCNHP 2017). As mentioned in Section 3.2, CALYX biologists discovered a MYGR roost inside a concrete box culvert in Asheville in August 2017. A check of the roost site during December 2017 revealed that no individuals were present. Further investigations will be conducted during 2018 to determine whether it may serve as a maternity roost, and how many individuals, of which sex, utilize the roost.

NCDOT is funding a comprehensive MYGR research project within the French Broad River watershed, which is being executed by Indiana State University. Field work for the project began in April 2018, and one of the goals is determining roost preferences of MYGR. Researchers have already identified two roost sites in buildings (Joey Weber, Indiana State University, personal communication), which is a roost type previously undocumented for this species in North Carolina. Additional roosts will likely be identified in the future as part of this project.

3.5 Reproduction and Young

MYGR are reproductively mature at two years of age (Tuttle 1976a) and mating season takes place between September and October. Copulation occurs upon arrival at hibernating caves, whereupon females immediately enter hibernation. Mating males may take a few weeks to replenish fat stores, but are typically in hibernation by early November (Tuttle 1976b, Tuttle and Stevenson 1978). Adult females store sperm throughout hibernation, a strategy known as delayed fertilization, and pregnancy begins following their emergence in the spring (Krulin and Sealander 1972). After a gestation period of 60 to 70 days (Saugey 1978), females give live birth to one young between late May and early June. During the reproductive season maternity caves are occupied by reproductively active females. All other individuals not actively mating, both male and female, occupy caves on the outlying edge of the home range (Tuttle 1976b).

Young, non-volant MYGR, experience healthy growth rates because their energy expenditure to thermoregulate is reduced by the roosting colony (Herreid 1963, 1967). In undisturbed colonies

young may take flight within 20 to 25 days after birth; some up to 30 to 35 days if disturbed (Tuttle 1975). Hunting is primarily learned by young on their own after learning to fly (Stevenson and Tuttle 1981); though lactating females will continue to nurse their offspring for a short time after becoming volant. Roosts are cool during this period of lactation and females are often required to feed continuously to sustain the high body temperatures required to nurse (Tuttle and Stevenson 1977).

3.6 Survivorship

Survival and growth of volant young is inversely proportionate to the distance travelled for shelter and food (Tuttle 1976a). MYGR have been recorded as living up to 17 years (Harvey 1992, Tuttle and Kennedy 2005), with a mean annual survival rate of 70 percent in males and 73 percent in females (Gunier and Elder 1971). While survivorship among juveniles is relatively high (Saugey 1978), only 50 percent of MYGR reach maturity (USFWS 1980). Mortality rates are higher during the spring migration when fat stores have been expended and food resources can be scarce (Tuttle and Stevenson 1977).

3.7 Foraging and Diet

MYGR forage primarily over open water where flying insects are abundant, and most foraging occurs within 6.5 to 9.8 ft. of the surface over open water near a forested shoreline (Tuttle 1976b, 1979, LaVal et al. 1977). In riparian areas, foraging occurs below treetop height, sometimes only 6 ft. above the water (LaVal et al. 1977, Brack 1985). Bats feed heavily along the edges of these aquatic resources, often observed within 16.4 ft. of the water's surface in Tennessee (Brady et al. 1982). In Missouri, MYGR were observed foraging low over the water, but also in the forest canopy near the river (LaVal and LaVal 1980). Abbreviated instances of bad weather in early spring and late fall are generally the only times that MYGR deviate from primarily feeding along local bodies of water, when they can be found foraging in the forest canopies (LaVal et al. 1977, Stevenson and Tuttle 1981). MYGR are known to establish foraging territories as insect numbers drop after dusk. Territories are controlled by reproductive females and are the preferred territories returned to annually (Brady et al. 1982, Goebel 1996).

Summer maternity roosts are typically located within 1.6 mi. of a river or reservoir over which the bats forage (Tuttle 1979), and are rarely located more than 13.1 mi. away from foraging areas (Tuttle 1976b). However, individuals may travel up to 114.8 mi. between prime feeding areas over lakes or rivers and occupied caves (LaVal et al. 1977, Tuttle and Stevenson 1977, Tuttle and Kennedy 2005). Forested areas along the banks of streams and lakes serve as corridors for travel and as protective feeding cover for newly volant young (Tuttle 1979, Brady et al. 1982). In addition, young often feed and take shelter in forest areas near the entrance to cave roosts (Tuttle 1979). Individuals may also fly overland from relatively land-locked roost sites to reach the main river channel or tributary systems that lead to open-water foraging sites (Thomas 1994, Best and Hudson 1996). Results of surveys conducted in Tennessee indicate that wetland depressions are also important foraging sites for MYGR (Lamb 2000). However, they do not feed in areas along rivers or reservoirs where the forest has been cleared (LaVal et al. 1977), and are rarely caught in the open or over streams (Caire et al. 1989). During times of limited food resources, males and pre-reproductive females may be excluded from foraging territories (Stevenson and Tuttle 1981).

MYGR of all ages feed almost exclusively on insects, with flies (Diptera), beetles (Coleoptera), caddisflies (Trichoptera), moths (Lepidoptera), wasps (Hymenoptera), stoneflies (Plecoptera), leafhoppers (Homoptera), and mayflies (Ephemeroptera) being the most important orders of insect prey (Rabinowitz and Turtle 1982, Clawson 1984, Brack 1985, Lacki et al. 1995, Best et al. 1997). Diet has been found to coincide most directly with the predominantly available prey

species in the foraging area (Clawson 1984, Barclay and Bingham 1994), including both terrestrial and aquatic species (Clawson 1984). A study examining fecal remains conducted by Brack and LaVal (2006) indicates that MYGR diets fluctuate to a minor degree depending upon varying factors such as age, sex, and location.

3.8 Migration

Gray bats migrate seasonally between wintering roosts and maternity caves. In the spring, bats emerge from hibernation and begin the migration to their summer habitats (Tuttle 1976b). Adult females typically leave the hibernaculum in late March or early April, with adult males and juveniles migrating several weeks later, between mid-April and mid-May (Harvey 1992). Though migratory distances for individual bats differs depending upon the specific geographic location, it is not uncommon for one-way migrations to vary anywhere from 27.3 to 845 mi. (Tuttle 1976a).

Fall migration most commonly begins in September and October (sometimes as late as December) and in the same fashion as spring migration, with adult females leaving the summering sites first and adult males and juveniles departing last (Tuttle 1976a, Layne 1978). When migrating from summer maternity roosts to their winter hibernacula, individuals commonly move between 55.8 and 1,433.7 mi, with some examples traveling as far as 2,260.5 to 2,542.7 mi. (Hall and Wilson 1966, Tuttle 1976a, Tuttle and Kennedy 2005). These great distances may sometimes be split by a short layover in small caves (Smith and Parmalee 1954).

Due to specific roost requirements, MYGR typically migrate to the same wintering sites within a given area (Hall and Wilson 1966). In addition to the larger group migration, small flocks of migrating individuals are thought to occur (Barbour and Davis 1969). Due to low food stores and long traveling distances, migration can be dangerous and lead to increased rates of mortality (Tuttle and Stevenson 1977).

Prior to winter hibernation, MYGR exhibit swarming behavior soon after reaching the hibernacula (Whitaker and Hamilton 1998). Swarming is an activity in which great numbers of bats fly in and out of the entrances to potential hibernating sites from dusk until dawn (Cope and Humphry 1977). This behavior is largely believed to be a method for increasing variation in the gene pool of a population, as it promotes mating between summer colonies previously isolated from one another (Kerth et al. 2003). Swarming is also thought to be a method for evaluating the suitability of wintering sites (Fenton 1969), as well as a possible means of transferring information between individuals with regard to the location of hibernacula (Humphrey and Cope 1976).

3.9 Threats to Species

As discussed in Section 3.3, the species may be experiencing some recovery. However, important threats to the species remain a cause for concern.

3.9.1 Human Disturbance

The primary cause of population decline in MYGR can be attributed to human disturbance of their natural habitat (Barbour and Davis 1969, Mohr 1972, Harvey 1975, Tuttle 1979, USFWS 1982, USFWS 2009b), with wintering sites and maternity roosts being especially susceptible to disruption. Commercialization of caves that allows for public access, spelunking, and looting for archaeological artifacts are activities that humans create most commonly resulting in disturbance to roosting bats (USFWS 1982, USFWS 2009b). Disturbance in the hibernacula occurs when a human enters the cave and bats wake from hibernation, using vital energy stores that cannot be recovered before emerging in the spring (Tuttle 1976b). Approximately 20 to 30 days of stored energy is depleted with each arousal (Daan 1973). Losing these fat stores can cause bats to leave the roost prematurely in search of food during unsuitable circumstances, which may result

in high mortality rates. During the first hour of arousal, individuals may lose up to 0.48 g. of body weight; a significant amount when contrasted with the typical hibernation losses of 0.01 g per day (Brady et al. 1982). When this human interference occurs in maternity caves it is typically most devastating in late spring and early summer (May to July), as non-volant offspring are in the roost. Thousands of bats may die from a single disruption (USFWS 1982). In addition, Stevenson and Tuttle (1981) found that banded MYGR tended to avoid roosts where they had been handled by researchers.

Humans are also impacting the environment in other ways that can negatively impact bats. Deforestation close to cave entrances and at foraging sites is likely to have negative effects on overall populations due to the removal of prey abundance and reduced cover from natural predators (Tuttle 1979). Recently volant young are especially susceptible to the effects of deforestation as they require the protection of forest cover while becoming more proficient fliers. Insecticide use has historically had a detrimental impact on MYGR populations (Clark et al. 1978), though many of the toxic substances are now banned from the market. Modern pesticides such as organophosphates and carbonates are of current concern. These chemicals may kill MYGR as a result of direct exposure, though they do not appear to accumulate in body tissues (Shapiro and Hohmann 2005).

Siltation of waterways where bats forage and drink may also negatively affect the species. As previously stated in Section 3.7, a large portion of MYGR diet is comprised of adult aquatic insects such as mayflies, stoneflies, and caddisflies. These groups of aquatic insects are especially susceptible to degraded water quality. Any substantial declines in the populations of these insects may have a detrimental effect on MYGR populations as well (USFWS 1982). Tuttle (1979) presented a correlation between a decline in MYGR numbers and an increase in sedimentation in several Alabama and Tennessee waterways.

Tied to increased siltation of waterways is impoundment of streams and rivers to create reservoirs. While it was originally suspected that this practice would increase suitable foraging habitat for MYGR, it was ultimately found that the opposite is true (USFWS 1982). Disturbance to roosting bats utilizing caves adjacent to these impoundments has also been observed. Noise from passing watercraft increased, and access to cave roosts that were previously far from population centers and roads were made more accessible (USFWS 1982). Furthermore, to avoid human disturbance, bats sometimes seek out secluded summer roosts that happen to be located over areas of deep water, and as a result, individuals may drown if the site is flooded (Tuttle 1979).

3.9.2 Natural Phenomena

Natural phenomena have also been observed to negatively affect MYGR populations. Natural flooding and the associated collapse of caves have a negative influence due to the bats' high roost site fidelity. Effects on MYGR from natural flooding are similar to those caused by man-made flooding for the purposes of creating impoundments, as discussed in the previous section.

Another natural threat to MYGR populations comes in the form of increasing temperatures due to climate change. Since MYGR are a cave-obligate species requiring highly specific hibernacula, they are acutely at risk from fluctuating climate conditions. As temperatures within caves rise they become less viable as winter roosts. In addition to the reduction of suitable wintering cave sites, the increase in overall temperatures may lead to earlier arousal from hibernation, resulting in higher energy expenditure and potentially premature parturition (Sherwin et al. 2013). A study examining the correlation between bat reproduction and climate change conditions draws similar conclusions. As global temperatures rise water resources diminish, in turn requiring higher

energy costs from bats traveling further distances for food (Adams 2010). These changes may have particularly adverse effects on nursing females, as the costs associated with traveling longer distances for food and water result in longer lactation times, slowing overall juvenile development (Tuttle 1976b).

3.9.3 White-nose Syndrome

Perhaps the most serious natural threat to MYGR populations is the fungal disease white-nose syndrome (WNS). The disease is believed to be caused by a fungus known as *Pseudogymnoascus destructans*; and its physical symptoms manifest in the form of visible white fungal growth on the wings, ears, and muzzle of affected bats (Cryan et al. 2013). Since its discovery in New York in 2006, WNS has had an overwhelmingly negative effect on North American hibernating bats, eradicating over 5 million individuals. Mortality rates in afflicted bats often exceed 90 percent (Thogmartin et al. 2013). Bats that have been infected with WNS display erratic changes in behavior including day-time flying and recurring arousal during hibernation (Cryan et al 2013).

In 2012, USFWS confirmed the first instance of WNS in MYGR (USFWS 2012b). The full impact of WNS on overall MYGR populations is still being determined. It seems plausible that WNS would pose a serious threat to a species like MYGR, where individuals overwinter in few high-density hibernacula, should it infect those colonies. However, some studies have found that *P. destructans* may not spread through MYGR colonies as quickly as once expected, nor be as substantial a threat to the species as initially suspected (Flock 2014, USFWS, 2014b). As of spring 2017, the species has yet to experience any WNS-related declines and their populations appear to have remained stable within Tennessee (Bernard et al. 2017) and Virginia (Powers et al. 2016). Several behavioral traits, such as preferred microclimates within hibernacula, sustained activity and foraging throughout winter (Bernard and McCracken 2017), and year-round cave use (Stevenson and Tuttle 1981, Tuttle 1976a) may enable this species to prevent or minimize the colonization of *P. destructans* during torpor.

3.10 Status of Gray Bat in the Action Area

Based on acoustic survey data conducted by CALYX and NCWRC, MYGR are known to be present in the vicinity of the proposed project roughly between spring and fall. Maternity, bachelor, and transient roosts have been identified near the Action Area. No hibernacula are known from North Carolina. No mist netting surveys were conducted within the Action Area, as the species was assumed to be present due to the close proximity of a maternity roost. However, extensive acoustic surveys and structure surveys were conducted during the summer of 2017. The results of these surveys are included in Appendix B and Appendix C, respectively. NCWRC conducted radio-telemetry tracking studies on bats captured at the nearby maternity roost during 2016 and 2017. Results of these studies are summarized below, with more detail included in Appendix G.

3.10.1 Acoustic Surveys

Three hundred and thirty-two (332) nights of data were collected from 13 detector locations in the Action Area between May 4, 2017 and August 2, 2017. Detector locations relative to the Action Area, as well as the study area used during the surveys are shown in Appendix A, Figure 5. A more detailed depiction of detector locations can be found on Figures 3A through 3K in the Acoustic Survey Report (Appendix B). Table 2, below, presents the results of the acoustic surveys, per detector location, per deployment week. The acoustic surveys suggested that MYGR are mainly using the French Broad River, and spending much less time on smaller streams. Few MYGR calls were identified in non-riparian areas, areas cleared of most vegetation, and the bog located between Long Shoals Road and the Blue Ridge Parkway, referred to as wetland WCH in the NRTR (NCDOT 2014a), (colloquially referred to as Biltmore Bog).

Table 4. Acoustic Deployment Schedule and Results

	Detector Site	Deployment Week 1	2	3	4	5	6	7	8	9	10	11	12	13
I-4400	1				0				2					
	2					3				1				
	3						0*	1			3			
I-4700	4			0				1				1		
	5	3				87				77				
	6		4				7				0**			69
	7			0				2				0**	3	
	8				2				2				7	
	9	0				0								
	10		7				5				30			
	11[1]			157	124	163	181	91	99	35	38	123	45	64
	12				1				0					
	13[1]									58	28[1]	9	9	

- (green) No MYGR call ID by either software
- (blue) MYGR call ID by BCID only
- (orange) MYGR call ID by EchoClass only
- (magenta) MYGR call ID by BCID and EchoClass
- (yellow) MYGR call ID by BCID, EchoClass, and Vetting
- # Number of MYGR calls identified by double vetting
- (hatched) Failed deployment
- * Detector fell over; some data recorded each night
- ** Detector electronic failure; no data recorded
- [1] CALYX biologists vetted 5% of the calls or a minimum of 50 calls, whichever was greater

The detector at site 9, located in the bifurcated section of the project between the French Broad River and the Blue Ridge Parkway, recorded very few bat calls, and no *Myotis* calls. This is likely due to the lack of large streams or water features in this area, site topography, elevated noise due to passing vehicles and a narrow road shoulder. It was pulled from service after two deployments. The detector at the Blue Ridge Parkway overpass (site 8) recorded 11 calls attributable to MYGR during three weeks of deployment). It is interesting to note the results of the deployments at these sites since they are located in one of the most heavily wooded portions of the Action Area, between the Long Shoals Road (NC 146) interchange and the Brevard Road (NC 191) interchange; however, no sizable water features are present here. Therefore, it follows that MYGR activity is low or absent in this area.

Detector site 5, which is the southernmost detector site adjacent to the river, and farthest from the known maternity roost (approximately 4 river mi.), produced a substantial number of MYGR calls. If bats are flying from the maternity roost to this detector location, they must pass through a section of the river that has a narrow or absent riparian buffer, and past the very well-lit area in the vicinity of detector site 6. This suggests that bats are either choosing to fly this distance from the maternity roost each night, or there is another roost somewhere closer to detector site 5. NCWRC staff have tracked a handful of bats from the maternity roost during the summers of 2016 and 2017, and all but one of the individuals flew north/northwest, rather than heading south toward the general direction of detector site 5 (Katherine Caldwell, NCWRC, personal communication).

This lends further suggestion that there may be an additional roost site somewhere in the vicinity of detector site 5. Furthermore, the handful of MYGR calls collected at detector sites 1 through 4 may also support the idea that an undocumented roost is located somewhere further south than the maternity roost. As per the sources cited in Section 2.6, MYGR do not typically travel these smaller streams unless they are travelling to and from a roost to suitable foraging sites associated with larger waterways.

Detector site 11, the I-26 crossing of the French Broad River, had a particularly high level of MYGR activity throughout the survey season, and consistently recorded more MYGR calls than any other detectors deployed during the same time frame. Furthermore, MYGR were active there throughout the night, with pulses of activity just after dusk and just before dawn, especially later in the season after pups became volant. To reiterate, this bridge was checked on foot and with the aid of a lift truck, so the examination was very thorough. No evidence of bat use was noted on this bridge.

MYGR are very active at the I-26 crossing relative to other areas along the French Broad River despite the fact that this location is extremely noisy and the airspace above the bridge is brightly lit by car headlights. Bats were observed flying under the bridges, rather than over them. This could be due to the desire to avoid the light from passing cars, avoid the possibility of predation by crossing open areas over the highway, or simply because bats were foraging on emerging aquatic insects associated with the highly oxygenated water created by the rocky riverbed in this area. This tendency to forage low over open water in areas with a mature riparian corridor agrees with that observed by others, as discussed in Section 2.6. Other detector locations had much less traffic noise and generally less light, but also lacked the rocky substrate that typically provides high-quality habitat for aquatic insects, which are a major component of MYGR diet. Even detector site 13, which lies between the maternity roost and the I-26 crossing did not exhibit the high numbers of MYGR calls observed at detector site 11. Likewise, detector site 10, which lies further downstream from detector site 11, had many fewer MYGR calls than detector site 11. So, presumably, MYGR are doing more than simply passing through the area at detector site 11; they are choosing to spend time there and making multiple passes in front of the detector. Due to the comparatively low numbers of MYGR calls recorded at detector site 10, it might also be possible that MYGR, in general, choose to fly away from the River before they reach site 10, perhaps flying over land to another location for foraging.

It is also interesting to note that Biltmore Bog did not appear to be an important foraging location for MYGR, as was anticipated. In fact, only five calls from this location (detector site 7) were likely attributable to MYGR.

NCWRC conducted acoustic monitoring at the nearby MYGR roost in 2017 and 2018, and determined that the bats returned to the roost in early to mid-March (Katherine Caldwell, NCWRC, personal communication). CALYX deployed an acoustic detector at the I-26 crossing of the French Broad River through the fall of 2017, and determined that MYGR will still utilizing that section of the river through mid-October. A detector was placed at that location again in spring 2018, and MYGR calls were recorded in mid-March. This information is not contained I the Acoustic Survey Report (Appendix B).

Personnel from NPS conducted their own acoustic surveys for bats during 2016 and recorded what they believe to be MYSO on Blue Ridge Parkway property near I-26. In a letter to NCDOT dated November 2, 2017 USFWS states their position that acoustic surveys conducted by NPS in 2016 were not conclusive for MYSO. During the process of vetting matching *Myotis* calls for

the acoustic survey report associated with this project, none of the high-quality calls examined had call characteristics consistent with MYSO.

3.10.2 Structure Surveys

Twenty-four (24) bridges and 18 culverts in the Action Area were inspected between April 26, 2017 and July 27, 2017 for the presence of bats or evidence of bat use (guano, staining, and/or urine). Figures 3A through 3K of the Structure Survey Report in Appendix C show the location of the bridges and culverts that were inspected. There was evidence of bat use on only one bridge within the Action Area. Due to the presence of a few pieces of guano on the vertical surface of the concrete bridge girders, it is assumed that the bridge on Long Shoals Road over the French Broad River may be used infrequently for night roosting bats. A small-footed bat (*Myotis leibii*) was observed roosting on this bridge in 2013 during a previous structure survey (NCDOT 2013b).

3.10.3 Telemetry Surveys

NCWRC attached transmitters to two MYGR from the nearby maternity roost during 2016 and 2017. NCWRC's 2016 to 2017 Gray Bat Telemetry Summary is included in Appendix G. In 2016, two bats were tracked for 12 days and the bats returned to the maternity roost each night. Bat A foraged along Hominy Creek in the area near Pond Road. Bat B foraged along the French Broad River just north of the I-40 crossing.

In 2017, three individuals were captured at the maternity roost and tracked for 13 days. On most nights, the bats returned to the maternity roost. However, one bat traveled over 20 mi. to a roost in Madison County on three nights. On seven nights, bat roost locations could not be found. Unlike the bats tracked in 2016, bats tracked in 2017 did not consistently return to the same foraging areas. One bat travelled south to forage along the French Broad River just north of Long Shoals Road. The other bats flew north from the roost and foraged along Hominy Creek, Bent Creek, Long Valley Lake (on Biltmore Estate property), and various locations on the French Broad River. Detailed information on tracking efforts is provided in Appendix G.

4.0 SPECIES STATUS FOR APPALACHIAN ELKTOE

The Appalachian elktoe is known to occur within a portion of the Action Area, specifically the main stem of the French Broad River (Appendix A, Figure 6). 21.3 mi. of the 22.2 mi. long project fall within the French Broad River watershed. The remaining 0.9 mi. drains to the Upper Broad River. Appalachian elktoe is not known to exist in the Broad River basin; therefore, the following discussion will focus on the French Broad River basin. Freshwater mussel surveys were completed June 13 through October 6, 2017 and the results of these surveys are included in the Freshwater Mussel Survey Report (Appendix D). The Future Land Use Study Area (FLUSA) developed for I-4400/I-4700 (NCDOT 2013a) was used as a boundary to provide environmental baseline information for Appalachian elktoe and its habitat in the French Broad River. The Action Area was not used for the environmental baseline since very limited environmental information was available along the narrow I-4400/I-4700 corridor. Data from the FLUSA are generally applicable to the smaller Action Area.

In addition, the area within the FLUSA had already been analyzed for the project Indirect Screening Report (NCDOT 2013a). A memo update (NCDOT 2017a) was provided and concurred with in 2017, to address the notable environmental features that were found subsequent to the 2013 Indirect Screening Report. This update altered the FLUSA boundary to include a previously missing portion of the French Broad River and updated the Indirect Effects Screening Matrix. The Notable Environmental Features column went from a moderate concern to a high level of concern with the introduction of two protected species known to be within the

FLUSA. The conclusion of the memo, concurred with by NCDOT on November 27, 2017, was that based on current data, because few indirect impacts are anticipated, the cumulative effect of this project when considered in the context of other past, present, and future actions, and the resulting impact on the notable human and natural features should be minimal. Therefore, the project's contribution to cumulative impacts resulting from current and planned development patterns is expected to be minimal within the smaller Action Area.

4.1 Watershed Conditions Baseline

The following information describes factors affecting the environment of Appalachian elktoe in the Action Area. The current physical and chemical conditions of the French Broad watershed are primary factors that influence the population status of the respective species. The majority of I-4400/I-4700 is in the French Broad River valley upstream (south) of Asheville. Approximately 22.2 mi. long, the project roughly parallels the French Broad River and then traverses uplands where large tributaries and smaller feeder streams are crossed. Land use along the I-4400/I-4700 corridor is mixed, consisting of large sections of residential areas, commercial and industrial stretches, and agricultural tracts.

The French Broad River is a major feature in the region, bisecting Buncombe County while providing a water source for a large portion of the study area. Due to the topography of the region, most other rivers, streams, and creeks flow into the French Broad River.

The Upper French Broad River subbasin (United States Geological Survey [USGS] hydrologic unit code [HUC] 06010105) covers an area of approximately 1,000,000 acres in Buncombe, Haywood, Henderson, Madison, Transylvania, and Yancey Counties. The Upper French Broad River drains Asheville, Brevard, Hendersonville, and many other municipalities. The headwaters of the Upper French Broad River are in western Transylvania County, which flow north to the Tennessee-North Carolina state line (North Carolina Department of Environment and Natural Resources [NCDENR] 2011).

The French Broad River basin has been impacted by various actions in the past. These impacts have likely affected the Appalachian elktoe. Past impacts to the river basin and the species, and how they relate to the present conditions and population status, are discussed below.

Beginning with the arrival of European settlers in the late 18^{th} century, the French Broad River basin became home to many industrial facilities, including paper mills, tanneries, manufacturing, and tobacco production. With no regulations to limit what could be dumped in the river, the river became polluted. These industries began to decline at the end of the 20^{th} century. With public outcry from the citizens in the Asheville area over the state of the river, the French Broad River was slowly cleaned up/improved (Dykeman 1955). The passage of the CWA in 1972, as amended, also improved water quality. The involvement of community initiatives, such as the Asheville Riverfront, continues to push forward the restoration of the French Broad River. Today, the river is used for recreation, such as tubing and rafting as well as a source of drinking water for local municipalities. The French Broad River, however, is not completely restored and still faces threats from coal ash leachate and continued development (Delaney 2013).

Water quality monitoring programs have been implemented by the NCDWR to assess water quality trends in North Carolina waters. One method used is the monitoring of benthic macroinvertebrates, or benthos, to assess water quality by sampling for selected organisms. A biodiversity rating is given to a water body sampled, based on the taxa richness of the stream and qualitative sampling for invertebrates intolerant of degraded water quality, such as mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), collectively referred to as

EPT. Excellent and Good ratings indicate that the best usage classification for that stream is being supported. A rating of Good-Fair indicates that the usage is supported, but is threatened. A Fair rating relates to a partial support of the best usage, and a Poor rating indicates that the best usage classification for that stream is not being supported.

Monitoring stations demonstrated overall improvements in EPT scores throughout the Upper French Broad River subbasin from the 1980s through the early 2010s (NCDEQ 2017a). While no stream was rated either Good or Excellent in the 2012 assessment (though not all streams were assessed), there has been some improvement from ratings of Poor or Fair in the late 1990s and early 2000s. Hominy Creek, Cane Creek, and Mud Creek showed improved scores from 2007 to 2012. Clear Creek, however, received a lower score in 2012, compared to 2007 (NCDEQ 2017a). EPT scores from monitoring stations within the FLUSA for I-4400/I-4700 are listed in Table 3.

Table 5. EPT Scores for Water Bodies Monitored in the Upper French Broad River Subbasin Portion of the FLUSA

Water Body	County	Location	Date	Rating
Hominy Creek	Buncombe	SR 3412	7/9/1992 7/10/1997 9/9/1997 5/16/2002 8/16/2007 7/24/2012	Poor Fair Fair Fair Fair Good-Fair
French Broad River	Buncombe	NC 146	8/4/1987 7/26/1990 7/8/1992 7/8/1997 9/10/2002 8/15/2007	Good-Fair Good-Fair Good Good-Fair Good-Fair Good-Fair
UT French Broad	Buncombe	SR 3495	5/25/2006	Fair
Cane Creek	Henderson	SR 1006	7/7/1992 7/8/1997 7/11/2002 8/28/2003 8/13/2007 7/26/2012	Good-Fair Good-Fair Fair Fair Poor Good-Fair
Mud Creek	Henderson	US 25	9/9/1997 7/13/2000 8/15/2007 7/26/2012	Fair Poor Fair Good-Fair
Mud Creek	Henderson	SR 1508	9/12/1985 7/7/1992 9/8/1997 7/12/2000	Poor Poor Poor Fair
Clear Creek	Henderson	SR 1513	7/7/1992 7/8/1997 7/12/2000 10/26/2000 3/13/2001 10/3/2001 8/13/2007 9/25/2012	Poor Poor Fair Poor Fair Fair Good-Fair Fair

Table 5. EPT Scores for Water Bodies Monitored in the Upper French Broad River Subbasin Portion of the FLUSA

Water Body	County	Location	Date	Rating
Mud Creek	Henderson	SR 1647	9/8/1997 7/11/2000 10/3/2001	Poor Fair Poor
Devils Fork	Henderson	US 64	7/13/2000	Poor

Another method of assessing water quality is a fish community assessment, which assigns an Index of Biotic Integrity (IBI). The IBI is a measure of species richness and composition, trophic composition, and fish abundance and condition. There are five IBI sites within the project FLUSA (Table 4; NCDEQ 2014). Results indicate mainly stable fish communities over the course of sampling; however, data points per site are sparse and recent data are not available.

Table 6. Fish Community Assessments Conducted in the Upper French Broad River Subbasin Portion of the FLUSA

Water Body	County	Location	Date	IBI Score/Rating
Cane Creek	Henderson	US 25	9/16/1997 6/4/2002	46/Good-Fair 50/Good
Clear Creek	Henderson	SR 1513	10/2/2001	44/Good-Fair
Mud Creek	Henderson	SR 1647	6/16/1997 6/4/2002	20/Poor 22/Poor
Bat Fork	Henderson	SR 1779	9/16/1997 6/4/2002	24/Poor 14/Poor
Swannanoa River	Buncombe	US 25	6/27/1993	32/Poor

Data provided by NCDEQ Fish Community Mapping – Most Recent Rating Per Station (as of Dec. 2014)

4.1.1 Best Usage Classification

NCDEQ assigns a best usage classification to all waters of North Carolina. These classifications, which are the responsibility of the NCDWR, provide a level of water quality protection to ensure that the designated usage of that water body is maintained.

The minimum designation of Class C waters imposes a minimum standard of protection for all waters of North Carolina; they are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses suitable for Class C. Table 7 lists the named streams within the Action Area in the Upper French Broad River subbasin, their Usage Classification and NCDWR index number (NCDWR 2017). Unnamed tributaries carry the classification of the receiving water body. Figure 7 in Appendix A shows the named streams.

Table 7. Named Streams within Upper French Broad Subbasin Portion of Action Area

Stream Name	Usage Classification	DWR Index #
Allen Branch	C	6-55-11-14
Austin Branch	C	6-70
Byers Creek	C	6-55-13
Cane Creek	C	6-57-(9)
Clear Creek	C	6-55-11-(5)
Dellwood Lake	C	6-69
Devils Fork	C	6-55-8-2
Dingle Creek	C	6-71

Table 7. Named Streams within Upper French Broad Subbasin Portion of Action Area

Stream Name	Usage Classification	DWR Index #
Ducker Creek	C	6-63
Dunn Creek	C	6-55-8-1-1
Featherstone Creek	C	6-55-12
Four Mile Branch (Bass Pond)	C	6-72
French Broad River	C	6-(54.5)
Hominy Creek	C	6-76
Kimsey Creek	C	6-57-22
Lake Coma	C	6-61
Long Valley Branch (White Creek) (Westerly Lake)	C	6-75
Mud Creek	C	6-55
Plateau Branch	C	6-74
Powell Creek (Lake Julian)	C	6-62

4.1.2 Impaired 303(d) Listing

As mandated in Section 303(d) of the CWA by the USEPA, states, territories, and authorized tribes are required to develop lists of impaired waters, which are defined as water bodies that do not meet water quality standards even after point sources of pollution have installed the minimum required levels of pollution control technology. Failures to meet standards may be due to an individual pollutant, multiple pollutants, or unknown causes of impairment. Streams on the 303(d) list are categorized based on type of impairment. The 2016 303(d) Category 5 streams in the Action Area are listed in Table 8 along with details of the impairments (NCDEQ 2017a). They are also shown in Figure 8 (Appendix A).

Table 8. 2016 303(d) Category 5 Streams Upper French Broad Subbasin of the Action Area (HUC # 06010105)

Stream	AU Number*	Length/Area	Reason for Rating	Parameter (Year)
Upper French Broad River Basin (HUC# 06010105)				
French Broad River	6-(54.75)b	8.2 FW mi.	Exceeding Criteria	Fecal Coliform (2012)
Mud Creek	6-55b	1.9 FW mi.	Fair/Poor Bioclassification	Benthos (1998)/Fish (1998)
Mud Creek	6-55c2	3.6 FW mi.	Fair Bioclassification	Benthos (2006)/Fish (2006)
Mud Creek	6-55c1	7.4 FW mi.	Fair Bioclassification	Benthos (2006)/Fish (2006)
Devils Fork	6-55-8-2b	2.7 FW mi.	Poor Bioclassification	Benthos (2006)
Cane Creek	6-57-(9)a1	8.8 FW mi.	Poor Bioclassification	Benthos (2006)

*AU = Assessment Unit **FW = Freshwater

4.1.3 Point Source Pollution

Point source discharge is defined as discharge that enters surface waters through a pipe, ditch, or other well-defined point of discharge. This includes municipal (city and county) and industrial

wastewater treatment facilities, small domestic discharging treatment systems (schools, commercial offices, subdivisions, and individual residents), and stormwater systems from large urban areas and industrial sites.

Under Section 301 of the Clean Water Act, discharge of pollutants into surface waters is prohibited without a permit by the EPA. Section 402 of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permitting program, which delegates permitting authority to qualifying states. In North Carolina, NCDWR is responsible for permitting and enforcement of the NPDES program. NPDES dischargers are divided into two categories: individual and general. General permits are issued for specific activities, including non-contact cooling water discharges, petroleum-based groundwater remediation, sand dredging, seafood packaging, and domestic discharges from single family residences. Individual permits are issued on a case-by-case basis for activities not covered under general permits. Individual permits are divided into two classes: major and minor. Major discharges are permitted to discharge one million gallons per day (MGD) or greater. Minor discharges are permitted to discharge less than 1 MGD (NCDEQ 2017b).

According to the NCDEQ (2017b), the FLUSA has 12 NPDES individual permitted discharges (Table 9) and seven NPDES general permitted discharges (Table 10) (Figure 9).

Table 9. Individual NPDES Permitted Dischargers within the FLUSA

Permit #	Facility	County	Type	Flow (gpd)*	Waterbody
NC0000396	Asheville Steam Electric Power Plant	Buncombe	Major	not limited	French Broad River
NC0025534	Hendersonville WWTP**	Henderson	Major	6,000,000	Mud Creek
NC0036641	Fletcher Academy WWTP	Henderson	Minor	100,000	Byers Creek
NC0037176	Bon Worth WWTP	Henderson	Minor	6,000	Allen Branch
NC0062634	Wedgefield Acres MHP WWTP	Buncombe	Minor	25,000	Pond Branch
NC0066362	Benson Apartments	Henderson	Minor	8,000	Mud Creek
NC0068799	Greystone Subdivision	Henderson	Minor	60,000	Clear Creek
NC0071897	Henderson's Assisted Living	Henderson	Minor	7,000	Featherstone Creek
NC0073393	Dana Hill WWTP	Henderson	Minor	30,000	Devils Fork
NC0074110	Mountain View Assisted Living	Henderson	Minor	5,000	Featherstone Creek
NC0083313	Brookside Village WWTP	Henderson	Minor	5,000	Featherstone Creek
NC0075680	Rosewood Mobile Home Park	Buncombe	Minor	20,000	Line Creek

*gpd = gallons per day **WWTP = wastewater treatment plant

Table 10. General NPDES Permitted Dischargers within the FLUSA

Permit #	Facility	County	Type	Waterbody
NCG500150	Berkeley Mill	Henderson	*CBBWW	Mud Creek
NCG500627	Adams Products Company	Buncombe	CBBWW	Swannanoa River
NCG550013	4800 Asheville Highway	Henderson	**SFD	Mud Creek
NCG550466	4 Hidden Creek Drive	Buncombe	SFD	UT to French Broad River
NCG551005	58 Whispering Hills Drive	Henderson	SFD	Byers Creek
NCG551105	4801 Asheville Highway	Henderson	SFD	Mud Creek
NCG551404	841 Sunlight Ridge Drive	Henderson	SFD	French Broad River

*CBBWW = Non-contact cooling, boiler blowdown wastewater **SFD = Single family domestic

4.1.4 Non-point Source Pollution

Non-point source (NPS) pollution refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities that contribute to NPS pollution, including land development, construction activity, animal waste disposal, mining, agriculture, and forestry operations, as well as impervious surfaces such as roadways and parking lots. A discussion of land cover in the FLUSA is in Section 4.3.4. The effects of non-point pollution on aquatic species associated with human development and associated impervious surface area are discussed below.

The Sedimentation and Erosion Control Program (SECP), established and authorized under the Sedimentation Pollution Control Act of 1973, applies to construction activities, such as roadway construction. This act delegates the responsibility of administration and enforcement to the NCDLR (Land Quality Section) of NCDEQ. The SECP requires the submission and approval of erosion control plans on all projects disturbing one or more acres prior to construction. The NCDOT, in cooperation with NCDWR, has developed a sedimentation control program for highway projects, which adopts formal Best Management Practices (BMPs) for protection of surface waters. Additional erosion control measures, as outlined in DSSW (15A NCAC 04B .0124 (a) – (e)), are implemented by NCDOT for projects within WS-I or WS-II water supply watersheds, Critical Areas, or any waters designated by NCDWR as HQW. When crossing an aquatic resource containing a federally listed species, NCDOT often commits to implement erosion control measures that meet the DSSW.

4.1.5 Ecological Significance

In addition to the Appalachian elktoe, several other rare aquatic species have been recorded in the Upper French Broad subbasin (Table 11) (Steve Fraley, NCWRC, personal communication) and are listed to provide an indication of the ecological significance and diversity of aquatic species in the area.

Table 11. Rare Aquatic Species in the Upper French Broad River Subbasin in North Carolina

Scientific Name	Common Name	NC Status	Federal Status*
Acipenser fulvescens	Lake sturgeon	SC	FSC
Alasmidonta raveniliana	Appalachian elktoe	E	E
Alasmidonta viridis	Slippershell mussel	E	FSC
Cambarus reburrus	French Broad River crayfish	SR	FSC
Carpiodes carpio	River carpsucker	SC	~

Table 11. Rare Aquatic Species in the Upper French Broad River Subbasin in North Carolina

Scientific Name	Common Name	NC Status	Federal Status*
Carpiodes cyprinus	Quillback	SR	~
Cottus carolinae	Banded sculpin	T	~
Cryptobranchus alleganiensis	Hellbender	SC	FSC
Erimystax insignis	Blotched chub	SR	~
Etheostoma jessiae	Blueside darter	SC	~
Etheostoma simoterum	Tennessee Snubnose darter	SC	~
Etheostoma vulneratum	Wounded darter	SC	FSC
Fusconaia subrotunda	Longsolid	SR	FSC
Hiodon tergisus	Mooneye	SC	~
Ichthyomyzon bdellium	Ohio lamprey	SR	~
Ictiobus bubalus	Smallmouth buffalo	SR	~
Ictiobus niger	Black buffalo	SR	~
Lampsilis fasciola	Wavy-rayed lampmussel	E	~
Lethenteron appendix	American brook lamprey	T	~
Luxilus chrysocephalus	Striped shiner	SC	~
Moxostoma breviceps	Smallmouth redhorse	SR	~
Necturus maculosus	Mudpuppy	SC	~
Notropis micropteryx	Highland shiner	SR	~
Notropis volucellus	Mimic shiner	SR	~
Noturus eleutherus	Mountain madtom	C	~
Noturus flavus	Stonecat	E	~
Percina caprodes	Logperch	T	~
Percina squamate	Olive darter	SC	FSC
Percina williamsi	Sickle darter	SC	FSC
Pleurobema oviforme	Tennessee clubshell	E	FSC
Polyodon spathula	Paddlefish	E	FSC
Potamilus alatus	Pink heelsplitter	SR	~
Sander canadensis	Sauger	SR	~
Strophitus undulatus	Creeper	T	~

* E, T, FSC, SC and SR denote Endangered, Threatened, Federal Species of Concern, Special Concern, and Significantly Rare, respectively.
* ~ Indicates that the species does not currently carry a federal status.

4.2 Appalachian Elktoe Species Information

A detailed description of characteristics and habitat requirements for the federally endangered Appalachian elktoe is provided below.

Appalachian elktoe (*Alasmidonta raveneliana*) (I. Lea 1834)
Status: Endangered
Family: Unionidae
Listing Date: September 3, 1993
Critical Habitat: Designated, see Section 4.5

4.2.1 Species Characteristics

Lea (1834) described the Appalachian elktoe from the French Broad River system in North Carolina. Its shell is thin but not fragile, oblong, and somewhat kidney-shaped, with a sharply

rounded anterior margin and a broadly rounded posterior margin. Parmalee and Bogan (1998) cite a maximum length of 8 cm. However, individuals from the Little River (French Broad River basin) in Transylvania County and West Fork Pigeon River (French Broad River Basin) in Haywood County measured more than 9.9 cm in length (USFWS 2009b). The periostracum (outer shell) of the Appalachian elktoe varies in color from dark brown to yellowish-brown in color. Rays may be prominent in some individuals, usually on the posterior slope, and nearly obscure in other specimens. The nacre (inside shell surface) is a shiny bluish white, changing to salmon color in the beak cavity portion of the shell. A detailed description of the shell characteristics is contained in Clarke (1981). Ortmann (1921) provides descriptions of the soft anatomy.

Many freshwater mussel species have similar reproductive strategies, which involve a larval stage (glochidium) that becomes a temporary obligate parasite on a fish. Many mussel species have specific fish hosts that must be present to complete their life cycle. Based upon laboratory infestation experiments, Watters (1994) lists the banded sculpin (*Cottus carolinae*) as the potential fish host for the Appalachian elktoe. However, the ranges of these species rarely overlap. Keller documented transformation of Appalachian elktoe glochidia (larval stage of mussels) on the mottled sculpin (*Cottus bairdi*) in 1999 (USFWS 2002b), and research at Tennessee Technical University (TTU) identified 10 fish species with encysted Appalachian elktoe glochidia from the Little Tennessee River in North Carolina (Jim Layzer, Tennessee Tech University, personal communication; Table 12).

Table 12. Fish Species Collected from the Little Tennessee River (NC) that Contained Encysted *Alasmidonta raveneliana* Glochidia

Common Name	**Scientific Name**
Banded darter	*Etheostoma zonale*
Wounded darter	*Etheostoma vulneratum*
Greenfin darter	*Etheostoma chlorobranchium*
Tangerine darter	*Percina aurantiaca*
Mottled sculpin	*Cottus bairdi*
Black redhorse	*Moxostoma duquesnei*
River redhorse	*Moxostoma carinatum*
Sicklefin redhorse	*Moxostoma sp.*
Northern hog sucker	*Hypentelium nigricans*
Warpaint shiner	*Luxilus coccogenis*

Additionally, nine fish species (Table 13) successfully transformed Appalachian elktoe glochidia in laboratory induced infestations (Jim Layzer, Tennessee Tech University, personal communication). All of the species listed in Table 11, with the exception of the wounded darter and rosyside dace, are known to occur within the Upper French Broad River subbasin (Rhode et al. 1994, Menhenick 1991). Based on monitoring of the Appalachian elktoe population in the Little Tennessee River by the NCWRC, it is apparent that the Appalachian elktoe is a bradytictic (long-term) breeder, with the females retaining glochidia in their gills from late August to mid-June (Steve Fraley, NCWRC, personal communication). Glochidia are released in mid-June attaching to either the gills, or fins of a suitable fish host species, and encysting within 2 to 36 hours. Transformation time (time until encystment) for the Appalachian elktoe occurs within 18 to 22 days, at a mean temperature of 64 °F (Jim Layzer, Tennessee Tech University, personal communication).

Table 13. Fish Species Collected from the Tuckasegee River (NC) Used for Laboratory Induced Infestation

Common Name	Scientific Name	Number
Wounded darter	*Etheostoma vulneratum*	17
Greenfin darter	*Etheostoma chlorobranchium*	32
Greenside darter	*Etheostoma blennioides*	3
Mottled sculpin	*Cottus bairdi*	19
River chub	*Nocomis micropogon*	20
Northern hogsucker	*Hypentelium nigricans*	3
Central stoneroller	*Campostoma anomalum*	6
Longnose dace	*Rhinichthys cataractae*	9
Rosyside dace	*Clinostomus funduloides*	1

4.2.2 Distribution and Habitat Requirements

The Appalachian elktoe is known only from the mountain streams of western North Carolina and eastern Tennessee. It is found in gravelly substrates often mixed with cobble and boulders, in cracks of bedrock, and in relatively silt-free, coarse sandy substrates (USFWS 1996).

At the time of listing, two known populations of the Appalachian elktoe existed in North Carolina: the Nolichucky River and its tributaries, and the Little Tennessee River and its tributaries. Historically, the species had also been recorded from Tulula Creek (Tennessee River drainage), the main stem of the French Broad River, and the Swannanoa River (French Broad River system) (Clarke 1981), but it was reported to have been eliminated from these streams (USFWS 1994, USFWS 1996). In fact, Ortmann (1918) reported that the mussel fauna in the French Broad River had been eliminated by pollution coming from lumber production in the Davidson River. Since listing, the Appalachian elktoe has been found in additional areas. These occurrences include a rediscovery in the French Broad River basin (Pigeon River, Little River and Mills River and French Broad River). Since 2004, the known range of Appalachian elktoe in the main stem of the French Broad River has expanded and now appears to be established at low density over a broad area (USFWS 2017a).

The USFWS (2017c) notes that overall, most of the surviving Appalachian elktoe populations are comprised of scattered occurrences, restricted to pockets or short reaches of suitable habitat.

4.2.2.1 Environmental Baseline in the French Broad River

At the time of listing, the Appalachian elktoe was thought to have been eliminated from the main stem of the French Broad River (USFWS 1994, USFWS 1996). No modern records of this species existed previously from the river, which was attributed to decades of pollution and development that had degraded the habitat. Records available from the NCWRC's database indicate that Appalachian elktoe were collected in 2005 from the French Broad River main stem at the Crab Creek Road crossing, just downstream of the Little River confluence (approximately 10 mi. from the Action Area in Transylvania County).

Since the rediscovery in 2005, the known range of the Appalachian elktoe has expanded considerably; it is now known to occupy a substantial portion of the Upper French Broad River between the towns of Mills River and Rosman, NC. Given that the rediscovery in the main stem of the French Broad River was close to the confluence with the Little River, where it was already known to occur, and the upstream and downstream direction of subsequent “discoveries” in the river, the scientific consensus is that these recent records of the Appalachian elktoe in the French Broad represent a range expansion from the Little River, rather than it having been previously overlooked (Jason Mays, USFWS, and Steve Fraley, NCWRC, personal communication). Reasons for potential population expansion in the Upper French Broad River basin may include

improved water quality, stabilization of suitable habitat providing for mussel colonization, and increased abundance of host fish. The population in the Upper French Broad River may be considered viable if it continues to increase (USFWS 2017a).

Mussel surveys were conducted for I-4400/I-4700 June 13 through October 6, 2017 at 23 distinct sites, all of which were in the French Broad River except for one site in Clear Creek and one in Cane Creek (Appendix D). Appalachian elktoe was found at four sites within the French Broad River, which was a substantial expansion (32 river mi. downstream) of the previously known extant range of this species in the river. Based on habitat conditions and the difficulty in detecting species that are present in low numbers, it is possible that the Appalachian elktoe occurs at other sites surveyed on the French Broad River, but was not detected. The species is assumed to be present in the French Broad River throughout the Action Area and continuing downstream to the Metropolitan Sewerage District of Buncombe County (MSD) wastewater treatment plant (WWTP).

4.3 General Threats to Species

The cumulative effects of several factors, including habitat loss and alteration associated with impoundments, channelization, mining, and dredging operations; pollutants in wastewater discharges (sewage treatment plants and industrial discharges); and runoff of silt, fertilizers, pesticides, and other pollutants from land disturbance have contributed to the decline of the Appalachian elktoe throughout its range (USFWS 1996, 2017a).

Although the 2017 status review for Appalachian elktoe (USFWS 2017a) notes that some populations appear to be stable (Tuckasegee, Cheoah, and Pigeon Rivers), others have experienced declines. A die-off in the Little Tennessee River, once considered the largest and most secure population, began in 2005 and continued through 2015, at which time monitoring efforts failed to find any live individuals. The population remains at or below detectable levels; the loss marks a substantial decrease of the global population (USFWS 2017a). The cause of this sudden decline remains unknown despite efforts to reveal a cause. Appalachian elktoe has also declined in portions of the South Toe River population (discussed in Section 4.3.1). The remaining populations remain isolated from one another by impoundments, and natural gene flow is not possible between the populations due to these barriers (USFWS 2017a). Since most Appalachian elktoe populations are restricted to scattered areas of suitable habitat, they are vulnerable to extirpation from catastrophic events (USFWS 2017a). 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.

USFWS (2017a) states that most of the surviving populations of the Appalachian elktoe continue to face substantial threats associated with development activities, agriculture operations, wastewater discharges, stormwater runoff, and nonpoint source pollutants.

4.3.1 Sedimentation

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 (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and by direct smothering of mussels (Ellis 1936; Marking and Bills 1979). In addition, the abrasive action of sediment on mussel shells has been shown to cause erosion of the outer shell, which allows acids to reach and corrode underlying layers (Harman 1974). Sediment accumulations of less than 25 mm have been shown to cause high mortality in most mussel species (Ellis 1936).

Appalachian elktoe have declined in the lower portion of the South Toe River, a tributary of the Nolichucky River. The cause appears to be related to sediment pollution deriving from the construction of a large highway project and other non-point sources of sediment in the South Toe River watershed, as well as a WWTP (USFWS 2017a). Appalachian elktoe are still present, but at reduced density in the affected reach.

The Little Tennessee River population of Appalachian elktoe occurs below the dam at Lake Emory. The river channel above Lake Emory carries a very high load of unstable sediments and is devoid of mussels. It is believed that Lake Emory previously served as a sediment trap that helped to protect the integrity of the river below the dam. However, the lake has filled in with sediments, and sediment accumulations affecting habitat quality in the river below the lake have become increasingly common (USFWS 2009a).

4.3.2 Habitat Alteration

The impact of impoundments on freshwater mussels has been well documented (USFWS 1992b; 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. In addition, the construction of dams often results in fragmentation of mussel populations, effectively blocking upstream expansion and recruitment of mussel and fish species and creating a barrier to fish migration. The construction of the Petitcodiac River Causeway in Canada in 1968, resulted in the extirpation of the dwarf wedgemussel because the causeway restricted the migration of Atlantic salmon (*Salmo salar*), which served as the fish host for the dwarf wedgemussel in this region (Locke et al. 2003).

4.3.3 Toxic Contaminants

Pollution in waterways is known to adversely affect aquatic organisms in a variety of ways (Choudri and Baawain 2016). With regard to freshwater mussels, the presence of toxic contaminants has been shown to contribute to widespread declines of populations (Havlik and Marking 1987; Bogan 1993; Neves et al. 1997; Richter et al. 1997; Strayer et al. 2004; Henley et al. 2016). In 2004, hundreds of Appalachian elktoe and other mussel species were found dead in a short reach of the Little Tennessee River immediately below the dam at Lake Emory (Mark Cantrell, USFWS, personal communication). The cause of this kill is unknown but a local resident reported smelling a strong chlorine odor in the area the day before the kill was discovered (USFWS 2009a). Toxic contaminants can produce lethal or sub-lethal responses in freshwater mussels. The sensitivities of freshwater mussels to toxic contaminants is variable based on species, life stage (glochidium, juvenile, or adult), and environmental conditions, as well as concentration and exposure type (water column, sediments, etc.), frequency, and duration. Several studies have indicated that early life stages of freshwater mussels are among the most sensitive aquatic organisms to various inorganic toxicants such as copper (Jacobson et al. 1993; Jacobson et al. 1997; Milam et al. 2005; Wang et al. 2007a; Wang et al. 2007b), manganese, and ammonia (Archambault et al. 2017, Wade 1992; Augspurger et al. 2003; Bartsch et al. 2003; Newton et al. 2003; Wang et al. 2007a; Wang et al. 2007b; Grabarkiewicz and Davis 2008).

Anthropogenic sources of ammonia and copper in surface waters include sewage treatment effluent, industrial wastewater effluent, and runoff and ground water contamination from agriculture, lawn/turf management, livestock operations, roadways, and faulty septic systems. Additionally, exposure to raw sewage can have numerous impacts on aquatic organisms, resulting in fish kills and damage to shellfish beds (USEPA 2011).

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 might not occur for up to 2 mi. below discharges of chlorinated sewage effluent. Similarly, Gillis et al. (2014) found that mussels were absent for 4.3 mi. below a WWTP on the Grand River in Ontario, Canada. Water quality measurements demonstrated that ammonia and nitrate concentrations, along with diel declines in oxygen, were associated with the extirpation of mussels in that 4.3-mi. reach.

When publishing the 5-year review for the Carolina heelsplitter (*Lasmigona decorata*), another federally endangered freshwater mussel that occurs in North Carolina, the USFWS stated that there were "currently no water quality standards, or monitoring requirements for ammonia, copper and phosphorus in North Carolina" (USFWS 2012a). In 2014 however, standards were developed for copper, as updated in the Triennial Review of Standards (North Carolina Register 2014).

In addition, studies indicate other toxicants present in wastewater effluent such as pharmaceuticals and personal care products (fluoxitine, estrogenic compounds, opiate derivatives etc.) cause a wide array of neurotoxicological (Gagné et al 2007a), reproductive (Bringolf et al. 2007; Gagné et al 2007b), and behavioral (Hazelton et al. 2013, Heltsley et al. 2006) impacts to freshwater mussels (de Solla et al. 2016).

Most of the streams that support Appalachian elktoe populations do not have adequate designations for protecting occupied reaches from pollutants associated with new or expanded wastewater discharges (USFWS 2017a). In 2008, problems with the effluent from the Burnsville WWTP on the Cane River coincided with the loss of the Appalachian elktoe from approximately 19 river mi. of the river (John Fridell, USFWS, personal communication).

Other sources of toxic contaminants in surface waters arise from highway and urban runoff. Gillis (2012) demonstrated that chronic exposure to a combination of WWTP effluent and highway runoff negatively affected freshwater mussel health and life span in urbanized watersheds. Although a specific cause was not identified, the assumption is that chronic exposure to multiple contaminants negatively effects health and longevity. Numerous pollutants have been identified in highway runoff, including various metals (lead, zinc, iron, copper, cadmium, etc.), sediment, pesticides, deicing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons (Gupta et al. 1981; Yousef et al. 1985; Davis et al. 2001; Gillis et al. 2014). The sources of these runoff constituents range from construction and maintenance activities to daily vehicular use.

Hoffman et al. (1984) concluded that highway runoff can contribute up to 80 percent of the total pollutant loadings to receiving water bodies, identifying, among others, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), lead, and zinc. PAH compounds are largely derived from petroleum related sources (e.g., gasoline, oil) and are of major concern from transportation-related runoff to aquatic systems due to their potential acute and chronic (e.g., mutagenic and carcinogenic) toxic properties (Humphries 2006). Potential effects of highway runoff have often been inferred from studies conducted on urban runoff; however, the relative loadings of pollutants are often much greater in urban runoff, because of a larger drainage area and lower receiving water dilution ratios (Dupuis et al. 1985). The negative effects of urban runoff inputs on benthic macroinvertebrate communities have been well documented (Garie and McIntosh 1986; Jones and Clark 1987; Field and Pitt 1990; Lieb 1998). The effects of highway runoff on freshwater bivalves have not been studied extensively. Augspurger (1992) compared sediment samples and soft tissues of three eastern elliptios (*Elliptio complanata*), a relatively common species upstream and downstream of the I-95 crossing of Swift Creek of the Tar River Basin in Nash County, North Carolina. The sediment samples, as well as the mussels, exhibited higher levels of aliphatic

hydrocarbons, arsenic, lead, zinc, and other heavy metal contaminants in the downstream samples. Because of the small sample size, the effect on the health of these mussels was not studied. In another study, contaminant analysis of stream sediments showed an increase of PAHs and some metals downstream of road crossings, although there was no direct correlation found between increasing contaminant levels and decreasing mussel abundance at these crossings (Levine et al. 2005). The eastern elliptio was the only mussel species found in large enough numbers for statistically valid comparisons. The eastern elliptio is generally considered more tolerant of water quality degradation than many other mussel species. However, Humphries (2006) did show that mussels from streams with higher average daily traffic counts (ADTC) exhibited greater levels of genetic damage compared to mussels from streams with lower ADTC values. Additionally, laboratory data showed increasing DNA damage relative to increasing PAH concentration. Humphries (2006) concluded that “PAHs are not likely contributing to acute toxicity of mussels in North Carolina streams, but the chronic, long-term pervasive effect of PAHs on native freshwater mussels remains uncertain.” Further research is needed before the effects of highway runoff on sensitive mussel species such as the Appalachian elktoe can be determined.

Contamination of surface water from toxic spills along roadways is known to have substantial impacts to aquatic communities. A toxic spill resulting from a tanker truck accident that was carrying Octocure 554 (a chemical liquid used in the rubber making process) killed several miles of mussel populations in the Clinch River near Cedar Bluff, Virginia (Richmond Times-Dispatch 1998). The spill killed thousands of fish and mussels, including three federally protected species. The presence of hazardous spill basins (HSBs) adjacent to crossings of waterways that support sensitive species provides the potential to avoid and/or minimize major kills such as this.

4.3.4 Hydrologic Changes Due to Changes in Land Use

The correlation of increasing development within a watershed and decreasing water quality is well documented (Lenat et al. 1979; Garie and McIntosh 1986; Crawford and Lenat 1989; Lieb 1998) and is largely associated with increases in impervious surface area. These increases in impervious surface area can affect water quality in a variety of ways, particularly regarding changes to stream flow, water temperature, total suspended sediment, and pollutant loadings.

Multiple studies have demonstrated that water quality and stream ecosystem degradation begin to occur in watersheds that have approximately 10 percent coverage by impervious surfaces (Schueler 1994; Arnold and Gibbons 1996; Stewart et al. 2000). NCWRC recommendations for management of protected aquatic species watersheds are to limit imperviousness to 6 percent of the watershed (NCWRC 2002).

The FLUSA is approximately 38.7 percent developed, with 1.7 percent in high intensity development (80 to 100 percent impervious surfaces), 4.9 percent in medium intensity development (50 to 79 percent impervious surfaces), 8.3 percent low intensity development (20 to 49 percent impervious surfaces), and 23.7 percent open space development (less than 20 percent impervious surfaces), based on the National Land Cover Dataset (NLCD, Homer et al. 2015). The higher the percent impervious surfaces in a watershed, the more stormwater runoff is created and potentially discharged into nearby streams without treatment. This stormwater often contains high amounts of fertilizers, pesticides, and roadway pollutants.

Increases in impervious surface area within a watershed can result in extremes (either high or low) in peak discharge, runoff volume, and base flow conditions.

4.3.4.1 Peak Discharge

Peak discharge is the maximum rate of stormwater flow expected from a storm event, measured in cubic feet per second (cfs). Increases in peak discharge equates to higher velocity, which in turn increases the scouring effect (surface erodibility) of the runoff. Accordingly, sedimentation will increase as erosion rates increase. Increases of peak discharge rates, coupled with deforestation, have been shown to result in stream narrowing and incision and subsequent loss of ecosystem function (Sweeney et al. 2004). Shields et al. (1994) found that during base flows, incised streams contained fewer habitat types, particularly pool habitats, and lower fish species diversity than non-incised streams. Conversely, increases in peak discharge can also result in channel widening, as streambanks become susceptible to mass failure (Simon and Rinaldi 2006). Harvey and Watson (1986) found that increases in channel cross-sectional area of up to 1,000 percent can occur within a few years.

4.3.4.2 Runoff Volume

Runoff volume is the amount of stormwater expected from a storm event, measured in acre-feet. Like peak discharge, runoff volume is another metric often used in determining effects of development. For example, increases in the amount of runoff normally equates to increased sediment. While the two indicators are related, when analyzed separately, both are useful in assessing impacts to aquatic systems.

In a stable system, an increase in the volume may have little impact if velocity does not change, provided that measures to slow the increased velocity have been implemented. However, the increased runoff volume may have enough sediment to cause detrimental effects. Regardless, it is important to consider both the rate (peak discharge) and the amount (runoff volume) when assessing effects to aquatic systems. Sufficient stormwater controls accompanying future development activities are important considerations for conservation of sensitive aquatic species such as Appalachian elktoe.

4.3.4.3 Base Flow

Increases of impervious surface lead to decreases in infiltration and base flow (groundwater flow) within adjacent streams. This can result in the following:

- Less water to cover the stream bottom during periods of reduced base flow.
- Increases in water evaporation and temperature in widened streams because of reduced overhanging tree cover and increased exposure to sunlight, especially in areas with shallower water.
- Extension of WWTP effluent “plumes” further downstream, if base flow is reduced and WWTP discharge remains constant or increases, as it takes longer for the stream to dilute the nutrients and other toxins in the effluent.

Just as the road network in a watershed affects peak discharge, it also can lead to a reduction of base flow. While the total amount of water remains relatively constant, base flows decrease because the rapid runoff (increases the timing and volume of peak discharge) reduces the total amount of water that can infiltrate and be stored in the soil (Castro 2003).

Prolonged periods of drought have been shown to adversely impact mussel species (Johnson et al. 2001; Golladay et al. 2005; USFWS 2012a), as mussels may face increased water temperatures and reduced DO concentrations (hypoxia, or eventually anoxia), increased predation, and emersion or stranding (Johnson et al. 2001). Exceptional drought conditions are becoming an increasing threat to the Appalachian elktoe due to the lack of dilution of pollutants

in WWTP discharges, increasing accumulations of sediment from lack of flushing flows, and elevated water temperature (USFWS 2009a).

While drought is recognized as a major threat for many mussel species, the actual low flow requirements of mussels is poorly understood. Johnson et al. (2001) and Golladay et al. (2005) assessed drought impacts on mussel assemblages in a number of streams in the Flint River basin of southwestern Georgia. Sites that ceased flowing during the drought had substantial declines in the abundance of all mussels as well as declines in species richness. However, sites that maintained some flow during the drought had increases in stable species of mussels and no change in special concern or endangered species through the drought. Mortality of mussels at sites that ceased flowing was attributed to reductions in DO concentration, which was highly correlated with water velocity.

Large reaches of many of the streams that support the species have been degraded by past and/or ongoing land disturbing activities and alterations to natural flow. In many instances, habitat for the Appalachian elktoe has been degraded and is marginal or unsuitable (USFWS 2017a).

4.3.5 Thermal Pollution

Concerns over effects of thermal pollution from urban runoff on aquatic systems have increased in recent years. Elevation of stream temperature can raise biochemical oxygen demand (BOD), lower dissolved oxygen (DO), and alter faunal composition (Poole et al. 2001, Roa-Espinosa et al. 2003). Typically, runoff from an impervious area will have a temperature similar to that of the impervious area. During the hot summer months, this could potentially make the stormwater runoff reach temperatures up to and above 90°F, which could be detrimental to aquatic life, such as freshwater mussels. Rising stream water temperatures have been shown to have lethal and sub-lethal effects on freshwater mussels during different life stages. Thermal stress on juvenile mussels was demonstrated to result in reduced burrowing capacity and inhibited byssal thread production, which may hamper their ability to escape predation or extreme high or low flows, as well as limit their attachment and dispersal capabilities (Archambault et al. 2013). The thermal tolerance of freshwater mussels "is controlled by multiple interacting and complex factors" (Pandolfo et al. 2012). For example, mussels are not only limited by their own thermal tolerances, but also by those of their host fish (Pandolfo et al. 2012). Pandolfo et al. (2010) suggested that freshwater mussels "already might be living close to their upper thermal tolerances in some systems."

Various stormwater BMPs have been shown to be effective in ameliorating temperature effects, for example, bioretention devices were shown to reduce runoff temperature by 50°F (Sustainable Technologies Evaluation Program 2014). The loss of riparian buffers as well as peak discharge related to channel widening can also contribute to stream temperature increases by increasing sunlight exposure and decreasing water depth.

4.3.6 Invasive Species

The introduction of exotic species such as the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) has also been shown to pose substantial 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). When Appalachian elktoe was listed as an endangered species, it was speculated that due to its restricted distribution, it "may not be able to withstand vigorous competition" (USFWS 1996). 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 1992a). The zebra mussel is not currently known from any river supporting Appalachian elktoe populations.

4.3.7 Loss of Riparian Buffers

Loss of riparian buffers can lead to degradation of adjacent aquatic habitats. The role of forested riparian buffers in protecting aquatic habitats is well documented (NCWRC 2002). Riparian buffers provide many functions including pollutant reduction and filtration, a primary source of carbon for aquatic food webs, stream channel stability, and maintenance of water and air temperatures. Numerous studies have recommended a range of buffer widths needed to maintain these functions. Recommended widths vary greatly depending on the parameter or function evaluated. Wide contiguous buffers of 100 to 300 ft. are recommended to adequately perform all functions (NCWRC 2002). The NCWRC recommends a minimum 200-ft. native, forested buffer on perennial streams and a 100-ft. forested buffer on intermittent streams in watersheds that support federally endangered and threatened aquatic species (NCWRC 2002).

4.4 Potential Effects of Roadway Projects on Freshwater Mussels and Habitat

There are a number of direct and indirect effects to freshwater mussels and their habitat that can result from roadway construction projects. In addition to direct impacts that occur during roadway construction, the roadway project can continue to result in indirect effects post-construction (operational effects, as well as indirect effects associated with project-induced development). While several threats are recognized, potential roadway construction effects on freshwater mussels and habitat fall into three main categories:

- Physical effects (habitat degradation, direct mortality of individuals),
- Water quality effects (chemical, temperature, and biological pollutants), and
- Water quantity effects (changes in peak and base flows).

4.4.1 Physical Effects

Physical effects associated with road construction include, but are not limited to, riparian land-clearing, physical loss of habitat (substrate fill), stream re-channelization, hydrologic modification, erosion associated with construction in the project corridor and within fill/borrow areas. The potential effects of these activities include physical injury to individual mussels from substrate disturbance and/or sediment deposition. Potential physical effects to mussel habitat include channel and stream bank scouring, channel erosion, and sedimentation, all of which reduce habitat suitability.

4.4.2 Water Quality Effects

Roadway construction can result in a variety of chemical and thermal water quality effects during construction as well as induced land use changes post-construction. These effects include the addition of various chemical and thermal pollutants to waterways originating from the project construction and facility footprint, as well as pollutants originating from induced land-use changes, particularly from commercial and/or residential developments (e.g., urban runoff, fertilizers, pesticides).

Numerous factors influence the potential for toxins from highway runoff to reach occupied mussel habitat, including:

- traffic volumes,
- distance of road crossing structure to occupied stream habitat,
- watershed size,
- stream gradient and characteristics (i.e. presence of natural low gradient pools, or beaver dams or other structures that may attenuate transport of toxins), and
- toxin attributes that affect exposure pathways (i.e. toxins binding to sediment).

The magnitude of the effects associated with roadway runoff originating from a specific crossing is also dependent on the amounts of toxins entering occupied habitat via other pathways (other tributaries, atmospheric deposition, runoff from adjacent land use, ground water inputs, etc.).

4.4.3 Water Quantity Effects

Water quantity effects are temporary and permanent alteration of flows. These include construction impacts (temporary dewatering, causeway construction, channel restriction, etc.), as well as hydrologic impacts from induced land use changes, as described above (increased runoff and storm flows, decreased infiltration, and associated base flow).

5.0 EVALUATED EFFECTS OF PROPOSED ACTION ON GRAY BAT

Implementation of this project has the potential to affect MYGR in a variety of ways, both during construction and once roadway improvements are in use (operational effects, as well as indirect effects associated with project-induced development). Potential project-related impacts to MYGR are considered in this section. The potential project-related impacts are presented in three categories:

1. Potential Effects from Highway Construction
2. Potential Effects from Highway Operation
3. Potential Effects from Interrelated/Interdependent Effects

Based on acoustic survey data conducted by CALYX and NCWRC, MYGR are known to be present in the Action Area between mid-March and mid-October. Although no roosts were identified during structure checks in the Action Area, maternity, bachelor, and transient roosts have been identified nearby. Bats are presumably flying from these roost sites into the Action Area. NCWRC telemetry studies in 2016 and 2017 revealed that MYGR who left the closest roost are using the French Broad River for commuting and foraging, although some individuals abandoned the river, choosing to fly over land or along large tributaries to the French Broad River such as Hominy Creek and Bent Creek.

The project closely parallels the river for roughly one quarter of its length. A few large tributaries and many small tributaries flow through the Action Area. Many more MYGR calls were recorded at detector locations along the French Broad River than on tributaries or upland locations. In fact, MYGR calls were recorded at all the detector sites adjacent to the river. Therefore, we assume that MYGR are utilizing the entire length of the river within the Action Area for foraging and commuting at night.

Calls attributable to MYGR at site 11 (at the I-26 crossing of the French Broad River) were many times more numerous than calls attributable to MYGR from other detector locations. As presented in Section 3.10.1, Table 4, calls from site 11 identified by BCID as MYGR were so plentiful that only 5%, or a minimum of 50 calls, were vetted each week. Bearing in mind this vetting strategy, this small sampling of calls averaged roughly 100 MYGR calls per week at site 11. By comparison, site 5 (also located on the French Broad River), the site with the next highest

weekly number of MYGR calls, totaled 87 calls attributable to MYGR based on 100% vetting of data collected during the week. The average number of calls attributable to MYGR from site 5 is 56. MYGR may be using the portion of the river at site 11 due to the rocky substrate that typically provides high-quality habitat for aquatic insects, which are a major component of MYGR diet.

While acoustic and telemetry surveys revealed the potential presence of MYGR in other areas, the likelihood of effects declines the further the action occurs from the French Broad River. This coincides with information that is commonly reported in scientific literature regarding the species' preference to concentrate activity near large waterways (Section 3.7). The severity of potential direct impacts associated with this project decreases during winter months (roughly mid-March to mid-October) when MYGR are hibernating, and during daylight hours in summer months while bats are roosting. Similarly, the severity of potential direct impacts is inversely related to proximity to the French Broad River.

It is important to note that no MYGR calls were recorded at detector site 9 (bifurcated section), and very few (11 over a three week period) were recorded at site 8 (the Blue Ridge Parkway overpass). These detectors were located in one of the most heavily wooded portions of the Action Area, between the Long Shoals Road (NC 146) interchange and the Brevard Road (NC 191) interchange, but no sizable water features are present here. Therefore, it follows that MYGR activity would be low or absent. In addition, telemetry studies performed by WRC did not track any bats to this area. So, we anticipate a low amount of activity between the Long Shoals Road (NC 146) interchange and the Brevard Road (NC 191) interchange.

5.1 Potential Effects from Highway Construction

Construction activities associated with the proposed widening project may include, but are not limited to clearing, grubbing, grading, installation of base material, installation of pavement, culvert extensions and replacements, bridge replacements, striping, signs, and lighting. MYGR are likely to be most vulnerable to effects from highway construction during months when they are not hibernating, and when flying adjacent to or across the active construction areas. Stressors from highway construction are generally long term in nature at the French Broad River crossing and the Blue Ridge Parkway, and generally short term in nature elsewhere, but could occur periodically during the entire construction process.

5.1.1 Lighting

For the safety of the construction personnel, equipment may be used to illuminate construction activities that may take place at night. Lighting associated with construction activities may be brighter than ambient light generated by headlights or nearby overhead lighting around interchanges or near developed areas. Night time construction activities could take place at any time throughout the life of the project. MYGR could be exposed to this stressor if they fly adjacent to or across active work zones during the months when they are not hibernating.

Lighting may exacerbate the barrier effect of roads, since those species reluctant to cross open spaces are also those most likely to avoid light. There are no data specific to MYGR for the use or avoidance of lighted areas that may occur along roadways. Research by Rydell and Baagøe (1996) indicates that bats in the genera *Eptesicus* (big brown bats, *Eptesicus fuscus*) and *Lasiurus* (red and hoary bats, *Lasiurus borealis* and *L. cinereus,* respectively) are the species typically noted foraging around artificial lights. In contrast, they noted that bats in the genus *Myotis* seem to avoid open spaces, preferring to feed in woodlands or low over water. Additional studies (e.g. Rydell 1992; Blake et al. 1994; Stone et al. 2009, 2012) have shown that road lighting deters many bat species, notably slow-flying, woodland-adapted species such as members of the

genera *Rhinolophus, Myotis* and *Plecotus*, from approaching the road. Therefore, it is possible that lighting may cause avoidance behavior in MYGR.

MYGR activity was recorded at detector site 6, which is a brightly lit area adjacent to the French Broad River. This area has lighting associated with the Long Shoals Road interchange, a large shopping center, and headlights associated with passing vehicles. The Interstate and shopping center sit at a higher elevation than the river, and create bright ambient light in the night sky. The bridge on Long Shoals Road has concrete guardrails that allow light from vehicles to pass through (i.e. "church window rail") onto the surrounding landscape. Riparian vegetation in this area has been almost entirely removed on the east side of the river, and the NCDOT right-of-way associated with Long Shoals Road (and bridge) creates a break in the forested vegetation that is approximately 300 ft. wide. The lack of forested riparian buffers in this area further allows the penetration of various forms of light into the space above the river. While MYGR certainly utilize this area for foraging and commuting, the number of MYGR calls at this location is much lower than the number of calls recorded at site 11 where the adjacent forest remains intact, and ambient light levels are much lower. This lends support to the idea that MYGR prefer to forage in darker areas with a more intact riparian buffer.

The portion of the roadway roughly located between the Long Shoals Road (NC 146) interchange and the Brevard Road (NC 191) interchange currently has no overhead lighting, so all ambient light is generated by automobile headlights. Additional construction lighting will create an elevated level of ambient light. While we assume that there will be little MYGR activity between the Long Shoals Road (NC 146) interchange and the Brevard Road (NC 191) interchange, we also assume that construction lighting will affect any MYGR that may be present.

5.1.1.1 Light Associated with Bridge Demolition/Construction

The results of acoustic studies indicate the highest amount of bat night time activity at the I-26 crossing over the French Broad River as compared to all other locations where bat detectors were deployed, even when those detectors were located in areas of contiguous, wide riparian forest habitat with little to no light associated with traffic. However, it is anticipated that additional lighting generated during night time construction activities at the French Broad River bridge and Blue Ridge Parkway Bridge will affect the MYGR that utilize this area. Bridge demolition/construction at the river is anticipated to last three to four years, and two to three years at the Blue Ridge Parkway.

5.1.1.2 Potential Light Impacts to Foraging and Commuting Habitat

As previously mentioned, within the Action Area, MYGR activity is highest along the French Broad River, where MYGR are presumably foraging and commuting. This will limit their exposure to construction lighting since the majority of construction will occur during the day. At the Blue Ridge Parkway, more night time construction activities may occur, but based on the results of acoustic surveys, as well as WRC telemetry studies, MYGR do not appear to be very active here.

Conservation measures for light:
During construction, lighting will only be used in areas where active construction is occurring. Otherwise, no additional lighting is needed. For paving operations, specifically, which will more than likely be at night, the area typically lit is directly adjacent to the paving machine. Therefore, the illuminated area will be small and moving.

Although acoustic surveys revealed that MYGR activity is relatively low in this location, NCDOT recognizes the importance of the contiguously forested area that lies south of the French Broad River crossing, as well as the portions of the project that lie closest to the river, where MYGR

activity is higher. Due to MYGR activity on the landscape between April 15 and August 15, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the French Broad River during this time. Therefore, construction-related lighting will be indirect in nature, and will not project into adjacent wooded areas or over the water surface of the river whenever practicable. This restriction will apply to locations between Brevard Road (NC 191) and Glenn Bridge Road (SR 3495) with the exceptions of the construction area associated with the access roads at the Blue Ridge Parkway and the existing brightly lit area associated with the Long Shoals Road (NC 146) interchange.

At the French Broad River bridge, the use of lights after sunset may be necessary to improve safety for work crews during construction. These are not operations that occur on a regular schedule. These activities, their likelihood of occurrence, and the type of lighting needed may include:

- Causeway construction – *Will occur* – Access road and causeway construction and removal may take place at night throughout the life of the project. This will allow the contractor to utilize the lower traffic volume to access the site. Installing the access roads and causeways at night allows longer-term operations to be constructed during daylight hours. Due to the easier site access the contractor may be able to construct the access roads and causeways more quickly. Constructing the access roads and causeways will be at the discretion of the contractor and not required at night.
    - Lighting for this operation will likely consist of one to two light plants that will be used to directly light up the construction area. Care will be taken to not shine light directly out into the river or into the adjacent forest.
- Drilled shafts – *Possible* – This is dependent upon construction schedule, contract, and availability of the concrete plant.
    - Lighting for this operation will be at water level. Lights on the drill rig will be used, and one light plant may be used if needed. Only the active work area (where the hole is currently being drilled) will be lit. No lights will be shining down from the bridge deck during this operation.
- Concrete pours during hot weather – *Will occur* – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include elements such as bent caps, end bents, and barrier rail wall.
    - The use of lights for this operation will be minimal. Because these will be small area and short duration (six hours or less) pours. Lights will generally be set up on the causeway, shining upward at the bridge member being poured. Small lights, such as headlights, will be used on the structure. There will be pump truck and concrete trucks with headlights either on the bridge deck or on the causeway.
- Deck concrete pours from May to November (summer) – *Will occur* – Deck concrete pours are generally larger, more complex, and more time consuming than other types of concrete pours. Consequently, they will need to occur at night between May and November depending on temperature and weather. These pours may be able to begin at midnight and pour into the morning hours.
    - Of all potential night time operations, this will be the operation with the most lighting. It is important to note that these operations will consist of one night of activity at a time; there will be no long term consecutive nights of operation. The majority of lighting will be at bridge deck level, with lights shining toward the bridge rather than down toward the river. Any lighting that shines down toward the river or adjacent woods will be indirect and minimal.

  - A pump truck will be positioned either at the end of the bridge at road surface elevation, or on the causeway. The vehicle's headlights will be used. Headlights on concrete delivery trucks will also be used.
  - Two to four light plants will be used on the bridge deck, depending on the size of the pour. These will most likely be positioned at either end of the pour shining down toward the deck and in toward the bridge; not facing toward the river. Small lights, similar to headlights, may be used to illuminate the screed (concrete surface), if needed.
- Beam setting – *Will occur* – Setting beams at night is required due to the volume of daytime traffic and the need to maintain traffic.
  - Cranes sitting on either of the causeways or on the new or existing bridges will be used to set the beams for the new bridges. There will be a light plant on the structure where the truck with the beams is parked, either on the new or existing structure. These lights will be shining toward the truck. There will also be lights shinning toward each structure where the beam ends sit.
  - It is difficult to determine if the lights will be placed on the causeway shining up toward the structure, or on the bridge deck shining down. This decision will need to be made on site at the time of the activity.
  - It is important to note that this operation will happen once every 1-2 months only during certain periods of construction. For each new span, this operation will occur for one to two nights, and for roughly six hours or less.
- Traffic shifts – *Will occur* – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and be of short duration, and will likely require minimal lighting on the bridge. All other activities with traffic shifts will occur beyond the end bents of the bridge and will not be part of the work on the bridge or in the area of the river.

There are other operations that may occur at night at the bridge; however, this would be unusual and evaluated on a case-by-case basis. The previously listed operations are not operations that occur on a regular schedule.

As part of their commitment to river users' safety, as well as minimization of effects to MYGR, NCDOT will place solar-powered, steady-state red lights on the causeway to alert river users to its location. Generators will not be used to provide power. These lights will be atop permanent structures, such as poles, on each causeway for the duration of the project. Red lights are unlikely to interfere with the normal activity of Myotis species foraging in this area (Spoelstra et al. 2017).

Between June 1 and August 1, female MYGR are pregnant, give birth, and raise their pups until they are volant. This is a critical time in the life cycle of MYGR, when females need to obtain sufficient nutrition to raise healthy pups, and both adult females and juveniles are most susceptible to disturbance. Therefore, NCDOT will commit to restrict the construction contractor working on the bridge over the French Broad River to no more than 28 total nights of work, and no more than four consecutive nights within a two-week period during this time period. Also between June 1 and August 1, NCDOT will limit construction lighting to whatever is necessary to maintain safety standards, and lighting will only be directed toward active work areas.

At the Blue Ridge Parkway bridge, the use of lights after sunset may be necessary to improve safety for work crews during construction. These are not operations that occur on a regular schedule. These activities, their likelihood of occurrence, and the type of lighting needed may include:

- Excavation and hauling excavated material – *Will Occur* – Excavation and removal of excavated material required for construction of the new bridge and road alignment will be necessary. This will require a small number of light plants, and headlights on excavation and hauling equipment.
- Concrete pours during hot weather – *Will occur* – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include, but are not limited to, elements such as joint closures, footers, and abutments.
  - The use of lights for this operation will be required. Lights will generally be set up to shine directly on the bridge deck work area. Small lights, such as headlights may be used on the structure. There will be a pump truck and concrete trucks with headlights on the bridge deck.
- Deck concrete overlays from May to November (summer) – *Will occur* – Night overlays are required during hot weather to achieve the proper cure. Consequently, they may need to occur at night between May and November depending on temperature and weather. These overlays may begin at midnight and last into the morning hours.
  - It is important to note that the majority of lighting will be at bridge deck level, with lights shining toward the bridge. Any lighting that shines towards the adjacent woods will be indirect and minimal.
  - A pump truck will be positioned at either at the end of the bridge at road surface elevation. The vehicle's headlights will be used.
  - Light plants will be used on the bridge deck, depending on the size of the overlay area. These will be shining down toward the deck and in toward the bridge. Small lights, similar to headlights, may be used to illuminate the deck as well if needed.
- Pre-cast segment placement - *Will occur* – Some of the estimated 56 pre-cast bridge segments will be placed/set at night. This will involve large trucks or tractor trailers carrying the pre-cast segments and cranes. Vehicle lights will be used. The crane will remove the pre-cast segment from the truck and place it adjacent to the previously placed bridge segment. This operation will also require light plants on the bridge, and possibly adjacent to I-26, as well as small lights, similar to headlights, if needed. Lights will generally be set up to shine directly on the segment placement and bridge deck work area.
- Traffic shifts – *Will occur* – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and will likely require minimal lighting on the bridge.
- Bridge Demolition –*May Occur* – Demolition of sections of the existing Blue Ridge Parkway bridge cannot occur during the day due to concern over such activity occurring above traffic. Therefore, demolition must take place at night when traffic volumes are lower and traffic can be shifted. Lighting will include light plants and the lights of required equipment to perform the demolition. Small lights, similar to headlights, may be used to illuminate the deck as well, if needed. Lights will generally be set up to shine directly on the bridge deck work area.

Summary of effects from light:
Most construction activities associated with the project will occur during the day, when bats are not actively foraging or commuting. While lighting will be minimized during construction, there is the potential that the light generated by these activities could have a negative effect on MYGR in

the area. Construction lighting at the French Broad River bridge, where MYGR activity is greatest relative to the rest of the project, is of biggest concern. The bats that regularly fly through this area are accustomed only to ambient light generated by traffic in an otherwise dark landscape. Bridge demolition will take place during daylight hours only. Therefore, no effects from lighting at the French Broad River bridge are anticipated during demolition. However, some bridge construction activities must occur at night. In general, effects from lighting associated with bridge construction will occur, but will be limited during the time of year that is most critical to the reproductive success of MYGR.

At the Blue Ridge Parkway, more night time activities will occur than at the French Broad River bridge. Light associated with excavation and hauling, concrete pours, setting of segments, traffic shifts, and bridge demolition may affect any MYGR present in this area during the time of year when they are not hibernating. However, telemetry and acoustic studies suggest that MYGR activity near the Parkway is relatively low.

Construction lighting may exacerbate the barrier effect of roads. Therefore, it is anticipated that MYGR will modify their preferred foraging and commuting areas due to increased light associated with construction activities. If MYGR avoid areas that are brighter than they are accustomed to, and particularly if they must do so for multiple years while bridge construction is underway, this may lead to increased travel time/distance between their roosts and foraging areas. This may potentially result in diminished fitness of adults and/or reduced survivorship of pups at nearby maternity roosts. As a conservation measure for this project, NCDOT will monitor bat activity at the French Broad River bridge construction site to try and determine whether bat activity is influenced by construction activities. This information may be beneficial for development of avoidance and minimization measures associated with other projects slated for future construction in locations where MYGR activity has been documented.

5.1.2 Noise

The use of construction equipment is anticipated to cause increased noise disturbance during construction activities within the Action Area. The majority of construction activities will take place during daylight hours, and will be temporary in nature. The noise associated with these activities is not expected to affect MYGR. However, MYGR flying over or adjacent to the roadway where active night time construction is occurring, during months when they are not hibernating (generally mid-March through mid-October), may be exposed to this stressor. During these times, MYGR may be exposed to overall noise levels, or intensity of noise that they may not have previously experienced in those locations.

5.1.2.1 Noise Associated with Bridge Demolition/Construction

As previously discussed in Sections 3.10.1 and Section 5.0, MYGR are most active at the French Broad River. MYGR are particularly active near the I-26 crossing, as evidenced by the acoustic data collected at detector site 11. Bridge demolition will take place during daylight hours only. Therefore, no effects from noise are anticipated during bridge demolition. In general, effects from noise associated with bridge construction will be minimal, since bridge construction is expected to take place almost exclusively during daylight hours. However, it is anticipated that additional noise generated during night time construction activities at the French Broad River bridge and Blue Ridge Parkway Bridge will affect the MYGR that utilize this area. Bridge demolition/construction at the river is anticipated to last three to four years, and two to three years at the Blue Ridge Parkway.

5.1.2.2 Potential Noise Impacts to Foraging and Commuting Habitat

As previously mentioned, within the Action Area, MYGR activity is highest along the French Broad River, where MYGR are presumably foraging and commuting at night. This will limit their exposure to construction noise since the majority of construction will occur during the day. At the Blue Ridge Parkway, more night time construction activities may occur, but based on the results of acoustic surveys, as well as WRC telemetry studies, MYGR do not appear to be very active here.

Conservation measures for noise:
Some construction activities associated with the replacement of the bridge over the French Broad River will take place after sunset, and will not occur on a regular schedule. These activities, their likelihood of occurrence, and the type of noise generated may include:

- Causeway construction – *Will occur* – Access road and causeway construction and removal may take place at night throughout the life of the project. This will allow the contractor to utilize the lower traffic volume to access the site. Installing the access roads and causeways at night allows longer-term operations to be constructed during daylight hours. Due to the easier site access the contractor may be able to construct the access roads and causeways more quickly. Constructing the access roads and causeways will be at the discretion of the contractor and not required at night.
    - Noise will be created by mainly by dump trucks and generators used to power light plants.
- Drilled shafts – *Possible* – This is dependent upon construction schedule, contract, and availability of the concrete plant.
    - Noise for this operation will be at water level, and will be created by generators used to power light plants and drill rigs.
- Concrete pours during hot weather – *Will occur* – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include elements such as bent caps, end bents, and barrier rail wall.
    - Noise will be produced by pump trucks and concrete trucks on the bridge deck or on the causeway.
- Deck concrete pours from May to November (summer) – *Will occur* – Deck concrete pours are generally larger, more complex, and more time consuming than other types of concrete pours. Consequently, they will need to occur at night between May and November depending on temperature and weather. These pours may be able to begin at midnight and pour into the morning hours.
    - It is important to note that these operations will consist of one night of activity at a time; there will be no long term consecutive nights of operation. The majority of noise will be at bridge deck level, and will be created by pump trucks, concrete trucks and generators used to power light plants.
- Beam setting – *Will occur* – Setting beams at night is required due to the volume of daytime traffic and the need to maintain traffic.
    - Cranes sitting on either of the causeways or on the new or existing bridges will be used to set the beams for the new bridges. Trucks carrying the beams, and light plants will be positioned on the bridge. Light plants and associated generators may also be placed on the causeways.
    - It is important to note that this operation will happen once every 1-2 months only during certain periods of construction. For each new span, this operation will occur for one to two nights, and for roughly six hours or less.

- Traffic shifts – *Will occur* – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and be of short duration, and will likely require minimal lighting, with associated generators, on the bridge. All other activities with traffic shifts will occur beyond the end bents of the bridge and will not be part of the work on the bridge or in the area of the river. This operation is expected to create minimal additional noise beyond ambient levels.

There are other operations that may occur at night; however, this would be unusual and evaluated on a case-by-case basis.

Between June 1 and August 1, female MYGR are pregnant, give birth, and raise their pups until they are volant. This is a critical time in the life cycle of MYGR, when females need to obtain sufficient nutrition to raise healthy pups, and both adult females and juveniles are most susceptible to disturbance. Therefore, NCDOT will commit to restrict the construction contractor working on the bridge over the French Broad River to no more than 28 total nights of work, and no more than four consecutive nights within a two-week period during this time period. Also between June 1 and August 1, NCDOT will limit construction lighting to whatever is necessary to maintain safety standards, and therefore, noise associated with generators used to power light plants will also be minimized.

Although acoustic surveys revealed that MYGR activity is relatively low in this location, NCDOT recognizes the importance of the contiguously forested area that lies south of the French Broad River crossing, as well as the portions of the project that lie closest to the river, where MYGR activity is higher. Due to MYGR activity on the landscape between April 15 and August 15, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the French Broad River during this time. Therefore, construction-related lighting will be indirect in nature, and will not project into adjacent wooded areas or over the water surface of the river whenever practicable. This restriction will apply to locations between Brevard Road (NC 191) and Glenn Bridge Road (SR 3495) with the exceptions of the construction area associated with the access roads at the Blue Ridge Parkway and the existing brightly lit area associated with the Long Shoals Road (NC 146) interchange. Since lighting in this area will be limited, associated noise created by generators used to power the lights will also be minimized.

Night time construction activities will occur at the Blue Ridge Parkway bridge. The use of lights after sunset may be necessary to improve safety for work crews during construction. Noise will be associated with light plants and construction vehicles during these activities. These are not operations that occur on a regular schedule. These activities, their likelihood of occurrence, and the type of lighting needed may include:

- Excavation and hauling excavated material – *Will Occur* – Excavation and removal of excavated material required for construction of the new bridge and road alignment will be necessary. This will require a small number of light plants, and excavation and hauling equipment. Engines associated with this equipment will create noise.
- Concrete pours during hot weather – *Will occur* – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include, but are not limited to, elements such as joint closures, footers, and abutments.
    - The use of lights for this operation will be required. Light plants, and associated generators, will generally be set up to shine directly on the bridge deck work area. There will be a pump truck and concrete trucks on the bridge deck, and their engines will create some noise.

- Deck concrete overlays from May to November (summer) – *Will occur* – Night overlays are required during hot weather to achieve the proper cure. Consequently, they may need to occur at night between May and November depending on temperature and weather. These overlays may begin at midnight and last into the morning hours.
    - A pump truck will be positioned at either at the end of the bridge at road surface elevation. The truck engine will create some noise.
    - Light plants and associated generators will be used on the bridge deck, depending on the size of the overlay area.
- Pre-cast segment placement - *Will occur* – Some of the estimated 56 pre-cast bridge segments will be placed/set at night. This will involve large trucks or tractor trailers carrying the pre-cast segments and cranes. Vehicle lights will be used. The crane will remove the pre-cast segment from the truck and place it adjacent to the previously placed bridge segment. This operation will also require light plants and associated generators on the bridge, and possibly adjacent to I-26.
- Traffic shifts – *Will occur* – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and will likely require minimal lighting, and associated noise from generators, on the bridge. This operation is expected to create minimal additional noise beyond ambient levels.
- Bridge Demolition –*May Occur* – Demolition of sections of the existing Blue Ridge Parkway bridge cannot occur during the day due to concern over such activity occurring above traffic. Therefore, demolition must take place at night when traffic volumes are lower and traffic can be shifted. Noise will be generated by light plants and equipment required to perform the demolition.

Summary of effects from noise:
Most construction activities associated with the project will occur during the day, when bats are not actively foraging or commuting. While none of the construction activities that may potentially occur at night are particularly noisy, there is the potential that the noise generated by these activities could have a negative effect on MYGR in the area. Construction noise at the French Broad River bridge, where MYGR activity is greatest relative to the rest of the project, is of biggest concern. The bats that regularly fly through this area are accustomed only to ambient noise generated by traffic in an otherwise quiet landscape. Bridge demolition will take place during daylight hours only. Therefore, no effects from noise are anticipated during bridge demolition. However, some bridge construction activities must occur at night. In general, effects from noise associated with bridge construction will occur, but will be limited to during the time of year that is most critical to the reproductive success of MYGR.

At the Blue Ridge Parkway, more night time activities will occur than at the French Broad River bridge. Light associated with excavation and hauling, concrete pours, setting of segments, traffic shifts, and bridge demolition may affect any MYGR present in this area during the time of year when they are not hibernating. However, telemetry and acoustic studies suggest that MYGR activity near the Parkway is relatively low.

Similar to lighting, noise may exacerbate the barrier effect of roads. Therefore, it is anticipated that MYGR will modify their preferred foraging and commuting areas due to increased noise associated with construction activities. If MYGR avoid areas that are noisier than they are accustomed to, and particularly if they must do so for multiple years while bridge construction is underway, this may lead to increased travel time/distance between their roosts and foraging areas. This may potentially result in diminished fitness of adults and/or reduced survivorship of

pups at nearby maternity roosts. As a conservation measure for this project, NCDOT will monitor bat activity at the French Broad River bridge construction site to try and determine whether bat activity is influenced by construction activities. This information may be beneficial for development of avoidance and minimization measures associated with other projects slated for construction in locations where MYGR activity has been documented.

5.1.3 Removal of Woody Vegetation

Clearing will likely begin almost immediately after the project is let for construction, and may continue for a period of up to two years. Clearing may occur at different locations along the length of the project, depending on construction timing/phasing. Clearing activities will take place during daylight hours, but may occur during any time of year, with the exception of the area on Blue Ridge Parkway property where tree clearing will occur between August 15 and May 15. MYGR flying across or adjacent to the roadway at night during months when they are not hibernating (mid-March through mid-October), may be exposed to this stressor.

As mentioned in Section 2.1.2, along the most contiguously forested portion of the Action Area, bats will have to fly farther to cross the interstate after clearing is complete. In addition, the opening in the riparian vegetation along the river will also increase to accommodate the access roads, and the temporary piping of streams SEE and SFG and associated SEC devices, as well as the minimum width required for roadway widening. Clearing at the Blue Ridge Parkway will be necessary to not only realign the Parkway for the new bridge, but also for installation of access roads. Clearing in this area may extend beyond the limits necessary to establish the permanent project footprint.

5.1.3.1 Potential Impacts to Foraging Habitat

There is evidence to suggest that *Myotis* foraging strategies may be more suited to foraging in forested areas than open areas (Humphrey et. al. 1977; LaVal et. al. 1977; Brack 1985; Garner and Gardner 1992; Gardner et. al. 1996; Murray 1999). However, MYGR are not typically observed foraging in forest canopies, other than during inclement weather and during early spring and late fall (LaVal et al. 1977, Stevenson and Tuttle 1981). Their typical foraging locations are lakes, rivers, and other large, open water bodies (Tuttle 1976b, 1979, LaVal et al. 1977), and in riparian areas associated with these resources (Brack and LaVal 2006).

To avoid flying through active construction areas, MYGR whose foraging areas occur within the Action Area, or whose foraging areas will be substantially fragmented, will have to expend an increased amount of energy to establish new foraging areas or new travel corridors between roosting and foraging areas. Additionally, they may be subject to an increase in inter- and intra-specific competition. Bats that remain loyal to certain foraging areas may continue to cross through newly cleared areas in the activity footprint and may have an increased risk of mortality from predation, although this risk is not detectable or measurable. It is unclear whether MYGR who regularly forage in the Action Area will experience difficulty in establishing new foraging areas due to the availability of remaining suitable foraging habitat in the surrounding landscape. However, MYGR are considered to be “selective opportunists”, meaning they consume a wide variety of insect prey, choosing the most ideal prey items available at the time, and adjusting their foraging locations based on prey availability (Brack and LaVal 2006).

Based on information collected during acoustic studies associated with this project, MYGR appear to have a preference for foraging at the I-26 crossing of the French Broad River. This suggests that they are not negatively impacted by the presence of the roadway nor the break in the adjacent riparian buffer. Furthermore, a large number of MYGR calls were recorded at detector site 5, which is located along a portion of the river very close to the Interstate. If bats are leaving the

maternity roost and flying upriver toward site 5, they are flying through multiple and extensive reaches of the River where the riparian buffer is extremely narrow or absent, and where the river parallels the interstate for approximately 2.5 mi.

In addition, MYGR activity was recorded at detector site 6, which is located adjacent to the river. Riparian vegetation in this area has been almost entirely removed on the east side of the river, and the NCDOT right-of-way associated with Long Shoals Road (and bridge) creates a break in the forested vegetation that is approximately 300 ft. wide. (For comparison, the existing cleared right of way width associated with the crossing at site 11 is approximately 200 ft. on the southeast bank and 134 ft. on the northwest bank.) MYGR continue to utilize this area for foraging and commuting, albeit in fewer numbers than were recorded at site 11.

5.1.3.2 Potential Impacts to Commuting Habitat

While MYGR foraging and commuting activity is typically associated with open water, the species is known to use forest interior or commute over land in some instances. MYGR, especially juveniles, are known to commute through heavily forested areas between roosts and foraging areas (Tuttle 1979, Brady et al. 1982), and LaVal et al. (1977) stated that some individuals, particularly males, flew “cross country” when leaving their roost in a forested setting, but always in a direction that took them to a nearby body of water within minutes of leaving the roost.

The nearest known roost is located in a two-lane bridge high above the river, rather than in a cave in a forested setting, which is more typical for the species. Therefore, it is unclear how having a roost in this setting influences the bats’ commuting preferences. Furthermore, in 2016 and 2017, NCWRC tracked bats initially following the river downstream, then travelling over land, rather than using the French Broad River for commuting. Based on the locations where transmitter signals were received, it is clear that at some point, some of the bats crossed not only I-26, but I-40 and I-240 as well. However, no individuals were tracked to the area between the French Broad River and the Brevard Road interchange (Appendix G)

In summary, based on information in the literature and the results of acoustic and telemetry surveys performed for this project, MYGR appear to be somewhat tolerant of breaks in forest cover. It is likely that MYGR foraging and commuting behavior will be altered by tree clearing during project construction. However, we do not anticipate the ability to measure, detect, or evaluate the effects to MYGR from these activities. No direct mortality is expected as a result of tree clearing, since MYGR do not utilize trees for roosting.

Conservation measures for tree clearing:
NCDOT produced a “best fit” design that includes widening to the median to every practicable extent. This reduces the overall project footprint and impacts to wooded areas. Cut and fill slopes were also reduces from the standard 4:1 to 2:1, which reduces the tree clearing limits. In order to further minimize the effects, tree clearing between the Blue Ridge Parkway and Brevard Road (NC 191), which includes the crossing of the French Broad River, will be minimized to every practicable extent in order to preserve as much of the mature woody vegetation as possible in this area. No trees will be cleared beyond what will be necessary to establish the permanent project footprint, to temporarily pipe streams SEE and SFG and establish associated SEC devices, and to install the access roads at the Blue Ridge Parkway overpass bridge.

Furthermore, NCDOT has agreed to restrictions for tree clearing on or adjacent to NPS property at certain times of year and under certain conditions. Although these avoidance and minimization measure were developed for MYSO and MYSE, they may also benefit any MYGR that may utilize the forested area in this location during the summer months. These restrictions are:

- No tree clearing will occur on NPS land between May 15 and August 15 to avoid potential impacts to MYSE.
- Emergence and/or acoustic surveys are required prior to any tree clearing that must occur between April 1 and May 1 or August 15 and November 15 to avoid potential impacts to MYSO.
- No significant tree removal within 5 mi. of known MYSO hibernacula can occur between April 1 and November 15.
- In the event that any MYSE roost trees are documented within 0.25 mi. of the project area, regardless of the time of year, the NPS will seek consultation with the USFWS before work proceeds.

Along the portion of the project from the Blue Ridge Parkway overpass to the northern terminus of the project, NCDOT will develop a revegetation plan that incorporates native woody and/or shrubby vegetation, as appropriate, for areas outside of the final slope stake limits disturbed during construction. A revegetation and monitoring plan will be developed, which will include the installation of native plants. Over time, these replanted areas will become mature forest, and the distance MYGR must travel to cross the interstate will be shorter.

Summary of effects from removal of woody vegetation:
Cleared areas may serve as ecological barriers for some species, including bats. The loss or fragmentation of foraging and commuting habitat associated with the proposed project could impact MYGR habitat in a variety of ways; including disruption of foraging and commuting activity. It is unclear whether clearing associated with the proposed widening project would increase the barrier effect to the extent that MYGR would no longer cross the road, or result in decreased crossing frequency. If MYGR avoid areas where clearing is occurring/has occurred, this may lead to increased travel time/distance between their roosts and foraging areas. This may potentially result in diminished fitness of adults and/or reduced survivorship of pups.

Cleared areas are susceptible to erosion, and this may contribute to an increase in suspended sediment into adjacent streams, and ultimately to the French Broad River. This aspect of project construction is further discussed in the next section (Water Quality).

5.1.4 Water Quality

A typical NCDOT project includes a number of measures to avoid, minimize, and offset the impacts to water quality during all phases of the project. For this proposed project, NCDOT has already implemented design changes to minimize impacts to surface waters and wetlands (Section 2.4.1, and Appendix F). NCDOT has also committed to the use of DSSW in specific areas of the project (Section 7.3.1), and will prepare a stormwater management plan that implements structural and non-structural post-construction stormwater BMPs to the maximum extent practical (Section 7.5.1).

Despite these measures, NCDOT activities may negatively affect water quality within the Action Area. These effects are anticipated to be short term in nature, and may include:

- temporary sedimentation from land-clearing and earth moving activities such as preparation, installation of drainage features, utility installation, culvert installation/extension, and grading activities;
- temporary sedimentation from in-water work associated with bridge demolition and construction activities such as investigative drilling for bridge footings, instillation and

removal of temporary causeways, removal of existing bents, and construction drilling, and
- accidental spills of petrochemicals, uncured concrete, etcetera

The extent of sediment inputs into waterways associated with the project is very difficult to determine. Duration and timing of rainfall, extent of clearing, proximity to waterbody, slope of cleared area, and other factors can all have a bearing on the amount of sediment that may potentially be generated during rainfall events. Likewise, the type, timing, amount, and proximity to a water source of any accidental spills relate to the magnitude of effect in the event of an accidental spill.

The installation of culverts, pipes, and bridge substructures can cause a geomorphically stable waterway to become unstable. The resulting scour and associated sedimentation will continue until the stream can return to a stable state. This stressor is likely to be more impactful to Appalachian elktoe, so a more detailed explanation of these processes are included in Section 6.1.6.

Eighty-six (86) streams, not including the French Broad River (Table 15 in Section 6.1) will be impacted in some way by the project. Most of them are small streams, which MYGR do not typically utilize for foraging and commuting, but activities associated with these streams may contribute to diminished water quality within the Action Area. Diminished water quality caused by sedimentation, contamination, and the destruction of wetlands and stream habitats where MYGR are present may reduce the availability of certain aquatic insects and reduce the availability or quality of suitable drinking sources. Insects associated with aquatic habitats make up a large portion of the diet of MYGR (Rabinowitz and Turtle 1982, Clawson 1984, Brack 1985, Lacki et al. 1995, Best et al. 1997). Many species of aquatic insects can be negatively affected by a decrease in water quality (Hilsenhoff 1982, Lenat 1993, Barbor et al. 1999, Ramezani et al. 2014). Therefore, a change in water quality can affect a portion of the prey base of the species. However, MYGR diet has been found to coincide most directly with the predominantly available prey species in the foraging area (Clawson 1984, Barclay and Bingham 1994), including both terrestrial and aquatic species (Clawson 1984).

MYGR foraging along waterways within the Action Area, and particularly along the river, during months when they are not hibernating, may be exposed to this stressor. If excess sediment or chemical pollutants make their way to the river where MYGR tend to commute and forage, exposure to this stressor may be later in time in the form of reduced prey base. If the prey base is reduced and MYGR are forced to find other foraging areas, this may lead to increased travel time/distance between their roosts and other foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups.

Conservation measures for water quality:
NCDOT shall commit to numerous measures to avoid and minimize effects to MYGR that may result from construction activities. These commitments are outlined in Section 2.4 and described in detail in Sections 7.1.1 (Minimization of Tree Clearing), 7.3.1 (Erosion Control Measures), 7.3.2 (Monitoring of Effectiveness of Sediment and Erosion Control Devices), 7.3.4 (French Broad River Bridge Replacement), 7.5.1 (Stormwater Control Measures), 7.7.2 (French Broad River Geomorphology Monitoring), and 7.8.1 (Reforestation and Monitoring).

Summary of effects of water quality:
Sedimentation or chemical spills associated with the bridge replacement over the river is not expected to affect MYGR to the extent of the Action Area downstream from the bridge due to the

dilution effect that occurs in such large waterbodies. Diminished water quality caused by construction activities is a greater concern for Appalachian elktoe. This aspect of potential effects caused by construction activities is discussed in greater detail in Section 6.1.

Although water quality impacts may cause a reduction in specific portions of the prey base and drinking sources for MYGR, adverse effects are likely to be undetectable due to the availability of alternative prey and drinking sources in the surrounding landscape. Bats may seek different areas for drinking and may turn to other types of prey. Therefore, we do not anticipate any measureable effect on MYGR due to potentially diminished water quality.

5.1.5 Stream Fill – Habitat Disturbance/Loss

Highway construction within and around water bodies often results in the placement of fill into streams and adjacent floodplains. Two types of fill may occur: permanent and temporary. Permanent fill consists of bridge bents and abutments, culvert and pipe construction or extensions, and roadway fill slopes. Temporary construction causeways and work bridges used for equipment access, as well as coffer dams and turbidity curtains are examples of temporary fill.

5.1.5.1 Potential Impacts to Foraging Habitat

There will be 18,238.6 linear ft. of permanent fill in French Broad tributaries, based on 2:1 slope stake limits plus a 25-ft. buffer. Temporary and permanent fill in relatively small tributaries to the French Broad River are unlikely to affect MYGR, since MYGR do not typically use smaller streams for foraging (Section 3.7). However, MYGR may use larger tributaries for foraging and commuting. Acoustic surveys identified MYGR calls at some of the large tributaries within the Action Area, such as Cane Creek and Clear Creek. Construction work and fill material in tributaries to the river may cause impacts to MYGR by affecting stream stability, resulting in sedimentation/erosion that could result in adverse effects to MYGR foraging habitat. This type of fill may also reduce the amount of instream habitat available for colonization by aquatic insects.

However, fill associated with the temporary causeways planned for the replacement of the bridge over the French Broad River is of greater concern. As discussed in Appendix E, construction of the new bridge is expected to take at least three years, and causeways will be in place, in various locations, for the duration of the bridge construction. The fill material used for the causeways will temporarily eliminate potential habitat for aquatic insects, which are an important component of the MYGR diet. Table 14 provides information on the amount of causeway material that will cover the existing riffle section at the French Broad River bridge through the various stages of the bridge replacement process, as well as the duration of each stage combination and cumulative duration through the end of that stage combination. Each stage combination is depicted in the "Surface Area of Proposed Causeways" Figures in Appendix E. Based on aerial photography, the approximate size of the riffle is 0.68 ac. The largest portion of the riffle to be covered by causeway material is roughly 0.2 acres (or 30%). This coverage will persist for approximately 96 weeks (1.8 years) as a result of material associated with causeway stage combinations 1AS+(1AN+2AN) through (1AN+2A+3A)+(1AS+3E). A much smaller portion (roughly 0.1 acres, or 14%) of the riffle will be covered by causeway material for an additional 38 weeks.

Table 14. Prime Foraging Area (ac.) Covered by Causeway Material during All Stages of French Broad River Bridge Replacement

Causeway Stage Combination*	Area (ac.)^	Duration of Stage Combination (weeks)	Cumulative Duration (weeks)
1AS+1AN	0.11	22	22
(1AS+1B)+1AN	0.113	6	28
1AS+(1AN+1C)	0.111	6	34
1AS+(1AN+2AN)	0.2	17	51
1AS+(1AN+2AN+2B)	0.22	3	54
(1AS+2C)+(1AN+2AN)	0.22	3	57
1AS+(1AN+2AN+2D)	0.21	5	62
(1AS+2E)+(1AN+2AN)	0.21	5	67
(1AN+2A+3A)+1AS	0.21	39	106
(1AN+2A+3A+3B)+1AS	0.22	3	109
(1AN+2A+3A)+(1AS+3C)	0.23	3	112
(1AN+2A+3A+3D)+1AS	0.23	9	121
(1AN+2A+3A)+(1AS+3E)	0.23	9	130
1A+4	0.07	4	134

* S= south side of river, N=north side of river
^ The entire riffle (prime foraging area) is 0.68 ac. in size

Temporary causeways also have the potential to cause a backup of water and alteration of channel flows. As presented in Appendix E, this potential exists under normal flow volumes while causeways are in place during bridge demolition and construction. While it is possible to make some predictions about the changes in WSE and velocities under various flow return periods (as presented in Appendix E Tables 2A, 2B, 3A, and 3B), it is not possible to predict the duration of the water level for a flood event since there are an infinite number of precipitation durations and intensities that can cause the water level to rise.

Conservation measures for stream fill:
Project design modifications for avoidance and minimization were described in Section 2.3.1. In summary, a best-fit widening alternative, where the existing median will be utilized and reduction of fill slopes reduced the impacts to streams by approximately 10,000 ft. This means that associated permanent fill created by culvert installation will also be reduced. Likewise, impacts to approximately 1.2 ac. of wetlands and 0.1 ac. of ponds were also avoided.

NCDOT proposes a three-span bridge design which will allow for minimization of temporary causeway fill material, and more than 50 percent of the river channel to remain free-flowing once causeways are in place. Causeway material will also be removed as construction staging proceeds, rather than installing one large causeway for the duration of the construction period. The three-span option eliminates the need for a center bent, resulting in fewer bents (permanent fill) in the river.

Summary of effects from stream fill:
We anticipate that the temporary fill associated with the causeways at the French Broad River will have the largest potential effect on MYGR. It is difficult to predict whether the potential changes to water surface elevation (WSE) and flow velocities caused by the temporary causeways would affect MYGR that utilize this area for foraging or commuting. However, the causeways will temporarily reduce the available habitat for aquatic insects at the bridge, where MYGR are known to forage. If the prey base in this area is reduced while causeways are in place, and MYGR are forced to find other foraging areas, this may lead to increased travel time/distance between their

roosts and other foraging areas. This may potentially result in diminished fitness of adults and/or reduced survivorship of pups.

5.1.6 Utility Relocation

The preliminary project designs do not include utilities design, which will be completed during the final design phase. Utility conflicts are mostly limited to interchanges and rest areas, as opposed to parallel services. Few utility relocations are planned for the section of the project between the Blue Ridge Parkway and the project terminus, which is the area of greatest concern for MYGR. The areas where utilities are currently located, as well as areas where they could potentially be moved are largely covered by maintained/disturbed habitat. Therefore, little, if any, woody vegetation would be removed for the relocations, and the impact to MYGR is expected to be negligible. Utility relocation at the rest areas will be necessary, and some forested areas may need to be cleared for this activity. However, the rest areas lie relatively far from the river, where the majority of MYGR activity occurs. Therefore, effects on MYGR from utility relocations for this project are not anticipated and/or are likely to be imperceptible.

5.1.7 Summary of Construction Effects:

Lighting, noise, removal of woody vegetation, reduced water quality, stream fill and associated habitat destruction, and utility relocation are stressors on MYGR created by construction activities associated with the I-26 widening project. Stressors that occur at the French Broad River crossing are anticipated to have the largest effect on MYGR, since acoustic surveys revealed a disproportionately high level of MYGR activity at this location. Construction lighting, noise, and the removal of woody vegetation at the French Broad River are anticipated to be the most impactful activities. Reduced water quality, stream fill, and utility relocation have effects that are not as well understood, and harder to quantify, but are nevertheless predicted to have at least some negative effect on the species. In total, construction effects from these stressors are likely to adversely affect MYGR by potentially diminishing the fitness of adults and/or reducing survivorship of pups.

5.2 Potential Effects from Highway Operation

Operational effects include effects that arise from maintenance and daily vehicular use of the facility once it is in operation, as well as natural responses over time to the proposed action’s construction effects that occur post-construction. MYGR flying across or adjacent to the roadway during months when they are not hibernating, may be exposed to potential effects from highway operation.

5.2.1 Traffic Volume Increase

Traffic forecasts for the Hybrid 6/8 Lane Widening Alternative indicate that daily traffic volumes will increase along the facility because of the capacity expansion (NCDOT 2014b). With this increase in traffic will come an associated increase in light, noise, and the elevated potential for bat-vehicle collisions. This stressor could affect MYGR if they fly adjacent to or across the highway during the months when they are not hibernating.

5.2.1.1 Lighting

Once the proposed roadway is in operation, and as traffic volume increases, the amount of ambient light generated by headlights will increase. Permanent lighting will be installed at the I-26/US 25 (Asheville Highway) interchange (NCDOT 2011) and the rest areas, but MYGR probably do not forage or commute in these areas due to the distance from French Broad River and the lack of suitable habitat. MYGR travelling across or adjacent to the roadway, particularly in areas near the river, during the months when they are not hibernating would be most susceptible to increased light. As discussed in Section 5.1.1, roadway lighting has been shown

to induce a barrier effect for some bat species. It is unclear whether there is a threshold of ambient light that would induce this effect for MYGR.

The guardrail on the bridge over the French Broad River is currently concrete parapet with a retrofitted metal rail on top, and a metal guardrail addition on the side facing traffic. These features allow automobile headlights to shine through the railing and over adjacent airspace above the French Broad River. The preliminary specifications for the proposed bridge call for 42-in., solid concrete "Jersey barrier" guard wall. This guardrail/wall type will be more effective in controlling the amount of light generated by passing vehicles to reach the surrounding airspace.

5.2.1.2 Noise

Effects from noise associated with increased traffic volume after the roadway is completed will become permanent, and will increase over time. It is difficult to predict the degree to which MYGR could be disturbed by the noise associated with the completed project. MYGR travelling across or adjacent to the roadway during the months when they are not hibernating would be most susceptible to increased noise.

Based on the Project Level Traffic Forecast Report (NCDOT 2012), peak hour bi-directional traffic volume between Long Shoals Road and Brevard Road was 4,952 vehicles (Base Year No-Build) and will increase to 9,904 vehicles for Future Year Build Hybrid 6/8-Lane Alternative in 2040 after construction is completed. Per the 2016 NCDOT Traffic Noise Manual, a 3 dB(A) increase in traffic noise is expected whenever the traffic volume is doubled. However, a 3 dB(A) increase in noise is barely perceptible to the human ear. Caution is advised when considering how these noise levels may be perceived by wildlife.

Knowing that MYGR are particularly active at the French Broad River crossing, NCDOT further analyzed the noise levels at this location. Using FHWA's Traffic Noise Model (TNM), version 2.5, 2011 base year noise levels on I-26 at the French Broad River are estimated to be 78 decibels (dB(A)). The 2040 design year noise levels with the project in place are predicted to be 76 db(A), a *decrease* of 2 dB(A). The following assumptions were used in the analysis:

1) The existing (dual) bridges over the French Broad River are four lanes. The proposed (single) bridge is eight lanes.
2) Traffic conditions resulting in the loudest traffic noise levels were used for the base year (2011) and design year (2040) noise levels. Traffic volumes used in the TNM modeling doubled between the base year and design year. The vehicle speed used in the base year and design year modeling was 65 mph.
3) Noise levels were based on receptor points placed just outside of the limits of the bridge(s) over the French Broad River. To more closely simulate the location of a bat under the bridge, the receptor points were placed at a height that is similar to the height of the bridge deck instead of the typical approach of placing receptors at 5 ft. above the ground. Doing this eliminated the approximate 20-ft. difference in elevation between the bridge deck and the ground underneath.
4) The TNM models used for this analysis were from the STIP I-4400/I-4700 Traffic Noise Report (NCDOT 2017b). It should be noted that the models through this area were highly simplified due to the absence of any nearby human receptors.
5) The reasons for the decrease in noise levels of 2 dB(A) are: 1) the existing dual bridges are being replaced with a single bridge, eliminating the potential for noise to pass through the gap (and under) the two existing bridges; and 2) the new bridge will feature

concrete Jersey barriers in the median and as guardrails on the bridge shoulders, which, based on the TNM model, reduce traffic noise levels at nearby human receptors.

6) A doubling of traffic volumes generally results in a 3 dB(A) maximum change in noise levels. A difference in noise levels of 3 dB(A) is barely detectable to human hearing.

Therefore, traffic noise levels perceived by humans are not predicted to get worse with the proposed widening of I-26 where it crosses the French Broad River. Please note that the TNM modeling methodology and noise levels reported here are based on human sensitivities to noise, and caution should be taken in extrapolating these noise levels to wildlife (Tracy Roberts, NCDOT Senior Traffic Noise & Air Quality Engineer (Contractor), personal communication).

As is evident by the presence of the various MYGR roosts that have been recently discovered in bridges near the Action Area, MYGR do not seem to be bothered by the associated level of traffic noise at those bridges. Although, it should be noted that most of the roosts are located on two-lane roads with lower traffic volumes than those associated with I-26. No effects from increased noise associated with operational activities of the proposed roadway are expected to occur at winter roosts, because none have been documented in North Carolina..

The results of acoustic studies presented in Appendix B reveal that there is an elevated amount of bat activity in general, and MYGR activity specifically, at the I-26 crossing over the French Broad River as compared to all other locations where bat detectors were deployed, even when those detectors were located in areas of contiguous, wide riparian forest habitat with much less traffic noise. This would suggest that MYGR are not deterred by the noise created by the current traffic volume at this location. There are no studies focused specifically on MYGR and noise effects. However, some studies suggest that MYSO (a congener) may be able to tolerate disturbance from vehicular traffic noise at a roost near a large airport (Sparks et al. 2009). Another study (Gomes et al. 2016) concluded that fringe-lipped bats (*Trachops cirrhosus*) in South America successfully shifted their foraging strategy with increased noise.

Conversely, bats in Indiana were twice as likely to display avoidance behavior when attempting to cross roads if vehicles were passing by; reversing course an average of 98 ft. from the vehicle. However, the height a bat flew, speed of the vehicle, type of vehicle or level of noise emitted by vehicles had no effect on the likelihood of bats reversing course an average of 98 ft. from the vehicle (Zurcher et al. 2010). Additionally, a comparison of echolocation search calls produced by Mexican free-tailed bats (*Tadarida brasiliensis*) at sites with and without anthropogenic noise from natural gas compressors revealed that bats modified their echolocation search calls in noise; producing longer calls with a narrower bandwidth. This alteration of calls might affect prey detection. (Bunkley 2015).

As previously mentioned, NCDOT commits to developing a revegetation plan that incorporates native woody and/or shrubby vegetation, as appropriate, for areas outside of the final slope stake limits disturbed during construction. In time, this vegetation will mature and add to the existing forested area, providing more protection from traffic noise and light to MYGR foraging and commuting along the river. Also, preliminary specifications call for a solid (Jersey barrier) guardwall on the replacement bridge. This will further alleviate some noise and light generated by passing vehicles. While the affects from noise and light on MYGR are anticipated, it is difficult to quantify those effects.

5.2.1.3 Vehicle Collisions

As mentioned in Section 2.1.2, bats attempting to cross the interstate in the heavily wooded area between the Blue Ridge Parkway and Brevard Road will encounter a wider opening in the forest.

MYGR that attempt to cross over the roadway during months when they are not hibernating could potentially be struck and injured or killed by passing vehicles. MYGR will be exposed to this stressor indefinitely into the future.

Bat mortality caused by impacts with passing vehicles is widely documented (Kiefer et al. 1995, Lesiński 2007, Gaisler et al. 2009, Russell et al. 2009, Lesinski et al. 2010, Medinas et al. 2013). Bat mortality may occur within the Action Area if bats fly too low to traffic when crossing over a bridge or roadway, although it is unclear whether MYGR, which typically forage within 6.5 to10 ft. of the water surface (Tuttle 1976b, 1979, LaVal et al. 1977) would be at risk for direct mortality related to the proposed project.

As previously discussed, there appears to be more MYGR activity at the French Broad River crossing than any other acoustically surveyed locations within the Action Area (Acoustic Survey Report, Appendix B). Therefore, it follows that this would be the location where NCDOT should be most concerned about MYGR mortality caused by vehicle collisions. However, on multiple occasions, bats were observed flying under the I-26 bridges at this location rather than flying over the bridges. Although it was impossible to identify the bats to species, we assumed that many of them were MYGR based on the results of acoustic analysis from this location.

It is also possible that the existing and proposed bridges may serve as protective underpasses for foraging and commuting bats. Many studies have shown that a wide range of bat species use underpasses to fly beneath roads (Bach et al. 2004; Kerth and Melber 2009; Boonman 2011; Abbott et al. 2012a; Berthinussen and Altringham 2012). Abbott et al. (2012b) concluded that bats used under-motorway routes, particularly river bridges, more than over-motorway routes. Additionally, a study of three bat underpasses in Europe (Berthinussen and Altringham 2012) concluded that bats are more likely to use underpasses if they are created on pre-construction commuting routes. Perhaps the MYGR in the Action Area are already utilizing the existing bridges during their commutes, which may serve as the "pre-construction state", and the replacement bridge will not change their commuting activity in this location.

Furthermore, studies in Europe have suggested that height is the most important cross-sectional measurement in predicting whether an underpass will be used by bats (Boonman 2011, Abbott 2012). Underpass height, more than width, was the critical dimension determining the number of bats flying through underpasses in studies in Ireland (Abbott 2012; Abbott et al. 2012a, b). The existing bridges at this location are approximately 30 ft. above the water surface. The proposed replacement bridge will be an equivalent height. This height allows ample room for MYGR to forage at their preferred height (6.5 to10 ft.) over the water.

Direct mortality is difficult, if not impossible, to quantify. A carcass search of the road shoulder is the most effective way to do this. However, any bats killed at bridge crossings may fall into the water below and wash downstream. Also, due to the volume and speed of traffic which poses a safety hazard for pedestrian surveys, as well as the speed with which bat carcasses tend to be consumed by scavengers, estimating the number of direct mortalities is not feasible.

Conservation measures for increased traffic volume:
NCDOT will minimize the tree clearing necessary for this project by choosing a "best fit" design, reducing slope stakes, utilizing retaining walls, and widening to the median in most areas. Tree clearing between the Blue Ridge Parkway and Brevard Road (NC 191), where forested areas are expansive, will be minimized to every practicable extent in order to preserve as much of the mature woody vegetation as possible in this area. Furthermore, along the portion of the project from the Blue Ridge Parkway overpass to the northern terminus of the project, NCDOT will revegetate any areas outside of the final slope stake limits disturbed during construction. A

revegetation and monitoring plan will be developed, which will include the installation of native plants. Over time, these replanted areas will become mature forest, and the distance MYGR must travel to cross the interstate will be shorter.

NCDOT will specify the use of solid “Jersey barrier” guardwalls on the new French Broad River bridge. This will reduce some of the light emitted by passing vehicles from shining into the surrounding landscape.

Summary of effects for traffic volume increase:
Increases in noise, light, and vehicle collisions are all anticipated as a result of increased traffic volume once the widened roadway is in operation. Effects from these stressors are expected to be long term in nature, more severe in heavily forested areas at night, during times of year when MYGR are not hibernating, and at the I-26 crossing of the French Broad River, where MYGR activity is highest.

It is unclear whether MYGR will adjust to new, higher levels of light and noise associated with the increase in traffic volume. However, as already discussed under “Potential Effects from Highway Construction”, increases in light and noise may exacerbate the barrier effect of roads. Therefore, it is anticipated that MYGR will modify their preferred foraging and commuting areas due to these stressors. It is impossible to determine the number of MYGR that may be killed due to direct mortality from vehicle strikes, although we anticipate that there may be an increase in this type of mortality once traffic volumes increase. If MYGR alter their foraging and commuting habits due to the increased light, noise, or potential for vehicle collisions, this could lead to increased travel time/distance between their roosts and other foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups.

The conservation measures that NCDOT will implement should reduce the effects from these stressors. The woody vegetation that will be retained or replaced will aid in buffering light and noise in adjacent forested areas. Furthermore, this will reduce the overall distance that bats must travel through open space should they choose to fly over the road. This may reduce direct mortality caused by impacts with passing vehicles.

Limited additional permanent lighting, and the installation of solid “Jersey barrier” style guardwall on the new bridge over the French Broad River will reduce the amount of ambient light associated with the completed project.

5.2.2 Tree Trimming and Hazard Tree Removal
Forested areas that are cleared as part of the construction process will need to be maintained in low growing, or herbaceous vegetation in most areas after construction is complete. Tree trimming and hazardous tree removal activities occur along roadside ROWs to reduce safety hazards from falling trees or limbs, or to improve line-of-sight issues. Potential effects to MYGR from this activity are described in Section 5.1.3. Hazardous tree-removal occurs on an as-needed basis, so quantifying the amount of habitat lost from this activity is not practicable. No MYGR roosts are anticipated to be impacted by this activity, and any clearing of this type along waterways where MYGR might be foraging or commuting is expected to be minimal. Therefore, we do not anticipate any detectible effects from tree trimming and hazard tree removal on MYGR.

5.2.3 Water Quality
After the construction associated with the proposed project is complete, the potential for negative impacts to water quality are generally low. There is the potential for the input of toxic chemicals that drip or drain from passing vehicles to be washed into nearby waterways during rain events.

There is also the potential for sediment input, through the alteration of hydrology in the Action Area, caused by the increase in impervious surfaces or increases in permanent fill in waterway from culvert extensions. These stressors may have a detrimental effect on MYGR foraging areas, and have already been discussed in Sections 5.1.4 and 5.1.5. It is important to bear in mind that MYGR prefer to spend their time foraging along the French Broad River, which has an extremely large watershed (approximately 660 sq. mi.). Therefore, water quality in the river nearest the proposed project is influenced by a variety of factors and activities, not only the activities associated with the proposed project.

If the prey base in the section of the river nearest the proposed project is diminished, or if drinking water quality suffers, MYGR may be forced to find alternative foraging areas. This could lead to increased travel time/distance between their roosts and other foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups.

Conservation measures for water quality:
NCDOT will implement measures to minimize effects from stormwater associated with the completed roadway to MYGR (and Appalachian elktoe). The stormwater commitments described above will meet the need for more stringent guidance for the Environmentally Sensitive Areas.

- NCDOT has developed stormwater commitment guidance, which will apply at crossings of the French Broad River and any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the river within the NCDOT right of way (Appendix H).
- NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater best management practices (BMPs) to the maximum extent practical, which is consistent with the Department's National Pollutant Discharge Elimination System (NPDES) Post-Construction Stormwater Program.
- When preparing the SMP, NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients, and heavy metals.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:
  - Bioswales
  - Bioembankments
  - Biofiltration conveyances
  - Soil improvement to maximize infiltration
- The NCDOT hydraulics engineer will consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP.

Summary of effects from water quality:
Due to the large size of the watershed, and the commitments that NCDOT has made for stormwater control, the likelihood that the completed project will directly contribute to diminished water quality in the French Broad River is low. Any effects to MYGR that might occur would be extremely difficult to assess, and we expect that we would not be able to measure, detect, or evaluate the effect.

5.2.4 Summary of Operational Effects

Tree trimming and hazardous tree removal, and changes to water quality are not anticipated to have a measureable effect on MYGR. However, traffic volume increases and associated increases in ambient light and noise, as well as MYGR-vehicle collisions are anticipated to occur

when the widened roadway becomes operational. These stressors are likely to be most impactful at the French Broad River crossing and the adjacent heavily wooded areas where acoustic surveys revealed a disproportionately high level of MYGR activity. Operational effects from these stressors are likely to adversely affect MYGR by potentially diminishing the fitness of adults and/or reducing survivorship of pups.

5.3 Interrelated/Interdependent Effects

Interrelated actions are those that are part of the larger action and depend on the larger action for their justification. Similarly, interdependent actions are those that have no independent utility apart from the action under consideration. (50 CFR §402.02)

5.3.1 Induced Land Development Effects

Project-induced changes in land use can be part of the indirect impacts of a road construction project, resulting from modifications in access to parcels of land and from modifications in travel time between various areas (Mulligan and Horowitz 1986).

Because the project area is within close proximity to Asheville, a variety of actions may affect MYGR or MYGR habitat in the area. The effects of secondary development are difficult to predict because this type of development is heavily dependent on outside factors such as the economy and population growth. Depending upon local land development regulations, unintended consequences of roadway improvements can include development demand, water/sewer availability, and other factors encouraging of additional development and sprawl. Improvements to levels of service, better accommodation of merging and exiting traffic, and reductions in travel times can have land development impacts outside of the direct project area. However, interdependent effects from secondary development adjacent to I-26 will be limited because access to the interstate will be restricted to the existing interchanges (NCDOT 2016).

While there is some available land adjacent to the project, it is not anticipated that growth patterns will change, as no new interchanges or connections are proposed. In addition, local planners have indicated that although population growth is anticipated in the project study area, the advancement of the project is unlikely to affect growth. Based on the results of the Indirect Effects Screening Matrix, the need for a Land Use Scenario Assessment is “not likely”, and there is a low to moderate concern for indirect impacts as a result of STIP Project I-4400/I-4700. (From Regional CES, NCDOT 2014c)

Development can and often does lead to a reduction in forest cover, increase in impervious surface area (which can negatively affect water quality), increase in noise generated by vehicles and machines, and an increase in lighting associated with commercial and residential expansion, among other stressors. These can affect MYGR if individuals are using undeveloped areas for foraging, commuting, or roosting. However, the potential for induced growth generated by the proposed project is limited. Therefore, impacts to potential MYGR habitat in areas adjacent to the proposed project are unlikely to result from the proposed project.

5.1.2 Effects Associated with Borrow/Fill, Staging and Storage

The contractor may use areas outside the Action Area for borrow pits or spoil areas. Waste and borrow areas will likely be required to dispose of and obtain materials for earthwork, and are also subject to clearing and grubbing. Construction contractors are responsible for addressing federally listed threatened and endangered species issues per NCDOT standard specifications. Most borrow and waste areas are sited in upland areas of previously disturbed habitat where tree removal is minimal. Appropriate SEC measures will be required in these areas. We do not anticipate the ability to measure, detect, or evaluate the effects to MYGR from these activities.

5.4 Cumulative Effects

Cumulative effects are defined under the ESA as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation" (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered under these effects because they require separate consultation pursuant to Section 7 of the ESA.

The Indirect Screening Report (NCDOT 2013a), the associated update (NCDOT 2017a), and the Asheville Regional Cumulative Effects Study (NCDOT 2014c) indicate that the I-26 widening project will result in few indirect impacts and minimal cumulative effects. The majority of the activities identified in these reports will likely require federal authorization, such as a CWA 404 permit, and would therefore have their own ESA Section 7 consultation and not be considered a cumulative effect under ESA for this action.

Restriction of right of way access to the existing interchanges will limit secondary development within the Action Area. However, some limited tree clearing, noise, and lighting due to private landowner activities is reasonably certain to occur. Loss of forested habitat, particularly if adjacent to waterways or the French Broad River, and an increase in sedimentation due to an expansion of impervious surfaces, particularly to the river, could prove detrimental to MYGR for reasons already discussed. Lighting around these developed areas or noise associated with construction activities may also prove detrimental to MYGR, depending on the exact location and proximity to MYGR foraging, commuting, and roosting habitat.

5.5 Beneficial Effects

The USFWS Endangered Species Act Consultation Handbook (1998) states that "beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat". While many of the effects discussed in this document may be adverse, some potential effects of the proposed project may be beneficial to federally protected species.

5.5.1 Waters of the United States Compensatory Mitigation

NCDOT is required to mitigate for impacts to wetlands and streams as per Section 404 of the CWA. Typically, NCDOT offsets unavoidable impacts through a combination of restoration, enhancement, and preservation activities.

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

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

5.5.2 Reduction in Permanent Fill at French Broad River Crossing

Permanent fill in the form of bridge bents will be reduced upon completion of the new bridge. The existing bridges have five interior bents each, arranged on spread footings, with only one of these bents situated on land. The proposed bridge will have two bents, both in the water. This means that more of the river bed will be available for colonization of aquatic fauna, including aquatic insects, which are the main food source for MYGR. Furthermore, MYGR will have fewer vertical impediments to navigate as they fly near the water surface through this section of the river while foraging and commuting.

5.6 Biological Conclusion for Gray Bat

No bats or evidence of bats were observed on any bridges or in any culverts that will be included in project construction activities. Direct impacts to MYGR due to modification or elimination of their summer roosts are not expected.

There are not any known MYGR hibernacula in Buncombe or Henderson Counties, and there are not underground mines located within the Action Area or within 3 mi. of the Action Area. Therefore, no impacts to MYGR winter roosting habitat are anticipated.

However, construction of the I-26 widening project, I-4400/I-4700, is expected to result in unavoidable adverse effects to MYGR foraging and commuting habitat, particularly at the French Broad River crossing. Therefore, it is concluded that the proposed action **"May Affect, Likely to Adversely Affect" MYGR**. Incorporation of conservation measures into the project will offset some of those effects. These measures are consistent with the recovery objectives outlined in the recovery plan for the MYGR (Brady et al. 1982), aiding particularly in the control of habitat destruction and research needs.

6.0 EVALUATED EFFECTS OF PROPOSED ACTION ON APPALACHIAN ELKTOE

Based on mussel survey data, the Appalachian elktoe has been found in the French Broad River within and upstream of the Action Area, albeit in very low numbers (Figure 4 of Appendix A). Any adults or juveniles present will be in the riverbed, while glochidia may be attached to host fish that reside in or move through the Action Area in the French Broad River. The species may be present year-round. Project construction has the potential to adversely affect the Appalachian elktoe in a variety of ways, both during construction and once the road is in use. Since they occur in aquatic habitat, potential effects to the Appalachian elktoe could occur considerable distances downstream of I-26 construction activity. Therefore, the Action Area includes portions of the French Broad River and some tributaries that are downstream of the I-26 construction corridor (see Section 2.2 for Action Area description, and Appendix A, Figure 3).

Potential direct, indirect, and cumulative effects to the Appalachian elktoe and its habitat were evaluated regarding this project and are discussed below. The project-related effects are presented in three categories:

1. Construction Effects
2. Operation Effects
3. Interrelated/Interdependent Effects

Measures that have been incorporated into the development of this project to avoid or minimize effects to Appalachian elktoe are also included in this evaluation.

6.1 Construction Effects

The project alignment crosses the French Broad River as well as waterbodies that drain to occupied Appalachian elktoe habitat in the French Broad River. As a result, there is potential for construction effects to occur that originate in areas not immediately adjacent to the French Broad River. Although construction-related effects could occur at any stream crossing within the watershed, the likelihood of such effects generally declines the farther the action is from occupied habitat.

In certain instances, sediment effects from construction sites can extend long distances. In 1997, a large plume of sediment in the Neuse River near New Bern was traced to a private construction site along Crabtree Creek in Raleigh, over 180 mi. upstream (Kays 2002). While this is an extreme example, it demonstrates the potential for project-related sedimentation to have far-reaching effects on the aquatic habitats downstream, which could happen during the construction of I-4400/I-4700, if sediment and erosion control measures are overtopped during major storm events. Potential effects are reduced if the stream drains into an impoundment (where sediments have a chance to settle out) prior to reaching occupied habitat, such as Kimsey Creek, which drains to a pond prior to reaching the French Broad River. Jurisdictional streams affected by the project are noted in Table 15.

Table 15. Effects to French Broad River Tributaries

Stream Name	NRTR Map ID	Distance to French Broad River (mi.)	Stream Effects (ft.) (2:1 SS+25 ft.)*	Stream Effects (ft.) (2:1 SS)**
UT to Dellwood Lake^	**SFG**	0.00	2010.0	662.3
Powell Creek (Lake Julian)* **	**SDN**	0.03	111.1	53.0
UT to French Broad* **	**SDU**	0.05	86.9	34.4
UT to French Broad* **	**SDK**	0.05	75.1	48.9
UT to French Broad * **	**SDF**	0.06	91.0	61.9
UT to French Broad* **	**SFX**	0.06	72.6	47.3
UT to French Broad* **	**SEQ**	0.07	74.5	24.2
UT to French Broad* **	**SDG**	0.07	68.9	43.0
UT to French Broad* **	**SDX**	0.08	1043.2	399.6
UT to French Broad* **	**SDW**	0.09	60.0	25.3
UT to French Broad* **	**SFO**	0.10	56.7	55.0
UT to French Broad* **	**SDE**	0.10	99.1	47.6
UT (to UT) to French Broad	SDV	0.10	55.3	25.5
UT to French Broad^	SEE	0.15	383.0	106.3
UT to French Broad* **	**SEF**	0.15	505.3	368.1
UT to Dellwood Lake* **	**SFI**	0.19	7.3	0.0
UT to French Broad* **	**SDY**	0.41	22.5	2.3
UT to French Broad* **	**SED**	0.43	66.7	9.4
UT to French Broad* **	**SEV**	0.47	43.7	16.8
UT to French Broad* **	**SDC**	0.50	102.5	44.2
UT to French Broad* **	**SEW**	0.55	37.9	12.8
UT to French Broad* **	**SEU**	0.55	18.3	10.6
UT (to UT) to French Broad	SDD	0.61	587.7	135.1

Table 15. Effects to French Broad River Tributaries

Stream Name	NRTR Map ID	Distance to French Broad River (mi.)	Stream Effects (ft.) (2:1 SS+25 ft.)*	Stream Effects (ft.) (2:1 SS)**
UT to Dellwood Lake* **	**SFR**	0.67	46.0	27.8
UT to Kimsey Creek	SCZ	1.00	40.6	15.2
Kimsey Creek	SCY	1.03	121.2	55.2
UT to French Broad	SDH	1.04	500.3	283.0
Cane Creek	SCW	1.08	201.2	41.7
UT to Kimsey Creek	SDR	1.09	213.5	213.5
UT to Dellwood Lake* **	**SFQ**	1.09	96.8	43.7
UT to Cane Creek	SCX	1.12	738.9	107.3
UT to Mud Creek	SCQ	1.28	433.7	408.7
UT to Mud Creek	SCR	1.33	92.6	60.3
UT to Mud Creek	SEN	1.34	335.5	0.0
UT to Mud Creek	SCT	1.34	191.1	75.8
UT to French Broad	SDI	1.44	342.3	254.9
UT to Higgins Branch^^	S1	1.61	114.0	114.0
UT to Cane Creek	SCU	1.67	183.4	87.9
UT to Mud Creek	SCO	1.74	22.0	0.0
UT to Long Valley Branch* **	**SFM**	1.86	382.0	29.0
UT to Long Valley Branch* **	**SFP**	1.90	50.0	22.7
UT to Mud Creek	SCK	1.99	139.2	87.3
UT to Mud Creek	SCN	2.00	705.6	397.5
UT to Higgins Branch	SZY	2.06	294.6	162.0
UT to Mud Creek	SCL	2.07	101.6	54.3
Long Valley Branch* **	**SFN**	2.19	43.8	24.9
UT to Mud Creek	SCM	2.21	6.1	0.0
UT to Mud Creek	SCH	2.32	38.7	10.2
Byers Creek	SBU	3.02	89.2	36.7
UT to Byers Creek	SBT	3.06	191.8	19.7
UT to Byers Creek	SBV	3.06	176.2	41.8
UT to Byers Creek	SCB	3.22	42.7	2.4
UT to Mud Creek	SBI	3.27	88.5	28.2
UT to Mud Creek	SBS	3.31	55.4	55.4
UT to Mud Creek	SBO	3.70	51.9	7.6
UT to Byers Creek	SCA	3.73	49.2	6.3
UT to Byers Creek	SCD	3.75	110.7	6.9
Featherstone Creek	SBP	3.95	41.0	1.9
UT to Mud Creek	SBG	4.54	449.0	79.5
UT to Mud Creek	SBF	4.59	169.0	36.4
Clear Creek	SBD	6.43	422.1	0.0
UT to Allen Branch	SBA	6.92	36.5	0.0

Table 15. Effects to French Broad River Tributaries

Stream Name	NRTR Map ID	Distance to French Broad River (mi.)	Stream Effects (ft.) (2:1 SS+25 ft.)*	Stream Effects (ft.) (2:1 SS)**
UT to Allen Branch	SAZ	7.15	236.7	84.9
UT to Camp Branch	SAS	9.36	54.6	13.3
UT to Camp Branch	SBL	9.38	137.1	36.6
UT to Devils Fork	SAV	9.49	7.4	0.0
UT to Devils Fork	SBW	9.50	75.4	0.0
UT to Devils Fork	SAW	9.51	60.5	34.1
Camp Branch	SAX	9.53	66.4	19.0
Devils Fork	SAJ	9.53	1091.1	75.0
UT to Devils Fork	SAO	9.58	59.8	10.9
UT to Devils Fork	SAP	9.60	0.0	0.0
UT to Devils Fork	SAR	9.72	38.2	10.6
UT to Devils Fork	SAB	9.89	1581.1	144.6
UT to Devils Fork	SAL	10.03	94.3	26.0
UT to Devils Fork	SAC	10.32	77.1	25.0
UT to Devils Fork	SAI	10.38	39.5	14.1
UT to Devils Fork	SAE	10.53	111.6	22.2
UT to Bat Fork	SAH	10.95	14.8	0.0
Dunn Creek	ST	11.60	0.6	0.0
UT to Dunn Creek	SV	11.65	76.6	14.6
UT to Dunn Creek	SW	11.73	666.7	274.2
UT to Dunn Creek	SQ	11.80	147.9	0.0
UT to Dunn Creek	SS	11.84	250.5	151.6
UT to Dunn Creek	SZ	11.85	234.0	0.0
UT to Dunn Creek	SAA	12.16	143.5	63.6
TOTAL			18,238.6	6,153.6

*Effects calculated based on current design proposed 2:1 slope stake (SS) limits plus 25 ft. (SS+25).
**Effects calculated based on current design proposed 2:1 slope stake (SS) limits. Effects for Streams SFG, SFO, and SEE calculated based on access road footprint.
*****Streams subject to DSSW and designated as Environmentally Sensitive Areas.**
^Stream to be temporarily piped for construction of access road.
^^Estimated effects for rest area expansion based on preliminary design.

The I-26 bridge replacement over the French Broad River is the crossing most likely to affect Appalachian elktoe due to its immediate proximity to occupied habitat. Tributaries to the French Broad River that are affected by I-4400/I-4700 are mostly crossed by culverts. Existing culverts will be retained and extended, and supplemental pipes will be added in some locations. Retaining culverts instead of replacing them will substantially reduce the potential for construction effects to extend downstream to mussel habitat in the French Broad River. Streams affected by construction vary greatly in distance to occupied habitat. Some are immediately adjacent to the French Broad, while others are many river miles upstream (see Table 15).

6.1.1 Stream Fill – Substrate (Habitat) Disturbance/Loss

Highway construction within and around water bodies often results in the placement of permanent and/or temporary fill into streams and adjacent floodplains. Examples of permanent fill are bridge bents and abutments, culvert and pipe construction or extensions, and roadway fill slopes. Temporary construction causeways and work bridges used for equipment access, as well as coffer dams and turbidity curtains are examples of temporary fill. Fill material can temporarily or permanently eliminate mussel habitat, or bury mussels, if they are present.

6.1.1.1 French Broad River Bridge – Description

The existing pair of I-26 bridges over the French Broad River consists of six-span structures with reinforced concrete decks that are approximately 450 ft. long and 33.4 ft. wide each. Interior bents are supported on spread footings and all but two of the ten interior bents are in the water. The structures will be removed and replaced with a single bridge approximately 464 ft. long and 153.3 ft. wide which will provide a total of eight travel lanes. To accommodate the bridge construction and maintenance of traffic, the new I-26 centerline will be shifted approximately 12.5 ft. to the south of the existing centerline.

This project is in the preliminary design phase, so detailed drawings are not currently available. Appendix E includes figures of the proposed access roads, a proposed causeway diagram, bridge profile, and proposed causeway sketches. Two bridge designs have been proposed (see Appendix E for more details). The preferred alternative (Alternative 2) is a three-span structure. The three spans are anticipated to have lengths of approximately 151 ft., 170 ft., and 143 ft. from east to west, and will require two bents in the river. Each bent will require ten drilled shafts. The unequal span arrangement avoids the existing foundations, including the center bent. This design reduces effects to the river by using fewer bents, maximizes the hydraulic opening with smaller causeways, and reduces anticipated construction time, which minimizes the amount of time the causeways will be in the river.

Due to insufficient area between the toe of slope and the top of bank to allow construction vehicles under the bridge, and the location of the interior bents within the river, causeways are required to provide construction access to the bridge. A work bridge was considered instead of a causeway; however, the bedrock that makes up the riverbed of the French Broad River in this location complicates the use of driven piles that would be required to set the foundations of temporary work bridges. The piles would need to be drilled, and this would increase the length of time it would take to construct the work bridge by approximately three months. In addition, work bridges would require a larger steel size pile drilled into rock and backfilled with concrete. The piles would be drilled every 30 ft. Consequently, driven piles that would typically be utilized for work bridges cannot be used, as drilled piles are costly, time intensive, and difficult to remove. As such, causeways are the preferred option for construction equipment to access the river and operate safely.

The proposed bridge is to be constructed in stages beginning on the upstream side. Access roadways will be built to tie to rock causeways located on each side of the river. The causeways at each bridge end will extend along the riverbank from one edge of the proposed superstructure to the other, under the existing bridges. These causeways will be used as work pads for construction cranes and other equipment needed during demolition and construction activities. Preliminary design sketches of the causeways are included in Appendix E. After access road construction is complete, causeway construction will begin. Details for the causeways and bridge demolition/construction are discussed in Section 6.1.1.3, French Broad River Bridge – Causeways and Staged Construction, and Section 6.1.1.4, French Broad River Bridge -

Demolition of Existing Structures. Roads needed to access the causeways are discussed below in Erosion/Sedimentation from Construction, Section 6.1.6.

6.1.1.2 French Broad River Bridge - Investigative Drilling

Investigative drilling for the French Broad bridge footings will require three 4-in diameter borings within each of the two bent locations: one at each edge and one in the middle, for a total of six. Each boring will reach a depth of 25 to 30 ft. This work will be completed before causeways are constructed. The drill rig is contained on a 15 by 20-foot (approximate) barge that is surrounded by a containment boom to minimize turbidity. Investigative drilling will be conducted approximately ten hours/day during daylight hours, drilling one hole per day. It will take 2.5 to 3 weeks to complete the work, including set-up time. The borings will cover about 75 sq. in. in total. Any mussels present in the drilling area will be killed. Additionally, the noise may adversely affect Appalachian elktoe if they are present in the vicinity when drilling occurs (discussed below in Section 6.1.4, Acoustic Effects on Appalachian Elktoe), or if host fish carrying their glochidia are present (discussed below in Section 6.1.2, Fish Host Effects). Given the rarity of Appalachian elktoe within the French Broad River, the chances of an individual occurring within the location of the borings is small, but cannot be completely discounted, as there will be (0.5 sq. ft.) disturbance to suitable habitat.

6.1.1.3 French Broad River Bridge – Causeways and Staged Construction

Causeways will be constructed along each side of the river in stages mirroring the construction of the bridge (see Table 16 Summary of Causeway Construction Stages, Section 6.1.6). Causeway size will be minimized as much as possible during each stage of construction, and the preliminary design of the causeways has been refined to maximize the free flow area of the river at all times. Pipes will not be used in causeway construction due to safety concerns for river users. The top causeway elevation (assumed to be 2,000 ft.) will provide 2 ft. or more clearance above the mean river flow.

In the first stage of construction (Stage 1A), the causeway along the east bank of the river near End Bent 1 will be constructed in full (Causeway Sketch, Sheet 1 of 6, Appendix E). This causeway will be approximately 318.4 ft. long along the eastern river bank allowing for the required tie-ins to the access roads in addition to allowing cranes and other construction vehicles to traverse under the existing bridges. The east bank causeway will extend approximately 52.5 ft. into the river. During Stage 1B, this causeway will be extended approximately 10 additional ft. into the water for a length of 74.8 ft. to drill the new shafts. Once the shafts have been drilled, the Stage 1B causeway will be removed. Stage 1B is expected to be in place for approximately six weeks. On the west bank of the river at End Bent 2, Stage 1A will construct a causeway for approximately 151 ft. along the river bank, extending approximately 62.5 ft. into the water. During Stage 1C, this causeway will be extended approximately 10 additional ft. into the water for a length of 77.4 ft. to drill the new shafts. Once the shafts have been drilled, the Stage 1C causeway will be removed. Stage 1C is expected to be in place for approximately six weeks. Without the causeways in place, the cross-sectional area of free flow is approximately 803 sq. ft. Under "normal" causeway conditions (Stage 1A), with no additional extensions of the causeway, approximately 462 sq. ft., or 58 percent, of free flow cross-sectional area is expected between the two causeways in the river. During Stage 1B or Stage 1C, free flow cross-sectional area of the river will be 435 sq. ft., or 54 percent.

During Stage 2A construction (Causeway Sketch, Sheet 2 of 6, Appendix E), approximately 72.8 ft. of causeway will be added to the downstream portion of the Stage 1A causeway on the west bank of the river to facilitate removal of the existing eastbound bridge and construction of the Stage 2 new bridge construction. The Stage 2A causeway will extend approximately 62.5 ft. into

the river. Stages 1A and 2A total approximately 224 ft. in length adjacent to the west river bank. As Stage 2A is added to Stage 1A on the west bank, a portion of Stage 1A will be removed from the east bank. This will decrease the length of the east bank Stage 1A causeway to approximately 244.5 ft. A temporary layer of rock will be left behind to protect the riverbank from scour until construction is complete. No rock will be permanently left on the riverbed.

The west and east bank causeways will be temporarily extended into the river to allow demolition of the existing bridge (Causeway Sketch, Sheet 2 of 6, Appendix E). Stages 2B and 2C are expected to be constructed, used for demolition, and removed over an approximate three-week period. Stage 2B and Stage 2C will not occur at the same time. These causeways will extend approximately 21 ft. into the river and run approximately 59 ft. along each river bank. This will leave approximately 406 sq. ft., or 51 percent, of free flow cross-sectional area.

Stages 2D and 2E (shown on Causeway Sketch Sheet 3 of 6, Appendix E) are similar in that they extend out from each side of the bank for approximately 10 ft. in the water. These temporary stages are necessary to drill the shafts for the proposed bents. Each is expected to be in place approximately five weeks before removal. Stage 2E is located on the east river bank and is 65.4 ft. in causeway length. Stage 2D is located on the west river bank and is 65.3 ft. in causeway length. Once the existing eastbound bridge is removed and the Stage 2 construction is complete, Stage 3 will begin.

During Stage 3A (Causeway Sketch, Sheet 4 of 6, Appendix E), approximately 96 ft. of causeway will be constructed along the western bank of the river, downstream of the section constructed during Stages 1A and 2A, and will extend 62.5 ft. into the river. As Stage 3A is added to Stages 1A and 2A on the west bank, another portion of Stage 1A will be removed from the east bank. This will decrease the length of the east bank Stage 1A causeway to approximately 207 ft. A temporary layer of rock will be left behind to protect the riverbank from scour until construction is complete.

Causeway Stages 3B and 3C are necessary to demolish the existing westbound bridge. Stages 3B and 3C are expected to be constructed, used for demolition, and removed over a three-week period (approximate). Stage 3B and Stage 3C will not occur at the same time. Stages 3B and 3C causeways will extend approximately 21 ft. into the river and run approximately 59 ft. along the east river bank. This will leave approximately 406 sq. ft., or 51 percent, of free flow cross-sectional area, while Stages 3B and 3C are in place.

Stages 3D and 3E are temporary stages necessary to drill the shafts for the bridge bents. These stages are expected to be in place approximately nine weeks each before removal. Stage 3D will be constructed on the west bank causeway and Stage 3E will be constructed on the east bank causeway (shown on Causeway Sketch, Sheet 5 of 6, Appendix E). Both Stage 3D and 3E will extend approximately 10 ft. into the water for a length of approximately 126 ft. While Stages 3D and 3E are in place, the free flow cross-sectional area of the river will be 435 sq. ft., or 54 percent.

As bridge work continues, the Stage 1A causeway on the east bank will be removed in its entirety (Causeway Sketch, Sheet 6 of 6, Appendix E). On the west bank, near End Bent 2, Stages 2A and 3A will be removed. Stage 1A will be partially removed, leaving 91.5 ft. of causeway along the river bank. From this causeway an extension will slope down into the water that is approximately 38.8 ft. long and 36 ft. wide. This will lead to the Stage 4 causeway, located in the center of the river, which runs for approximately 225.3 ft. parallel to the riverbanks and is 26 ft. wide. This ‘L’-shaped extension will be necessary to remove the bents of the existing bridge from the center of the river; it will be in place approximately four weeks. While this final Stage 4 is in place, the free flow cross-sectional area will be approximately 67 percent.

The area of the causeway along the east bank, near End Bent 1, will be approximately 11,800 sq. ft. (Stage 1A) at its largest size, without the temporary extensions. The east bank causeway will be expanded between approximately 440 and 1,100 sq. ft. (approximate) with short-term extensions to construct the new Interior Bent 1 and to remove the existing bents.

The area of the causeway along the west bank, near End Bent 2, will be approximately 14,800 sq. ft. (Stages 1A, 2A, and 3A). The west bank causeway will be expanded between 440 and 1,100 sq. ft. (approximate) with short-term extensions to construct the new Interior Bent 2 and to remove the existing bents.

During Stage 4, when the east bank causeway is completely removed, the west bank causeway will be reduced along the riverbank and extend out into the river to remove the center bents. This causeway will be approximately 10,020 sq. ft. The largest causeway combination at any one time will be approximately 0.57 ac. The total riverbed footprint for all the causeways combined will be approximately 1.01 ac.

The total time for which causeways will be in place will be approximately 186 weeks (see Appendix E for causeway staging diagrams). The proposed causeway construction and phasing will allow free flow of 138 ft., or a cross-sectional free flow area of 58 percent under "normal" construction conditions (Stages 1A, 2A, 3A). The design of the causeways has been refined to maximize the free flow area of the river at all times.

The proposed bridge installation and demolition over the French Broad River will occur in four stages in conjunction with the causeway stages. They are detailed in Appendix E. Language outlining the staged construction will be included in the construction contract. Once the center bents are demolished, all remaining causeways will be removed, including causeway material left along the riverbank for temporary protection. Access roads will also be removed.

Any mussels present in the riverbed where causeway fill is to be placed will be buried. Mussels could also be buried if causeway material washes downstream during high flow events. It is not practicable to determine the exact number of individual mussels that will be affected by causeway construction. If they are present in the bridge construction area, the number is expected to be low, given the rarity of Appalachian elktoe within the French Broad River and given the substrate type (mostly bedrock). Host fish carrying glochidia may be temporarily disrupted when causeway construction begins, but may be able to swim away if they are not trapped by the causeway material. Although the loss of habitat from the causeways is temporary (anticipated to last 186 weeks), the causeways could have long-lasting effects on the Appalachian elktoe's re-colonization of the habitat if there are areas of riverbed that are substantially disrupted during the removal of the causeways. Since much of the riverbed is bedrock, substantial compaction of the substrate is unlikely, thus, long-term adverse effects to habitat suitability are anticipated to be minimal. The effects of the causeways on river flow, including the potential effects of riverbed scouring downstream and pooling of water upstream, are discussed in Section 6.1.6, Alteration of Flows/Channel Stability. The causeway design has been refined to allow for a maximum free flow area of the French Broad River. To ensure bridge construction will not result in substantial changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel and bank monitoring at the I-26 bridge construction site. If monitoring reveals excessive bank erosion, bank instability, and/or sedimentation associated with the bridge replacement, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner. Other avoidance and minimization measures for the causeways are discussed in Section 7.3.

6.1.1.4 French Broad River Bridge - Demolition of Existing Structures

During demolition, each bent will be removed by either by tipping it over and removing the entire bent, or by cutting off the bent at riverbed elevation. It may be necessary to drag the bents out of the river, once they have been severed. Because the remains of each cut-off bent will be at riverbed elevation, no backfill will be needed. If the bent is on land, it will be removed to 1 ft. below ground elevation. Exposed steel will be cut off. The method of removal will be dependent on the foundation conditions present at the site. According to existing bridge plans, the structure is supported by spread footings (no piles underneath). The new structure will have bents directly adjacent to the existing bents. No loose portion of the existing bents will remain in the riverbed. To avoid potential adverse effects to Appalachian elktoe, riverbed substrate will not be used as backfill.

Every effort will be made to avoid dropping pieces of the existing bridge into the river. NCDOT shall provide USFWS with the French Broad River bridge demolition plan and allow 15 days for review prior to plan finalization. All resource agencies will be invited to review the demolition plan and will be notified prior to start of demolition so they may have a representative on site. It is not possible to predict the amount of, or if any bridge material will be dropped into the river; however, this possibility was factored into the assessment of effects. If bridge material does inadvertently go into the river, it will be removed promptly. Any mussels or host fish present may be crushed by toppling or dragging a bent. Given the rarity of Appalachian elktoe within the French Broad River, the chance of an individual occurring within the demolition area is low.

6.1.1.5 French Broad River Bridge – Construction Drilling

With ten shafts per bent, the bridge footings will require approximately 70 days of drilling at each of the two interior bents, assuming the substrate is mostly rock (Cameron Cochran, NCDOT Division 13 Regional Bridge Construction Engineer, personal communication). Drilling will be conducted in three different phases separated by significant periods of time. Each phase will require additional time for set-up and pouring the bent. Each drill shaft will be roughly 40 ft. deep and approximately five ft. in diameter, for a total of approximately 400 sq. ft. (for both bents). There is potential for individual mussels to occur within the location of the bents; any that are present will be lost. See Section 6.2.1, Post-construction Alteration of Flows/Channel Stability, for further discussion of the bents. Drilling noise may adversely affect mussels or host fish in the vicinity; see Sections 6.1.2 and 6.1.4 for more information.

The drilling fluid will be a mixture of bentonite (a natural, inert clay material) and river water, the majority of which is recycled. When constructing drilled piers, a containment system will be developed so that substrate material does not enter the river and affect Appalachian elktoe by impairing water quality. The drilled core is typically pulled out by crane.

6.1.1.6 French Broad River Bridge Access Roads

Based on the proximity of wetlands and streams adjacent to the existing roadway, terrain, and right-of-way restrictions, temporary access roads to the causeways for construction and demolition of the bridge are necessary for transporting materials and construction equipment to the bridge worksite. Access road locations are illustrated in Appendix E. The access roads will be built parallel to I-26, one in each quadrant. The access roads will require approximately 3.75 acres beyond the current slope stake limits for the project. This area will be cleared of trees and other vegetation; however, most of the area would need to be cleared as part of the typical construction process for this project regardless of the need for access roads.

The temporary access roads, if not maintained properly, could transport sediment into the river until disturbed slopes become stabilized with riprap, matting, or other measures. Since the roads

slope down toward the river, they could channel sediment directly into Appalachian elktoe habitat. The potential effects to water quality from sediment will be temporary, but adverse effects to Appalachian elktoe habitat could be long-lasting if riverbed habitat became covered with sediment. The access road design will use DSSW to address sediment and erosion control. The proposed access roads parallel to I-26 westbound in the northeast and southeast quadrants are within 10 and 30 feet of jurisdictional streams SFG and SEE. These streams require a 50-foot buffer zone according to NCDOT policy. However, the proposed access roads at the southeast and northeast quadrants are within 30 and 10 ft., respectively, of streams SEE and SFG, which does not allow enough room for a buffer. Therefore, to avoid sedimentation and erosion of the streams NCDOT shall temporarily pipe approximately 106.3 ft. of stream SEE and approximately 662.3 ft. of stream SFG during bridge construction and demolition. These temporary pipes will be removed once the bridge construction and demolition are complete and the pipe is removed.

The access roads will be placed in each quadrant of I-26 and the French Broad River. The roads will tie to the temporary construction causeways located on the corresponding side of the river. The size of access roads and construction staging areas will be minimized wherever possible. The access roads and construction staging areas will be established from the start of the project and designed with erosion-control measures. Temporary retaining walls will be used on the outer edges of the access roads to reduce effects to adjacent land and jurisdictional features.

As mentioned above, NCDOT has committed to using DSSW for the access roads, which will reduce the potential for adverse effects to Appalachian elktoe; however, sediment and erosion effects cannot be entirely eliminated. Numerous factors influence the extent and magnitude of these types of effects, making them difficult to quantifiably predict. As such, some level of direct sedimentation/erosion-related adverse effects are anticipated to occur as a result of project construction, which could temporarily or permanently affect mussels by smothering them or altering their habitat.

6.1.1.7 Tributaries to French Broad

The tributary streams within the Action Area are not known to be occupied by Appalachian elktoe; however, construction work and fill material in streams may cause downstream effects to the species by affecting stream stability, resulting in sedimentation/erosion that could result in temporary or permanent adverse effects in the French Broad River by altering mussel habitat or smothering mussels.

Up to 86 jurisdictional streams within the Upper French Broad River subbasin will be affected by the project, not counting the French Broad River itself, assuming all streams within a 25-ft. buffer of the slope stake limits will be affected (see Table 15). Without the 25-ft. buffer, 15 fewer streams will be affected. Twenty-six (26) French Broad River tributaries affected by the project are directly crossed by I-26. With the exception of the bridges at Clear Creek and Cane Creek, all the tributaries have been crossed using some type of culvert or pipe structure. No new permanent culverts will be added as part of the project, although at least four streams will have supplemental pipes added, based on designs available at the CP4a merger meeting in October of 2017 (Appendix F). The supplemental pipes range from 0.5 to 11.6 miles from the French Broad River. Remaining culverts will only be extended. Streams SEE and SFG will be temporarily piped during bridge construction to minimize effects from two of the access roads to the French Broad River. Detailed hydraulic designs for affected streams have not been developed yet, although hydraulic structure modifications at 12 of the larger tributaries are presented in Table 1 of Appendix F.

The I-26 bridges over Clear Creek and Cane Creek will be replaced, which may cause temporary turbidity in their respective streams. With sufficient erosion control measures, the work is not

anticipated to substantially affect habitat occupied by Appalachian elktoe, given how far they are from occupied habitat (6.3 mi. and 1.0 mi. respectively). No causeways will be needed for either bridge replacement; no bents are currently in the water and no bents will be placed in the water for the new bridges.

Culverts can initiate channel erosion when the outlet end is above the streambed (perched culvert) creating a waterfall that can lead to bed scouring and bank erosion as well as acting as a barrier to fish migration. The potential for these types of effects will be taken into consideration when extending the structures at each crossing. With proper installation, the lengthened crossing structures are not anticipated to result in substantial degradation of the stream channels, beyond the effects of the structures currently in place.

Although the Proposed Avoidance/Minimization Measures discussed below (Section 7.0) will help reduce effects to Appalachian elktoe habitat, there is still the potential for temporary effects from erosion and sedimentation during construction. Effects from sedimentation are expected to be temporary, while construction is underway, but excessive sediment could permanently cover areas of habitat. The closer a stream is to the French Broad River, the greater the potential for effects to occupied habitat. Effects to French Broad River tributaries total 18,238.6 linear ft., based on 2:1 slope stake limits plus a 25-ft. buffer (Table 6 of Appendix F). Without the 25-ft. buffer, effects will be 6,153.6 linear ft. Affected streams range in distance from immediately adjacent to the French Broad River to several miles away. NCDOT will use Design Standards in Sensitive Watersheds and will demark Environmentally Sensitive Areas to minimize erosion and sedimentation (see Section 7.3.1).

The replacement of the Blue Ridge Parkway bridge over I-26 will require one or two access roads to be installed on the south side of the Parkway to facilitate hauling of materials between the Parkway and the Interstate. The access roads will be over 1000 ft. away from Appalachian elktoe habitat in the French Broad River and will not affect any jurisdictional streams or wetlands. In addition, the land between the Parkway and the French Broad River is heavily wooded, which should prevent any erosion from reaching the French Broad River. As such, no effects are anticipated to Appalachian elktoe habitat as a result of the Blue Ridge Parkway bridge replacement.

6.1.2 Fish Host Effects

There is the potential for fish infested with Appalachian elktoe glochidia to be present in streams while highway crossing structures are being constructed or modified. Lethal and sub-lethal effects to these fish from construction would, in turn, affect the attached mussel glochidia.

6.1.2.1 Physical Effects

Mortality of individual fish can occur during construction in a variety of ways. Individuals can be crushed while shafts are drilled for bridge footings or causeway placement. Demersal species like darters are inherently more susceptible to this type of injury than pelagic species like shiners, as they have an affinity to the stream bottom and seek cover within the substrate when threatened. Shiners occur more in the water column and would swim away from the impact area. Most potential fish host species identified for the Appalachian elktoe are demersal.

Causeway construction may also strand individuals in areas that are dewatered or force them to congregate into ponded areas where temperature and dissolved oxygen (DO) levels may affect their health and/or survival. Dispersal of host fish from the areas being affected by construction may temporarily increase their susceptibility to predation while they seek alternate habitats. The

results to glochidia may range from sub-lethal effects like physiological stress to mortality. The duration of potential effects to host fish will last through the construction phase of the project.

6.1.2.2 Acoustic Effects on Fish Hosts

Acoustic effects can also occur to fish while shafts are drilled for bridge construction and during causeway placement. Underwater sound waves emitting from these actions can cause potentially lethal tissue damage to fish. Sound generated at the drilling site may be transmitted into the water in two ways. The first is where the noise is transmitted from the drill bit-sediment interface into the surrounding substrate before becoming refracted back into the water column. The second is where vibrations travel up the drill shaft and then become transmitted into the water (Kongsberg Maritime Limited 2015).

With ten shafts per bent, the bridge footings will require approximately 70 days of drilling at each of the two interior bents, assuming the substrate is mostly rock. Pile driving for end bents will take approximately eight days per bent. Although pile-driving will take place on land, there is the potential that the sound may transfer into the river.

There are several factors that affect the level of acoustic effect, including frequency, sound pressure, acoustic impulse, and distance from source (Caltrans Office of Environmental Engineering 2001). In addition, factors such as shallow water depth, temperature gradients, soft-bottom substrate, bottom topography, and currents can cause noise levels to attenuate (Washington State Department of Transportation [WSDOT] 2017).

Anatomical and physiological traits of the fish species may also influence their susceptibility to sound effects. Fish with a close coupling between the swim bladder and the inner ear are most sensitive (WSDOT 2017). For example, shiners and other ostariophysan fishes contain a series of small bones called Weberian Ossicles that connect the auditory system to the swim bladder, whereas, darters and other species in the Neotelostei clade do not have a close swim bladder-auditory system connection.

In fish species that are hearing specialists, the gas-filled swim bladder acts as a transducer that converts noise pressure waves to vibrations, allowing the fish to detect noise and vibration. Fish species with no swim bladder, or a small one, tend to have a relatively low auditory sensitivity. Studies have shown that the level of inflation of the swim bladder greatly influenced hearing sensitivity of species with Weberian Ossicles, and had no significant effect on species without this structure (Moyle and Cech 1988).

The size of the fish also influences sensitivity to sound effects, as larger fish appear to be able to withstand a greater sound impulse than small sized fish (Caltrans Office of Environmental Engineering 2001, Yelverton et al. 1975). A further summary of the effects of acoustics on fish, including bridge construction related effects, are provided in Caltrans Office of Environmental Engineering (2001) and references contained within.

Acoustic effects may be lethal to host fish and any glochidia they may be carrying. Sub-lethal effects on host fish from acoustic effects can range from tissue damage to effects to the fish sensory system, which may affect their ability to detect predators. These could in turn affect the ability of attached glochidia to successfully transform into juveniles. Although the noise that causes these potential effects will be temporary, damage to fish tissues and/or sensory systems could be permanent. Acoustic effects associated with bridge construction are expected to take place over a three to four-year period.

To summarize, project construction has the potential to result in lethal and non-lethal effects to fish hosts and the glochidia they are carrying. Given the rarity of the Appalachian elktoe in the French Broad River and the relatively small area of potential effect compared to the large amount of potentially suitable habitat within the occupied portion of the French Broad River, adverse effects to individual fish serving as fish hosts are unlikely to occur, but cannot be discounted entirely. Any adverse effects to fish hosts are expected to be minor and are not expected to hinder the expansion of the Appalachian elktoe population in the river.

6.1.3 Disruption of Fish Host Migration

In addition to the effects of bridge and causeway construction and culvert/pipe crossings that were discussed above, another concern with construction of these structures is the potential to create barriers to fish migration. Disruption of fish migration can indirectly affect freshwater mussels if the individual fish that are disturbed serve as fish hosts for the mussel species and are infested with glochidia at the time when their migration patterns are disrupted. Temporary causeways placed in flowing waters can disrupt migration patterns of host fish by creating a physical obstruction in the streambed or by creating increased velocities from channel constriction that are too high for fish to swim through.

At the French Broad River crossing, causeways are needed for demolition of the existing structures and construction of the new bridge. The total time for which causeways will be in place is 186 weeks (approximate). With the primary causeways in place (Stages 1A, 2A and 3A), the river free flow will be constricted to 58 percent, or a cross-sectional free flow area of 462 sq. ft. out of 803 sq. ft. This will affect river velocity (see Table 3, Change in Velocity for Proposed Construction of the I-26 Bridge, Appendix E).

Because the causeways are temporary (estimated to be in place 186 weeks), they are not expected to permanently interfere with normal migration of any fish species in the French Broad River. Temporary disruptions to the normal migration of individuals of some fish species may occur while the causeways are in place. Due to an increase in river velocity, individual fish may be restricted or deterred from swimming upstream of the causeways. In addition, noise and disruptions from causeway and bridge construction (drilled shafts, pile driving) may also affect fish movements such as migration and dispersal.

The temporary restriction of individual fish from habitat upstream or downstream of the causeway and bridge construction site will not affect the existing distribution of the Appalachian elktoe, as all of the identified potential fish host species that occur in the French Broad are widely distributed throughout the river. Quantifying potential disruptions to fish host migration on glochidia transformation would be very difficult and require intensive fish sampling and examination.

Appalachian elktoe are not known to occur in tributaries affected by the I-4400/I-4700 project. Aside from Cane Creek and Clear Creek, these tributaries are considered too small to support the Appalachian elktoe. Therefore, work to lengthen culverts at I-26 crossings is not likely to affect host fish migration. Furthermore, disruption of fish host migration is not anticipated to occur at the crossings of Cane Creek and Clear Creek as the crossing structures are bridges; no causeways will be needed for either bridge replacement, no bents are currently in the water and no bents will be placed in the water for new bridge construction. Given the rarity of the Appalachian elktoe in the French Broad River, adverse effects to individual fish serving as fish hosts are unlikely to occur, but cannot be discounted entirely. Any adverse effects to fish hosts are expected to be minor and are not expected to hinder the expansion of the Appalachian elktoe population in the river.

6.1.4 Acoustic Effects on Appalachian Elktoe

The effects of anthropogenic noise on freshwater mussels have not been studied; a literature review did not provide any information on the subject. However, research has suggested potential negative consequences of anthropogenic noise on marine bivalves, which suggests noise may have implications for freshwater mussels. In a laboratory experiment conducted on blue mussels (*Mytilus edulis*), playback of ship noise caused degradation of mussel DNA, indicating a chemical response to stressful noise conditions (Kershaw 2016). Recent research found that oysters (*Magallana gigas*) close their shells in response to low-frequency sound (Charifi et al. 2017). Closed shells are an indicator of distress and could affect eating, digestion, spawning, and the ability to perceive biological clues (Quenqua 2017). Although studies have been limited to marine and estuarine species, they indicate there is the potential for anthropogenic noise to affect freshwater mussel species such as Appalachian elktoe by inducing a physiological and/or behavioral stress response. Quantifying the effect, if any, would be difficult and would depend on the level of noise exposure and duration.

6.1.5 Erosion/Sedimentation from Construction

Excessive suspended solids in the water column, sedimentation, and turbidity result in reduced biodiversity as well as a decline in productivity at all trophic levels (Gilbert 1989). The detrimental effects of erosion/sedimentation on freshwater mussels were discussed above (see General Threats to Species, Section 4.3). Because of sloping topography in the project area, ground-disturbing activities such as clearing/grubbing vegetation, grading, and extending culverts have the potential to result in sedimentation in nearby waterways and the potential to degrade habitat occupied by Appalachian elktoe.

Clearing and grubbing will likely begin immediately after the project is let for construction, and may continue for a period of up to two years. Clearing may occur at different locations at different times as work progresses along the length of the project, depending on construction timing/phasing. Clearing activities may occur during any time of year, with the exception of the Blue Ridge Parkway property, where tree clearing will only occur between August 15 and May 15 of any given year.

The amount of sedimentation/erosion that will result from land disturbance and the level to which it adversely effects Appalachian elktoe habitat in the French Broad River is difficult to predict and is dependent on several factors, such as the frequency and duration of rainfall events during construction that exceed the erosion control design devices, construction duration and adherence to proper maintenance of erosion control devices, and the promptness to respond to and remediate erosion control failures. Ambient turbidity in the French Broad River varies, so determining the degree of turbidity due to project construction would be difficult. Ambient monitoring stations on the French Broad River closest to the Action Area measured turbidity ranges from 1.5-140 NTUs (Nephelometric Turbidity Units) upstream and 1.7-190 NTUs downstream of the Action Area (NCDENR 2011). Other factors include distance to occupied habitat, slope, overland surface roughness, size of disturbance, and size of the drainage area, all of which vary across the project. Jurisdictional streams affected by the project range in distance from immediately adjacent to occupied habitat in the French Broad River to 12.2 mi. away (see Table 15). Project widening will occur mostly in the median, which has few steep slopes. The portion of the project heading to French Broad River rises approximately three percent in the mile north of the river and approximately two percent in the 1.5 mile stretch to the south of the river. The portion of the highway that runs parallel to I-26 is fairly flat, with a slight rise at the Long Shoals Road interchange. NCDOT will use DSSW and demark Environmentally Sensitive Areas to reduce the potential for sedimentation and erosion to occur from the project.

6.1.6 Alteration of Flows/Channel Stability

Geomorphically stable stream channels and banks are essential for the survival and conservation of many freshwater mussel species, including Appalachian elktoe. Stream channel instability can result from bridge construction and culvert/pipe crossings. Natural stream stability is achieved when the stream exhibits a stable dimension, pattern, and profile such that over time, the channel features are maintained, and the channel neither aggrades, nor degrades. Channel instability occurs when scour results in degradation or when sediment deposition leads to aggradation (Rosgen 1996). The placement of fill, such as bridge piers, culverts, pipes, and causeways, into streams can alter the normal flow pattern of a water body by reducing flow velocities upstream and increasing sedimentation and flow velocities downstream, resulting in scour and erosion.

Effects to mussels in tributaries to the French Broad River from the alteration of flow or channel stability are not expected, since most crossings will only consist of culvert extensions, and Appalachian elktoe are not known to occur in any tributaries in the Action Area. Adverse effects to French Broad tributaries have potential to affect Appalachian elktoe habitat however, depending on the amount of scour and resulting sedimentation and the distance the sediment travels downstream to habitat in the French Broad River, where mussels or their habitat could become smothered. The potential for this effect will continue until the affected stream becomes stabilized. The degree of this potential effect will vary, depending on the amount of stream disturbance and the distance to the French Broad River.

The initial construction of a bridge is known to cause changes in the flow of the river and corresponding erosive processes that can alter the adjacent habitat. Adding and removing interior bents will likely cause minor local scour on the riverbed until a state of equilibrium is reached. The design of the bridge crossing at the French Broad River was developed to minimize the number of in-stream bents; only two will be used. Given the prevalence of bedrock at the bridge crossing, the degree of riverbed scouring is expected to be minimal.

Causeways to be used at the French Broad River bridge construction site were designed to result in the least amount of fill in the river as possible. Causeway construction will be phased, which will limit the amount of causeway in the river at any one time. The effects of increased velocities on channel stability are expected to last while causeways are in place, reverting to normal conditions once the causeways are removed. Table 16 summarizes the width of free-flowing river, the remaining percent of total river width, cross-sectional free-flow area, and the duration of each causeway phase.

Table 16. Summary of Causeway Construction Stages

Stage	Duration (weeks)	Water Surface Elevation[1]	River Free Flow	River Free Flow (Cross Section)		Sketch Sheet No. (Appendix E)
			Distance (ft)[2]	Area (ft)[2]	Percent	
Existing	n/a		253	803	100	n/a
1A, 2A, 3A	130[3]	1994.01	138	462	58	1, 2, 4
1B[4]	6	1994.03	128	435	54	1
1C	6	1994.03	128	435	54	1
2B	3	1994.06	117	406	51	2
2C	3	1994.03	128	435	54	2
2D	5	1994.03	128	435	54	3
2E	5	1994.03	128	435	54	3
3B	3	1994.06	117	406	51	4
3C	3	1994.03	128	435	54	4

Table 16. Summary of Causeway Construction Stages

Stage	Duration (weeks)	Water Surface Elevation[1]	River Free Flow	River Free Flow (Cross Section)		Sketch Sheet No. (Appendix E)
			Distance (ft)[2]	Area (ft)[2]	Percent	
3D	9	1994.03	128	435	54	5
3E	9	1994.03	128	435	54	5
4	4	1994.11	129	534	67	6

[1]Water Surface Elevation (ft.) measured at the causeways.
[2]Distance between the two causeways, where the causeways are widest.
[3]Total time for construction is approximately 3-4 years. This duration only includes the time when Stages 1A, 2A, and 3A are in place (no extensions).
[4]The 10-foot extensions (Stages 1B, 1C, 2D, 2E, 3D, and 3E) may occur at the same time, at the contractor's discretion.

The hydraulic effects of placing causeways in the river were modeled using the USACE Hydrologic Engineering Center's River Analysis System (HEC-RAS). HEC-RAS models were constructed to represent conditions during mean hydraulic events and during 100-year flood events at stations along the French Broad River. The HEC-RAS models were used to determine the approximate WSE and the velocity of the river without the causeways (existing condition), with the causeways in place (Stages 1A, 2A, and 3A), and with the temporary 'L' causeway (Stage 4). Detailed results of the HEC-RAS models are shown in Appendix E.

The causeways will restrict river flow and can result in upstream pooling with an increase in WSE, depending on the size of the causeways in place at a given time and the baseline water level of the river. With the primary causeways (Stage 1A, 2A, 3A) in place during a 100-year flood, an additional increase of 10 in. of flood water would occur approximately 0.6 mile upstream. Although there is a predicted 10-in. increase of WSE, the associated decrease in flow rate (-0.46 ft./sec.) eliminates the potential for increased channel scour. While a 100-year flood event is extremely unlikely (1% chance to occur in a given year), it is anticipated that causeways will be in the river for a period of three to four years; thus, there is a 3-4% chance of a 100-year flood event during the project construction. It is not possible to predict the duration of the water level for a flood event since there are an infinite number of precipitation durations and intensities that can cause the water level to rise.

As the area under the bridge is reduced by the causeways and temporary causeway extensions, the velocity of the river water passing through the causeway opening is expected to increase. This is observed for all models at every bridge and causeway river station (RS) studied. The most notable increase in velocity, as well as the greatest velocities in general, occurs at RS 8279.2 BR D (just downstream of the causeways). An increase in WSE is observed at RS 8279.2 BR D during each construction stage for the mean flow return period (average rainfall event), while a decrease in WSE is observed for the 100-year flood event. Because this river station experiences the greatest velocities and most volatile WSEs, the area downstream of the causeways will not be disturbed any more than necessary. Monitoring for channel stability during construction will extend 100 ft. upstream and 250 ft. downstream of the causeway locations.

With the primary causeways in place (Stages 1A, 2A, 3A), an average rainfall event would cause an increase in WSE 0.02 mi. (approximately 106 ft.) upstream of the causeways (RS 8280) of approximately nine in. for most of the construction duration. This increase is less than the seasonal variation in WSE, which regularly fluctuates by more than one foot at this location on the French Broad River. Consequently, the rise in WSE created by the causeways is considered insignificant in its effect on the Appalachian elktoe and its habitat. At RS 8280, as WSE increases, the river velocity decreases. During mean hydraulic conditions, the velocity decreases less than

one foot per second, which is also considered insignificant in its effect on the mussel. Beyond this point upstream, the measurable effects to water levels and velocity are not expected to reach a level where potential "take" could result.

Increases in WSE do not result in adverse effects to mussels in and of themselves; however, the additional WSE could potentially affect mussels by slowing flow rate, which could result in increased sediment deposition, smothering mussels or their habitat. Increased velocity from the causeway constriction could result in streambed scour. Scouring could affect any mussels in the riverbed, washing them downstream and/or causing shell erosion. The effects of scouring on the riverbed may be limited, since much of it is bedrock. Higher velocities could also disrupt movement of host fish as discussed above.

Effects from the alteration of flow in the French Broad River from causeways could occur while they are in place. The primary causeways (Stages 1A, 2A, 3A) are anticipated to be in place for approximately 130 weeks, while temporary causeway extensions will be in place between three and nine weeks. The area of effect is limited to 0.02 mile (106 ft.) upstream of the causeways, the causeway footprints, and the immediate downstream vicinity of the causeways. Beyond these areas, alterations in WSE are less than seasonal variations. Since the 0.02-mi. upstream section currently consists of lower velocity habitat (pool habitat), it already experiences a higher degree of sediment deposition than downstream of the bridge. Therefore, water pooling (reduced velocity) upstream of the causeways is not expected to substantially alter the existing conditions and will not cause a noticeable effect to Appalachian elktoe. Most of the riverbed where the causeways will be placed and immediately downstream is bedrock, so adverse effects to mussels from channel instability or scour are not anticipated as a result of increased river velocity. To ensure bridge construction at the French Broad River crossing will not result in significant changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel and bank monitoring. If monitoring reveals substantial changes to channel stability associated with the bridge replacement, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner. Other avoidance and minimization measures for the causeways are discussed in Section 7.3.

6.1.7 Utilities

There is a sewer line adjacent to the French Broad River within the Action Area that is a major line for southern Asheville and must be maintained. The line is a 42-in. pipe branching to 36-in. and 24-in. sections. NCDOT will leave the line in place (no relocation), which will minimize the amount of disturbance and limit erosion along the river. Other utility lines in the Action Area are mostly limited to I-26 interchanges, as opposed to parallel services, which will also minimize disturbance along the French Broad River. Utility relocations will occur at the reconstructed I-26 rest areas, but they will be small in size and are located relatively far from the French Broad River. No effects to Appalachian elktoe or occupied habitat are anticipated as a result of utility line relocations.

Summary of construction effects: Permanent and temporary stream and river effects associated with the construction of I-4400/I-4700 may adversely affect Appalachian elktoe individuals present in the Action Area. Project construction includes a 1.01-acre temporary causeway footprint in the French Broad River and 400 square ft. of permanent fill for bridge bents, which could bury or crush mussels if they are present. There will be 18,238.6 linear ft. of permanent fill in French Broad tributaries, based on 2:1 slope stake limits plus a 25-ft. buffer. Mussels in the Action Area downriver of construction areas could be affected by sedimentation associated with construction, should it occur, but the degree of this effect would be difficult to quantify. Work associated with the replacement of the French Broad River bridge, including

access roads, causeways, and drilling for bridge bents has the greatest potential to adversely affect mussels. Given the rarity of the Appalachian elktoe in the French Broad River, adverse effects to individual mussels are unlikely to occur, but cannot be discounted entirely, since there could be juveniles or glochidia present that were undetectable during surveys, and any mussels downstream of the construction area could be harmed or killed by sediment, if they become buried. While construction activities may have future long-term effects on Appalachian elktoe's ability to colonize or recolonize riverbed areas due to substrate compaction, these effects are unlikely, or can be considered insignificant given the prevalence of bedrock in this portion of the river. Since there is an abundance of suitable habitat in the French Broad River relative to the areas affected by the project, the scope of the effect on habitat is anticipated to be relatively minimal.

6.2 Operational Effects

6.2.1 Post Construction Alteration of Flows/Channel Stability

As noted above, geomorphically stable stream channels and banks are essential for the survival and conservation of many freshwater mussel species, including Appalachian elktoe. Once construction is completed, stream channel instability can occur over time as streams adjust to the channel alterations from construction, which could eventually affect occupied habitat and/or host fish species. The constructed project road network within a watershed can be a factor affecting channel stability, as increased impervious surfaces can alter the timing and volume of peak flows by intercepting rainfall that would otherwise become subsurface water and decreasing the time for overland runoff to reach the stream channel. As a result, even though a watershed receives the same amount of precipitation, it is transported through the system much more quickly, thus resulting in higher peak discharges and resultant increases in stream power. This increased stream power can more effectively erode the streambed and banks (Castro 2003).

The preferred alternative will widen I-26 from four lanes to six lanes for roughly 13.6 mi. and to eight lanes for roughly 8.6 mi., so there will be an increase in impervious surfaces. The eight-lane widening will occur in the northern portion of the project, which is closest to the French Broad River. The eight-lane section will have an approximate increase in paved surfaces from 87.5 acres to 150.1 acres. For the portion of the six-lane widening that falls within the Upper French Broad River subbasin, paved surfaces will increase from approximately 129.4 to 184.7 acres. There will be an overall increase of 117.9 acres of pavement within the Action Area located in the Upper French Broad River subbasin due to the I-26 widening. (These calculations assume all existing and new traffic lanes will be twelve feet wide, all outside shoulders will remain twelve feet wide, and inside shoulders will be increased from six to twelve feet. Calculations do not take into account paved areas in the median, or paved areas that may be added at interchanges or rest areas.)

The increased impervious surfaces will cause an increase in stormwater runoff. It is not possible to calculate the change in stormwater runoff until project design is more complete; however, hydraulic design for the project will take the increase in stormwater into account as design work continues, in order to prevent stream instability. Increases in impervious surface can result in extremes (either high or low) in peak discharge, runoff volume, and base flow conditions (see Section 4.3.4 for more information). Increases in peak discharge (increased runoff velocities) and runoff volume cause erosion and sedimentation, which could bury mussels, their habitat, or alter habitat downstream.

The addition of stream crossing structures (bridges, culverts, pipes, etc.) can lead to channel instability. In the past, culverts have been particularly problematic. Culverts have often lead to channel instability by constricting the flow, which increases erosional forces. Historically, the

design of culverts only accounted for the passing of water, and not bed materials, sediment, or woody debris. As such, significant problems at culverts have occurred including "(1) plugging due to large wood transport, (2) sediment deposition at the inlet due to the backwater effect, and (3) high velocity flows exiting the culvert resulting in channel scour" (Castro 2003). Channel instability associated with a culvert crossing is not static, rather the instability can be far reaching and effect the channel, and in turn the aquatic community, for considerable distances both upstream and downstream, as "streams are linear systems that move mass and energy along the channel primarily in upstream/downstream directions and through the floodplain in all directions" (Castro 2003).

The post-construction influence of crossing structures on channel destabilization that could affect mussel habitat depends on the following factors:

- design of the structure
- distance of crossing structure to occupied habitat
- watershed size
- stream gradient and characteristics, i.e. presence of natural grade control (bedrock outcropping, etc.)
- low gradient pools, beaver dams or other structures that may attenuate flow velocity, and
- conditions adjacent to the structure, including degree of development and road network (impervious surfaces).

Up to 86 jurisdictional streams within the Upper French Broad River subbasin will be affected by the project. No new permanent culverts will be added, although at least four streams will receive supplemental pipes. Remaining culverts will be extended.

The effects of culverts on fish passage are well documented (Baggett et al. 2001, Moser and Terra 1999, Carey and Wagner 1996). Although culvert design incorporates measures that reduce the potential for effects, some culverts may still act as barriers to host fish species post-construction. These potential barriers to fish migration are not expected to result in adverse effects to the Appalachian elktoe because the tributaries currently do not provide habitat for the Appalachian elktoe for reasons other than the presence of culverts or pipes (stream size too small, high gradient, water quality issues, etc.). However, the presence of perched culverts could affect future expansion of the mussel into limited areas of recovering habitat via the movement of host fish carrying glochidia.

The effects of post-construction alteration of flows/stability in the French Broad River are expected to be minimal, since only two bridge bents are to be placed in the river, and much of the riverbed substrate consists of bedrock. The effects of post-construction alteration of flows in tributaries to the French Broad are expected to be minimal, since most affected streams will consist of culvert extensions and any associated alteration of flows/stability would have occurred during the initial construction and early operation of the I-26 facility. During final design for culverts, there is the potential for improvements in flow within the existing crossing structures, such as the creation of low-flow channels and remediation of perched outlets.

6.2.2 Roadway Runoff

Numerous pollutants have been identified in highway runoff, including various metals (e.g., lead, zinc, iron), sediment, pesticides, deicing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons (see Section 4.3.3, Toxic Contaminants, for details on how these pollutants effect freshwater mussels). The French Broad River already receives roadway runoff from I-26. Any mussels present may experience locally increased exposure to runoff due to the I-4400/I-4700

widening project and the resulting increase in impervious surface from the highway. Widening of existing roadways could also result in locally increased exposure to thermal pollution due to the increased impervious footprint of the highway.

The effects from roadway runoff will be long-lasting, spanning the life of the highway. There are no existing data to determine if this potential increase in pollutant exposure would pass a threshold that would adversely affect the mussels. The effects of increased exposure will be minimized by stormwater control measures to be implemented by NCDOT (see Section 7.5.1, Stormwater Control Measures). NCDOT recognizes that the Appalachian elktoe is sensitive to excessive amounts of silt, nutrients, and heavy metals. Therefore, the Department shall commit to using a hierarchical BMP selection process for stormwater treatment, which is optimized to treat silt, nutrients and heavy metals. Furthermore, the elimination of deck drains on the new bridge structures, including the French Broad River crossing, will lessen the potential effect and may even result in an overall net benefit (see Section 6.5).

6.2.3 Toxic Spills

Roadway construction can also affect the aquatic environment by increasing the potential for toxic spills from vehicular accidents once the facility is in operation. As evidenced from the Clinch River in Virginia (Section 4.3.3), toxic spills resulting from traffic accidents can be devastating to mussel populations. The type (i.e. commercial truck, etc.) and volume of traffic affect the potential for toxic spills to occur. The location where there is the highest potential for hazardous spills to affect Appalachian elktoe is at the crossing of I-26 over the French Broad River, although any spill within the watershed has the potential to affect the species. The Texas Department of Transportation and the FHWA commissioned a study that evaluated roadway hazardous material spill incidents associated with transportation on Texas highways. The study found that between 2002–2006, more than 900 hazardous material spills of varying volumes were recorded in the state, and it was speculated that rainy/wet roadway conditions may be a factor in the frequency of spills. The results were used to develop design guidelines and parameters to reduce the risk of exposure to travelers and individuals responsible for spill cleanup (Thompson et al. 2011).

There is no way to accurately predict where and when toxic spills associated with the facility will occur; such an event could occur during the lifetime of the facility. According to the US Department of Transportation, there were 391 reported transportation related incidents involving hazardous materials in North Carolina in 2017 (USDOT 2017). For more information about the effect of toxins on mussels, see Section 4.3.3. It is difficult to predict the magnitude of the effects to Appalachian elktoe if such a spill were to occur along the facility due to the following variables: actual presence of Appalachian elktoe in the vicinity of the spill, the toxicity of the contaminants, the amount spilled, and the quantity of river flow. The elimination of deck drains on all project bridges (Section 6.5, Beneficial Effects) will lessen the potential of adverse effects associated with toxic spills. Appalachian elktoe are already at-risk from potential toxic spills along I-26, but if traffic increases post-project due to reduced travel times (NCDOT 2014c), it may increase the risk for toxic spills.

6.3 Interrelated/Interdependent Effects

6.3.1 Induced Land Development

Qualitative analyses of the probable development patterns in the FLUSA suggested that Project I-4400/I-4700 would not have a notable indirect effect on land use in the FLUSA (NCDOT 2016), so land use effects within the smaller Action Area should not be notable either. Potential land use effects as a result of the I-26 widening are somewhat tempered by the fact that the project is not expected to provide any new access or opportunities for traffic exposure to properties and will generate marginal travel time savings (NCDOT 2016).

6.3.2 Effects Associated with Borrow/Fill, Staging and Storage

The contractor may use areas within the Upper French Broad River subbasin for staging, storage, refueling, borrow pits, or spoil areas. Any of these areas that occur within the watershed of occupied habitat have the potential to result in adverse effects to Appalachian elktoe by affecting water quality from sedimentation, erosion, and introduction of toxic compounds into streams via stormwater channels, ditches, and overland runoff or from spills/leaks during the hauling process. The extent and magnitude of these effects is dependent upon distance to occupied habitat, as well as soils and topography, which influence transport of sediment and toxicants to occupied habitat.

The potential for these effects to occur can be minimized by developing measures to control sedimentation, erosion, and prevent the introduction of toxic compounds from entering streams in these areas. No state riparian buffer rules apply to the Action Area; however, Henderson County requires a 30-foot riparian buffer around all perennial streams, which should exclude borrow pits and spoil/storage areas from buffer areas, thus helping to protect water quality and, as a result, Appalachian elktoe. Staging areas for construction equipment will be confined to NCDOT right-of-way as much as possible to limit the amount of land disturbance that will occur during construction.

At this time, the locations of potential borrow/spoil sites, staging areas, equipment storage areas, and refueling areas have not been chosen. NCDOT standard guidance for borrow/fill sites provides a layer of environmental protection for waterbodies. Before they are permitted, staging sites are required to be identified by the contractor and discussed with NCDOT and USFWS, and as such will be subject to the same regulations and guidance as the rest of the project. Water quality effects associated with borrow/fill, staging and storage have the potential to occur throughout project construction, but existing regulations and the review process make it unlikely that project-related effects will occur.

6.4 Cumulative Effects

Cumulative effects are defined under the ESA as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation" (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered under these effects because they require separate consultation pursuant to Section 7 of the ESA.

The Indirect Screening Report (NCDOT 2013a), the associated update (NCDOT 2017a), and the Asheville Regional Cumulative Effects Study (NCDOT 2014c) indicate that the I-26 widening project will result in few indirect impacts and minimal cumulative effects. The majority of the activities identified in these reports will likely require federal authorization, such as a CWA 404 permit, and would therefore have their own ESA Section 7 consultation and not be considered a cumulative effect under ESA for this action. Restriction of right of way access to the existing interchanges will limit secondary development within the Action Area.

Small-scale highway or utility improvements in the Action Area could affect local water quality, which in turn could result in adverse effects to the Appalachian elktoe. Applications of pesticide along I-26 or adjacent utility lines could ultimately reach waterways and habitat occupied by Appalachian elktoe. Quantifying the degree of water quality degradation is difficult to project and will be dependent on the location of the future activities, the amount of impervious surface area associated with the activity, and any stormwater and buffer controls that are put in place.

6.5 Beneficial Effects

NCDOT makes every attempt to eliminate direct deck drainage into water bodies whenever federally protected aquatic species or sensitive habitats are present. This commitment will be incorporated into the structure design plans. Currently, drainage from the deck of the existing French Broad River crossing structures flows directly into the river. The proposed design for the bridge over the French Broad River will include shoulders sufficient to convey runoff and eliminate direct discharge into the river. The replacement bridges at Cane Creek and Clear Creek will also be designed to eliminate direct deck drainage into their respective creeks.

This may result in localized improvements to water quality, and thus have a beneficial effect on the Appalachian elktoe. The beneficial effects will be minor at the Cane Creek and Clear Creek bridges, since they are 1.0 and 6.3 mi. upstream of occupied Appalachian elktoe habitat, respectively. The effects at the French Broad River bridge will be greater than at the two creeks, since occupied habitat is immediately below the bridge. The duration of the effects will last the lifetime of each bridge, potentially several decades. If existing culverts along the project alignment are adversely affecting stream habitat, improvements such as low flow channels, and the elimination of perched outlets will be incorporated into the design of the culvert extensions as practicable.

6.6 Biological Conclusion for Appalachian Elktoe

While the Appalachian elktoe is currently rare in the French Broad River, the population appears to be expanding. The I-26 widening project, I-4400/I-4700, is expected to result in unavoidable adverse effects to Appalachian elktoe. Therefore, it is concluded that the proposed action "**May Affect, Likely to Adversely Affect**" Appalachian elktoe. The direct and indirect adverse effects from this project as well as the changes to the environmental baseline should not preclude the expansion of the Appalachian elktoe through the Action Area. Incorporation of conservation measures into the project will offset some of the effects. These measures are consistent with the recovery objectives (A-1, C-4) outlined in the recovery plan for the Appalachian elktoe (USFWS 1996) and will help further facilitate the expansion of the French Broad River population.

7.0 CONSERVATION MEASURES

The following measures are being implemented by NCDOT to avoid/minimize and offset potential effects from construction activities and roadway operation to MYGR and Appalachian elktoe. These conservation measures fall into two general categories:

1. Measures to avoid/minimize effects
2. Measures to compensate for, or partially offset anticipated effects

Some of these efforts directly benefit one species or the other, but many are beneficial to both species. These measures are summarized below and categorized per the species that may derive the most benefit from the activity. These measures have been further classified by the broad groups of activity associated with this project: road construction, bridge replacement, and road operation.

7.1 Measures to Avoid/Minimize Effects to Gray Bat during Road Construction

The following measures are proposed by NCDOT to avoid/minimize potential impacts from construction activities to MYGR.

7.1.1 Minimization of Tree Clearing

NCDOT is proposing a "best fit" design that includes widening in the median to the extent practicable. This should reduce the overall project footprint to avoid and minimize impacts to forested areas, thereby potentially reducing impacts to riparian habitat utilized by MYGR for foraging and commuting. NCDOT reduced project cut/fill slopes from the standard 4:1 to 2:1, which reduced impacts to jurisdictional streams and wetlands, and associated riparian habitats. Specific minimization measures are outlined in the meeting summary included as Appendix F.

From north of the French Broad River south to the Blue Ridge Parkway, the I-26 corridor is remarkable in the amount of contiguous forest adjacent to the interstate, including a large forested median. This habitat provides a sound and light barrier from interstate traffic, a water quality buffer for the tributaries in the area that drain to the river, and terrestrial connectivity over the interstate for bats that may cross on the upland rather than flying directly over the river. As previously mentioned in Section 2.1.2, the use of retaining walls in this area will result in a minimal amount of tree clearing. Tree clearing between the Blue Ridge Parkway and Brevard Road (NC 191) will be minimized to every practicable extent in order to preserve as much of the mature woody vegetation as possible in this area. No trees will be cleared beyond what will be necessary to establish the permanent project footprint, to temporarily pipe streams SEE and SFG and establish associated SEC devices, and to create the access roads at the Blue Ridge Parkway.

As the project proceeds through the Merger process, NCDOT will continue to coordinate with the Merger Team to identify avoidance and minimization measures to forested areas.

7.1.2 Time of Year Restrictions for Tree Clearing on NPS Property

NCDOT has agreed to restrictions for tree clearing on or adjacent to NPS property at certain times of year and under certain conditions. Although these avoidance and minimization measure were developed for MYSO and MYSE, they may also benefit any MYGR that may utilize the forested area in this location during the summer months.

7.1.2.1 Indiana bat

As recent as September 19, 2016, the NPS and USFWS biologists conducted acoustic surveys and determined MYSO to be present in the area of potential effect on the Blue Ridge Parkway. Because the project includes construction on NPS land that might be within habitat that is suitable for MYSO, emergence and/or acoustic surveys shall be conducted prior to removal of trees if the work will be conducted between April 15 and August 15. No significant tree removal within 5 mi. of known hibernacula can occur between April 1 and November 15.

7.1.2.2 Northern long-eared bat

Because the project includes construction on NPS land that might be within habitat that is suitable for MYSE, tree clearing shall be allowed only between August 15 and May 15. In the event that any MYSE roost trees are documented within 0.25 mi. of the project area, regardless of the time of year, the NPS will seek consultation with the USFWS before work proceeds. Although this avoidance and minimization measure was developed for MYSE, it may also benefit any MYGR that may utilize the forested area in this location during the summer months.

7.1.3 Roadway Construction Lighting

Although acoustic surveys revealed that MYGR activity is relatively low in this location, NCDOT recognizes the importance of the contiguously forested area that lies south of the French Broad River crossing, as well as the portions of the project that lie closest to the river, where MYGR activity is higher. Due to MYGR activity on the landscape between April 15 and August 15, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in

active work areas closest to the French Broad River during this time. Therefore, construction-related lighting will be indirect in nature, and will not project into adjacent wooded areas or over the water surface of the river whenever practicable. This restriction will apply to locations between Brevard Road (NC 191) and Glenn Bridge Road (SR 3495) with the exceptions of the construction area associated with the access roads at the Blue Ridge Parkway and the existing brightly lit area associated with the Long Shoals Road (NC 146) interchange.

7.2 Measures to Avoid/Minimize Effects to Gray Bat during Bridge Replacement

The following measures are proposed by NCDOT to avoid/minimize potential impacts from bridge replacement activities to MYGR.

7.2.1 Night Time Construction Activities at the French Broad River

As part of its evaluation, NCDOT took into consideration the time of day when construction and demolition may take place. It was determined that some work would likely need to be completed at night. These activities include causeway construction, drilling shafts, concrete pours during hot weather, deck concrete pours from May to November, beam setting, and traffic shifts. The amount and type of lighting for all activities will be minimized to the extent possible. Furthermore, by restricting the amount of night time activities at the bridge, the amount of overall noise for the duration of the bridge construction will also be reduced. NCDOT will make the following commitments where night time construction associated with the bridge replacement is concerned:

- To minimize potential impacts to lactating females and their pups, between June 1 and August 1, NCDOT will commit to restrict the construction contractor to no more than 28 total nights of work, and no more than four consecutive nights within a two-week period.
- Lighting used for construction will be limited to whatever is necessary to maintain safety standards, and will only be directed toward active work areas.

7.2.2 Red Safety Lighting

As part of NCDOT's Communication Plan specific to the construction/demolition of the I-26 bridge over the French Broad River, NCDOT will place solar-powered, steady-state red lights on the causeways to alert river users to their locations. Generators will not be used to provide power.

7.3 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Road Construction and Bridge Replacement

Various measures have been incorporated into the project to avoid and minimize adverse effects to Appalachian elktoe by reducing impacts to the French Broad River and its tributaries.

7.3.1 Erosion Control Measures

Conservation measures associated with erosion control will benefit both Appalachian elktoe and MYGR. A SEC plan will be in place prior to any ground disturbance. A number of measures have been incorporated into NCDOT projects that occur within or upstream of water bodies that contain federally protected aquatic species. Implementation of NCDOT's Best Management Practices for the Protection of Surface Waters (BMPs) will minimize impacts to water resources during the pre-construction, construction, maintenance, and repair situations.

When projects occur in watersheds that contain protected aquatic species, NCDOT implements erosion control measures that exceed the standard BMPs, incorporating the Design Standards in Sensitive Watersheds (DSSW) [15A NCAC 04B .0124 (a) – (e)], regardless of the NCDWR stream classification:

- Uncovered areas shall be limited to a maximum total area of 20 ac.
- Erosion and sedimentation control measures shall be designed and constructed to provide protection from the runoff of the 25-year storm event, instead of a 10-year storm.
- Sediment basins will have a settling efficiency of at least 70 percent for the 40-micron (0.04mm) size soil particle transported into the basin by the runoff of a two-year storm.
- Newly constructed open channels shall be constructed with side slopes no steeper than two horizontal to one (2:1) vertical if a vegetative cover is used for stabilization. The angle for side slopes shall be sufficient to restrain accelerated erosion.
- Ground cover sufficient to restrain erosion must be provided within 15 working days or 60 calendar days following completion of construction, whichever period is shorter.

The sedimentation and erosion control plans shall adhere to the DSSW where practicable within the existing and proposed right of way for the following areas:

- From the Blue Ridge Parkway bridge to the northern terminus of the project.
- For portions of the project within 1 mi. and draining directly to streams that are identified as NCDEQ and/or NCWRC designated trout streams.
- For portions of the project within 1 mi. and draining directly to streams where aquatic threatened or endangered species are present.

Environmentally Sensitive Areas will be demarcated within the Action Area. The Environmentally Sensitive Areas will be defined by a 50-ft. buffer zone on both sides of jurisdictional streams measured from top of streambank, in which the following shall apply:

- The Contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations.
- Once grading operations begin, work shall progress in a continuous manner until complete.
- Erosion control devices shall be installed immediately following the clearing operation.
- Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment.
- Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 ft. in height measured along the slope, or greater than 2 ac. in area, whichever is less.
- All sedimentation and erosion control measures, throughout the project limits, must be cleaned out when half full of sediment, to ensure proper function of the measures.

The proposed access roads in the southeast and northeast quadrants are within 30 and 10 ft., respectively, of streams SEE and SFG (see figure for proposed access roads in Appendix E). Streams SEE and SFG have been identified as Environmentally Sensitive Areas that require special procedures be used for construction activities within a 50-foot zone on both sides of the streams measured from top of bank. However, there is insufficient space for the 50-ft. buffer, so to reduce sediment and erosion caused by the access road, NCDOT will temporarily pipe streams SEE and SFG during bridge construction and demolition. USFWS and USACE will have the opportunity to review the design of the SEC measures for streams SEE and SFG. A revegetation and stream monitoring plan shall be developed for streams SEE and SFG, to observe vegetation success and stream stability. The revegetation and stream monitoring plan shall be approved by the USACE and will commence once the bridge construction and demolition are complete and

the pipe is removed. The length of Stream SEE and SFG to be piped is approximately 106 ft. and 662 ft., respectively; it is the portion of the streams that run parallel to I-26.

Contract language regarding erosion control will include the following, or similar language as appropriate:

"The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor's operations in writing."

"In the event that the Contractor's operations are suspended in violation of the above provisions or it is determined the Contractor is not deemed to be pursuing the work in a continuous manner in accordance with his submitted and approved schedule, the sum of $1000.00 per day will be charged the Contractor for each and every calendar day that such suspension takes place. The said amount is hereby agreed upon as liquidated damages due to extra engineering and maintenance costs and due to increased public hazard resulting from a suspension of the work. Liquidated damages chargeable due to suspension of the work will be additional to any liquidated damages that may become chargeable due to failure to complete the work on time."

7.3.2 Monitoring of Effectiveness of Sediment and Erosion Control Devices

NCDOT has developed erosion control measures for the project, specifically to protect the Appalachian elktoe and its habitat, but measures to protect water quality will also benefit MYGR. Two Construction Project Inspectors, one for I-4400 and one for I-4700, will monitor SEC devices for the life of the project. Inspections of erosion control devices will be done daily for construction associated with the French Broad River bridge replacement. For the remainder of the project, the standard inspection schedule (weekly, or after a rainfall event of one-half in. or greater) will apply. The Roadside Environmental Unit of NCDOT also has Field Operations Engineers that perform compliance inspections of the erosion control devices a minimum of twice a month during the life of any project. These inspections are generally more frequent on projects within an endangered species habitat.

NCDOT will also commit to the following:

- NCDOT will install a rainfall data logger at the river to continuously monitor and record rainfall events.
- NCDOT will self-report to USFWS any sediment/erosion control device failures that result from excessive rainfall events (exceeding a 25-year storm event). The NCDOT inspector will report any failures to the Division Environmental Officer, who will contact the agency within 24 hours. If there are any failures in SEC measures, NCDOT will meet with resource agencies and work to adaptively manage SEC devices for future storm events while construction continues.

7.3.3 Agency Coordination

NCDOT will continue to identify avoidance and minimization measures to all Waters of the U.S. and ensure that major hydraulic structures associated with the project are designed and installed to minimize negative impacts to stream stability (and therefore, water quality) to the greatest extent practicable. As part of this process, NCDOT will continue to coordinate with the Merger Team to identify avoidance and minimization measures and ensure that project impacts are minimized to every practicable extent, including impacts to federally protected species.

In addition:

- NCDOT will invite representatives from USFWS, USACE, and NCWRC to the pre-construction meeting for the proposed project, as well as to all subsequent field inspections prior to construction, to insure compliance with all special project commitments.
- NCDOT will provide USFWS with the SEC plan and allow 15 days for review.
- NCDOT will provide USFWS with the French Broad River bridge demolition plan and allow 15 days for review.
- NCDOT will invite all resource agencies to review the demolition plan and will be notified prior to start of demolition so they may have a representative on site.
- NCDOT will invite USFWS and USACE to review the design of the SEC measures for streams SEE and SFG, as well as the revegetation and monitoring plan.
- NCDOT will contact USFWS if new information about MYGR is discovered, as it relates to the project.
- NCDOT will report any dead bats found on the construction sites to USFWS.

7.3.4 French Broad River Bridge Replacement

The avoidance and minimization measures associated specifically with the bridge replacement over the French Broad River are summarized below, and are discussed in greater detail in the I-26 Bridge over the French Broad River Proposed Construction and Demolition document (Appendix E). Note that the document includes a table listing avoidance and minimization measures that were developed in coordination with NCDOT, FHWA, USFWS, USACE and NCDWR. Many of these measures are discussed elsewhere in Section 7 of this Biological Assessment. The remaining measures are listed below. While many of these measures were developed specifically with Appalachian elktoe in mind, the associated benefits to MYGR should also be noted. In particular, the commitments that result in improvements to or maintenance of water quality.

- NCDOT will install temporary retaining walls on the outer edges of the access roads to reduce impacts to adjacent forested land and jurisdictional features.
- The footprint for the access roads will not extend beyond the permanent project footprint.
- Streams SEE and SFG will be temporarily piped for the duration of construction. A revegetation and monitoring plan shall be developed for streams SEE and SFG for when the project is complete and the pipe is removed. Monitoring for stream stability and vegetative success will take place for a minimum of 3 years after construction.
- Activities in the floodplain will be limited to those needed to construct the proposed bridge and remove the existing bridges.
- Causeways will be used instead of multiple work bridges which would require drilled piles and take longer to install. The use of causeways also means that work bridge support piers will not be present, thereby eliminating obstacles in the flight path of bats foraging and commuting through the work zone.
- Causeways will have 1:1 slopes to minimize their size.
- NCDOT will require the contractor to use clean rock (free of debris and pollutants) for the construction of the causeways to minimize unnecessary sediment input into the river.
- Causeway material will be removed to the extent practicable and either disposed of off-site or used in areas that require permanent stone protection after project completion. NCDOT will also require that concrete barriers (barrier rail) be placed along the

downstream edge of each causeway to limit the downstream movement of causeway material during high flow events.

- Causeway material will be added/removed as needed for each stage to minimize the causeway footprint over the length of the project.
- The Stage 4 causeway extension will be sloped to allow water to flow over the top, reducing overall impact to channel flow (Appendix E).
- To minimize disturbance to the riverbed, all readily detectible causeway material will be removed, to the extent practicable, while removing as little of the original riverbed as possible.
- Construction fabric will not be used under the causeway material, as it has a tendency to tear into tiny pieces and float downstream during removal.
- Any equipment that is placed on the causeways will be removed any time throughout a work day when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, they must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded.
- NCDOT will require the contractor to use new or steam-cleaned equipment to access causeways that are under water if these causeways are utilized for removal of existing bents in under-water conditions.
- NCDOT will commit to requiring its contractor to have clean, non-leaking equipment, diapers on-site for each causeway, and spill kits located at each causeway.
- With the exceptions noted below for the drill rig and crane, all construction equipment shall be refueled outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater) and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater), not in a Water of the U.S. Areas used for borrow or construction by-products will not be located within wetlands or the 100-year floodplain.
- When constructing drilled piers for the French Broad River bridge, a containment system will be developed so that material does not enter the river. Material by-product will be pumped out of the shaft to an upland disposal area to the extent practicable and treated through a proper stilling basin or silt bag.
- The SEC plan will be in place prior to any ground disturbance for the French Broad River bridge replacement. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- Construction of the new bridge will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river.
- The causeway design has been refined to allow for a maximum free flow area of the French Broad River. The original design provided for only a 28 percent free flow area of the river at the causeway's largest size. The design was refined and now allows a 51 percent minimum free flow area when the causeway is at its greatest extent.

- Removal of the existing bridge shall be performed so as not to allow debris to fall into the water. If debris is dropped in river, it will be immediately removed.
- The current barrier on the bridge is a one bar metal rail on concrete parapet with retrofitted guardrail. It will be replaced with concrete barrier rail, a 42-in. solid, concrete "Jersey barrier" style guard wall.

7.4 Measures to Avoid/Minimize Effects to Gray Bat during Roadway Operation

7.4.1 Minimal Additional Roadway Lighting

NCDOT has determined that minimal additional permanent lighting will be required for this project. Lighting at interchanges may be relocated, to allow for reconfiguration or expansion of the interchanges, but new lighting will only be required at the US 25 interchange and the rest areas.

7.5 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Roadway Operation

7.5.1 Stormwater Control Measures

Due to project scheduling constraints, stormwater treatment commitment language was developed prior to the development of drainage design information. Since design information was not yet available, commitments for stormwater treatment best management practices (BMPs) could not be made for specific locations at the time this BA was developed. Instead, NCDOT has developed stormwater commitment guidance, which will apply at crossings of the French Broad River and any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the river within the NCDOT right-of-way (Appendix H).

NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater BMPs to the maximum extent practical (MEP), which is consistent with the Department's NPDES Post-Construction Stormwater Program (NCDOT 2014d). The goal of the SMP is to provide long-term protection for federally-listed species that depend on the French Broad River for their survival. To demonstrate attainment of the MEP standard, NCDOT commits to the following set of guidelines for preparation of the SMP:

NCDOT recognizes that the Appalachian elktoe is sensitive to excessive amounts of silt, nutrients, and heavy metals. Therefore, when preparing the SMP, NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients and heavy metals. At each discharge location outside of the 100-year floodplain, the hydraulics engineer will evaluate the feasibility of installing either an infiltration basin or a media filter as described in NCDOT's BMP Toolbox. If one of these BMP types is a feasible option, then NCDOT commits to including it in the SMP. If an infiltration basin or a media filter is not feasible because it would either affect forested habitat for MYGR or because of site constraints (e.g. topography, high water table, etc.), then NCDOT commits to providing a description of these constraints in the SMP as supporting information for selecting a BMP. In such cases the hydraulics engineer will select another BMP type from NCDOT's Toolbox (NCDOT 2014e) that is feasible. Preference will be given to water quality swales, vegetative conveyances, vegetated filter strips, and preformed scour holes (PSHs). In flat, bottomland terrain, PSHs will be used to the maximum extent practical to eliminate outfalls by converting concentrated flow into distributed flow, thus maximizing infiltration and evapotranspiration of the runoff.

The presence of two endangered species – one terrestrial (MYGR) and one aquatic (Appalachian elktoe) – within the Action Area presents unique stormwater management challenges. Optimizing BMP selection for one species may be suboptimal or even detrimental to the other. Because of

this unique situation, NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:

- Bioswales
- Bioembankments
- Biofiltration conveyances
- Soil improvement to maximize infiltration

Because design standards have not yet been formally approved by NCDEQ for inclusion in the BMP Toolbox, the hydraulics engineer will be required to consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP.

The stormwater commitments described above will meet the need for more stringent guidance for the Environmentally Sensitive Areas. It is expected during the design phase that additional coordination and clarification of these stormwater BMPs will occur through consultation with the NCDOT Stormwater Group.

7.6 Conservation Measures to Benefit Gray Bat

The following conservation measures will be undertaken by NCDOT to benefit MYGR.

7.6.1 Monitoring for Gray Bat Return and Activity

NCDOT will perform acoustic monitoring at the French Broad River bridge beginning in early spring 2018 to try and determine the timing of increased MYGR activity at this location (presumably after the bats cease winter hibernation). This may provide valuable information about the ecology of the species in the area, and may suggest a need for an adjustment to construction moratoriums for this species on future projects.

Acoustic surveys for MYGR began at the French Broad River bridges in April 2017. Therefore, it is unknown when MYGR became active at this location earlier in the spring of that year. NCDOT deployed an acoustic detector at the French Broad River bridge on March 1, 2018 and determined that MYGR activity was first detected in mid-March. NCDOT will leave an acoustic detector in place through the fall of 2018 when MYGR activity trails off for the season. NCDOT will share this information with USFWS and NCWRC, because it should be helpful in understanding MYGR activity in construction areas for use on future projects.

NCDOT will also conduct acoustic monitoring for MYGR immediately prior to and during construction at the French Broad River bridge. Acoustic data may provide valuable information on bat activity in general, and MYGR activity, in particular, as it relates to project construction.

In order to try and determine whether MYGR avoid the active construction zone, NCDOT will investigate the use of night-vision video recordings, or other methods, in an attempt to monitor bat activity at the bridge while active night time construction is underway.

7.6.2 NCDOT-Sponsored Gray Bat Research Project

In 2017 NCDOT, with the cooperation of the USFWS and NCWRC, committed to a three year study on MYGR within the French Broad River Basin. This study will serve as a conservation measure for NCDOT projects within Divisions 13 and 14 for a limited time. NCDOT will provide $900,000 in funding to Indiana State University to conduct the research project, which will aid in the recovery and conservation of MYGR. The end goal is to gather the information needed to allow NCDOT and USFWS to enter into a programmatic consultation to cover MYGR for NCDOT

Divisions 13 and 14, as well as help to develop species specific avoidance and minimization measures. Within this study NCDOT will incorporate all data previously collected from the French Broad River watershed associated with NCDOT projects I-4400/4700 and I-2513, as well as data collected by NCWRC. Also, using the NCDOT-developed standard operating procedure for bat habitat assessments (2014f), NCDOT will collect data on the extent of bridge/culvert use in western North Carolina, defining characteristics of bat bridges and the surrounding landscape (e.g., bridge type, surrounding land use, bridge characteristics), as well as how the bridge is being used (night roost, day roost or both) and data on the timing of use by bats. This information will be merged with the existing data NCDOT has collected at more than 600 bridges from 1996-2017. This study will put radio tracking devices on MYGR to determine summer foraging habitat and distribution and locations of additional roosts, including possible winter roosts (which have not been found in North Carolina).

7.7 Conservation Measures to Benefit Appalachian Elktoe

The following conservation measures will be undertaken by NCDOT to benefit Appalachian elktoe.

7.7.1 French Broad River Conservation Funding

NCDOT will provide $500,000 in funding to the North Carolina Nongame Aquatic Projects Fund for the French Broad River Conservation Plan proposed by USFWS, which will aid in the recovery and conservation of Appalachian elktoe. The funding will be held by the NCWRC. A multi-agency/organization group of mussel species experts, including USFWS and NCDOT, will determine how to expend the funds.

The French Broad River Conservation Plan proposes to improve aquatic habitat and diversity and to mitigate risks in the French Broad River. It may include the following:

- Species Reintroduction: Developing a normal cohort of companion species will benefit long-term Appalachian elktoe recruitment and survival; mussel species are healthier in dense multi-species mussel beds (Vaughn et al 2008).
- Early Warning and Emergency Capacity: A monitoring network and propagation facility devoted to species introduction pairs an early warning system with emergency production capacity to immediately mitigate unforeseen effects to the Appalachian elktoe population should the need arise.
- Genetic Management Program: A study of the genetic health/potential genetic drift of the population will provide feedback to the previous two program aspects and will fine tune management of Appalachian elktoe.
- Miscellaneous: Other projects could include development of technologies such as the use of passive integrated transponder (PIT) tags to passively locate mussels; radio tracking equipment to study movement of mussels during high flow events; development of techniques to artificially stabilize habitat for the placement of propagated mussels; and/or a cost-benefit study of watershed improvement options.

7.7.2 French Broad River Geomorphology Monitoring

To ensure bridge construction at the French Broad River crossing will not result in substantial changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel and bank monitoring at the I-26 bridge construction site. The goal is to document the morphological condition at the French Broad River bridge site and to evaluate the impacts of construction and temporary causeways on river habitat.

Monitoring will consist of surveying the French Broad River channel bathymetry and riverbanks before and during the construction of the I-26 crossing (approximately 3.5 years). Mapping will occur before construction and then every quarter during construction, with one final survey after the causeways are all removed. Monitoring will cover at least 100 ft. upstream and 250 ft. downstream of the causeway locations. The river bank survey could be performed using LIDAR mapping and the bathymetric survey via sonar (remote controlled or from a boat). Methods may vary dependent on river levels. The work may require procuring a platform to collect bathymetric data.

The survey will provide a complete digital terrain model (DTM) of the stream bed and banks from each survey conducted. Cross sections can be produced at any interval as needed, but the DTM will be more accurate with little to no gaps in data. NCDOT will retain an experienced firm or staff members to analyze the DTM and compile a final report to be submitted to USFWS.

7.7.2.1 Conditions Surveys

Mapping of Channel Bed Topography: the DTM survey of the stream channel bed will be conducted 100 ft. upstream and 250 ft. downstream of the footprint of the temporary causeways, including the area underneath the bridge. Special attention will be given to any scour areas that may result from bridge supports. The surveys will collect points from left top of bank to right top of bank and will map the locations of bridge supports. The survey will be conducted such that an accurate three-dimensional representation of the stream bed can be produced from the collected data. The DTM can produce cross sectional representation every 20 ft. Photos or videos will be taken of stream banks, streambed, and bridge structures to visually document the condition of the sites.

7.7.2.2 Data Reporting

The survey information collected above will be processed into graphs and base mapping. The graphs and maps produced will be included in the Appendix of the report, described below. NCDOT and resource agencies will be supplied with electronic copies of all data. Survey data will be provided in MicroStation format.

A summary report will be provided to NCDOT and the resource agencies describing the purpose of the project, methodology used in collecting the data, and hard copies of graphs and mapping that are produced from the surveys.

If monitoring at the French Broad River reveals excessive bank erosion, bank instability, and sedimentation associated with the bridge replacement, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner.

7.8 Conservation Measures to Benefit Gray Bat and Appalachian Elktoe

The following conservation measures will be undertaken by NCDOT to partially offset unavoidable project related effects to MYGR and Appalachian elktoe.

7.8.1 Reforestation and Monitoring Plan

As previously discussed, forested areas provide cover for commuting MYGR. Furthermore, the role forested riparian buffers play in protecting aquatic habitats is well documented (NCWRC 2002 and references therein). Riparian buffers provide many functions including pollutant reduction and filtration, a primary source of carbon for the aquatic food web, stream channel stability, and maintenance of water and air temperatures. Therefore, preservation or replacement of forested areas will benefit both MYGR and Appalachian elktoe.

Coordination between the NCDOT, NPS, and FHWA will continue during the design and construction of the project to minimize impacts to Blue Ridge Parkway operations and visitor experience as well as the Mountains-to-Sea Trail. These agencies, as well as the North Carolina State Historic Preservation Office (SHPO) signed a memorandum of agreement that requires the Eastern Federal Lands Highway Division (EFLHD) of FHWA to develop a re-vegetation/landscaping plan to re-establish native vegetation and provide for a continuous visual experience for the trail and Blue Ridge Parkway user.

For the portion of the project from the Blue Ridge Parkway overpass to the northern terminus of the project, NCDOT will develop a revegetation plan that incorporates native woody and/or shrubby vegetation, as appropriate, for areas outside of the final slope stake limits disturbed during construction. The revegetation areas will be visually monitored following planting by NCDOT. The monitoring shall be conducted annually for a minimum of three years after final planting. Photo documentation shall be utilized to document the success of the vegetation and a report shall be submitted to the USFWS within sixty (60 days) post monitoring.

The revegetation shall include some or all of the following proposed species:

- White oak (*Quercus alba*)
- Yellow poplar (*Liriodendron tulipifera*)
- American sycamore (*Platanus occidentalis*)
- River birch (*Betula nigra*)
- Tag alder (*Alnus serrulata*)
- Black willow (*Salix nigra*)

Plantings associated with the rest area will include re-establishment of vegetative buffers, and the development of site landscaping that will include landscape trees (1:1 in-kind replacement with native species), turf, and recreational/sitting areas (for the traveling public). Once the facility is complete, it will have continued maintenance to monitor the sustained growth of the vegetative buffers, and matured development of the landscape.

Streams SEE and SFG will be temporarily piped for the duration of construction. USFWS and USACE will have the opportunity to review the design of the SEC measures associated with streams SEE and SFG. A revegetation and monitoring plan shall be developed for Streams SEE and SFG to commence once the bridge construction and demolition are complete and the temporary pipes are removed, which will likely be similar to the structure presented above for the area between the Blue Ridge Parkway overpass and the northern terminus of the project.

8.0 OTHER FEDERALLY LISTED SPECIES WITHIN THE ACTION AREA

In addition to MYGR and Appalachian elktoe, three additional species are known or assumed to be present in the Action Area: bog turtle, MYSE, and MYSO. Brief descriptions of characteristics and habitat requirements for each of these listed species are provided below, along with a Biological Conclusion concerning potential impacts to each species from the proposed action. Any necessary surveys for these species were completed per USFWS guidance. Biological Conclusions of “May Affect-Not Likely to Adversely Affect” are given for these species.

8.1 Bog Turtle

Status: Threatened Due to Similarity of Appearance
Family: Emydidae
Listed: November 4, 1997
Critical Habitat: None designated

8.1.1 Species Characteristics

The bog turtle is one of the smallest turtles in North America, rarely exceeding 4 in. in length and weighing only about 4 oz. The orange to yellow patch on either side of the neck, against a dark brown or ebony skin and carapace color easily distinguishes it from other turtles (USFWS 2001a).

8.1.2 Distribution and Habitat Requirements

Bog turtles inhabit slow, shallow, muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps, all with saturated, muddy substrates and open canopies. Sedges, rushes, herbs, and small shrubs like blueberry and tag alder are common. Mosses and carnivorous plants may also be present. The turtles depend on a mosaic of microhabitats for foraging, nesting, basking, hibernation, and shelter (USFWS 2000). Beaver, deer, and cattle may be instrumental in maintaining the essential open-canopy wetlands (USFWS 2001a, USFWS 2011a).

8.1.3 General Threats to Species

There are two major threats to the species' continued existence: habitat loss due to the draining and filling of wetlands for farming and development, including housing, roads, and golf courses, and the illegal collection of wild bog turtles for the pet trade (USFWS 2011a).

8.1.4 Presence in Action Area

The southern population of Bog turtle is listed as Threatened due to similarity of appearance with the northern bog turtle population. This listing was put in place to help protect the northern population without probations to the southern population. The southern population of the species is not subject to section seven consultations requirements under the Endangered Species Act.

8.1.5 Conclusion of Effects – Bog Turtle

No conclusion of effects is required for this species.

8.2 Indiana Bat

Status: Endangered
Family: Vespertilionidae
Listed: March 11, 1967
Critical Habitat: None within Action Area

8.2.1 Species Characteristics

MYSO is a small flying mammal less than 2 in. long with a wingspan of 9 to 11 in. wide. It weighs about 9.3 g and has fur that is brownish to grayish black above and buff to light brown below. MYSO feeds only on insects, including moths, beetles, flies, bees, wasps, flying ants, and mosquitos. It hibernates from October to April in large, dense clusters of up to several thousand individuals and requires caves and mines with stable temperatures between 38°F and 43°F and high relative humidity. After emerging from hibernation, the bats migrate to their summer roosting and feeding areas in eastern woodlands. A few individuals have been found under bridges and

old buildings, and several maternity colonies have been found under loose bark and in the hollows of trees. (USFWS 2007, Harvey et al. 1999).

8.2.2 Distribution and Habitat Requirements

The range of MYSO centers on cavernous limestone regions in the eastern United States. MYSO have different summer and winter habitat requirements. Winter habitat is in caves and abandoned mines that usually have standing water on the floor. The bats migrate to the winter habitat between September and November; they stay there with occasional periods of activity until they emerge in mid-March to early May. Hibernation only occurs in regions where winter temperatures are stable and around 40 degrees Fahrenheit. Suitable summer habitat includes roosting, foraging, and commuting areas. Summer roosting habitat includes forests and woodlots containing potential roost trees, which have exfoliating bark, cracks, or crevices in trees (alive or dying) or snags that are greater than 3 in. diameter-at-breast height (dbh). Roosting habitat may contain dense or loose aggregates of trees with variable amounts of canopy closure. (While any tree greater than 3 in. dbh has the potential to be MYSO summer roosting habitat, solid stands of 3 in. dbh and smaller trees are not considered suitable roosting habitat; suitable roosting habitat would generally consist of forest patches with larger trees also present.) Bridges are occasionally used for roosting by MYSO in the summer (USFWS 2007).

Foraging habitat consists of forested patches, wooded riparian corridors, and natural vegetation adjacent to these areas. Commuting habitat includes wooded tracts, tree-lines, wooded hedgerows, streams or other such pathways that are within or connected to roosting or foraging areas. Streams that have been stripped of their riparian vegetation do not appear to offer suitable foraging habitat. Rivers as foraging areas and as migration routes are extremely important to this species (USFWS 2007).

8.2.3 General Threats to Species

Threats to the species include destruction or degradation of summer and winter habitat, overutilization for commercial, recreational, scientific, or educational purposes, disease, predation and other negative anthropogenic effects (USFWS 2007).

8.2.4 Presence in Action Area

During the process of vetting matching *Myotis* calls for the acoustic survey report associated with this project, none of the high-quality calls examined had call characteristics consistent with MYSO.

No MYSO roost tree surveys or mist-netting surveys were conducted for this project. Structure checks were performed for all bridges and large culverts within the Action Area, and no evidence of bat use was found on any structures that are expected to be included in construction activities. All mines within 3 mi. of the proposed project are either known or presumed to be surface mines, and no caves or mines were observed during site visits. Furthermore, a small rock outcrop was also investigated and did not provide adequate roosting habitat for MYSO (too shady, shallow and damp) (Appendix C).

Personnel from NPS conducted acoustic surveys for bats during September 2016 and recorded what they believe to be MYSO on Blue Ridge Parkway property near I-26. However, in a letter dated November 2, 2017, USFWS stated their position that these surveys are inconclusive for MYSO. Therefore, the species does not appear on the list of protected species for Buncombe and Henderson Counties. Forested habitat which could be used for foraging is present in the Action Area, and the species is assumed to be present on Parkway property within the Action Area.

A review of NCNHP records, updated July 2018, indicates the nearest MYSO roost tree record at a location approximately 22 mi. west of the Action Area (EO ID 27984, last observed in 2008) in Haywood County, NC, and represents multiple roosting individuals. The closest mist net record (EO ID 28682, last observed in 2005) is from a location approximately 60 mi. west of the Action Area in Graham County, NC, and represents two captured females. The nearest MYSO hibernacula (EO ID 17770) is recorded approximately 11 mi. east of the Action Area in Rutherford County, NC and represents multiple observations from 1980 to 1995.

8.2.5 Conclusion of Effects – Indiana Bat

The majority of the proposed road widening will occur within existing NCDOT right of way, and will mainly occur in the existing median. With the exception of a bifurcated section of the interstate between the Blue Ridge Parkway and the French Broad River, the median contains no woody vegetation. Clearing in this area will be limited due to the presence of a jurisdictional stream (labelled SDX in the 2014 NCDOT Natural Resources Technical Report). Areas outside the existing right of way that may require clearing are limited to existing interchanges, which are already cleared of most woody vegetation and tend to be urbanized.

Although no MYSO roost tree surveys were conducted for this project, it is highly unlikely that MYSO would choose to roost in trees within this wooded area, or in any wooded areas immediately adjacent to the interstate due to elevated levels of disturbance caused by light and noise from passing vehicles.

Due to the fact that some tree clearing will be necessary on Parkway property, and NPS believes MYSO to be present on Parkway property based on their acoustic surveys, the NPS prefers to exercise caution and assume presence of MYSO on Parkway property. Therefore, NCDOT has agreed that emergence and/or acoustic surveys shall be conducted prior to removal of trees if the work is conducted between April 15 and August 15. Furthermore, no significant tree removal within 5 mi. of known hibernacula, should any be discovered within that radius, will occur between April 1 and November 15. This project commitment is described in Section 7.1.2.

The project is not anticipated to have direct or indirect effects to MYSO. Therefore, it has been determined that the project "May Affect, Not Likely to Adversely Affect" this species based on discountable effects. However, USFWS is not requiring consultation for this species for this project.

8.3 Northern Long-eared Bat

Status: Threatened
Family: Vespertilionidae
Listed: May 4, 2015
Critical Habitat: None Designated

8.3.1 Species Characteristics

MYSE is a medium-sized bat with an average adult body weight of 5 to 8 g, and an average body length of nearly 4 in. Fur can be medium to dark brown dorsally, with lighter brown fur ventrally. Ears, tail, and wing membrane are all dark brown. As the common name implies, this species can be distinguished from other Myotids by its characteristically long ears, which extend beyond the tip of the nose when pressed forward (USFWS 2015a).

8.3.2 Distribution and Habitat Requirements

In North Carolina, the MYSE occurs in the mountains, with scattered records in the Piedmont and coastal plain. In western North Carolina, MYSE spend winter hibernating in caves and mines. Since this species is not known to be a long-distance migrant, and caves and subterranean mines are extremely rare in eastern North Carolina, it is uncertain whether or where MYSE hibernate in eastern North Carolina. During the summer, MYSE roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees (typically ≥3 in. dbh). Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat also has been found, rarely, roosting in structures like barns and sheds, under eaves of buildings, behind window shutters, in bridges, and in bat houses. Foraging occurs on forested hillsides and ridges, and occasionally over forest clearings, over water, and along tree-lined corridors. Mature forests may be an important habitat type for foraging (USFWS 2015a).

8.3.3 General Threats to Species

The biggest threat to the species is the infectious wildlife disease known as white-nose syndrome. There are other factors that cause mortality and harm to the northern long-eared bat and these include: wind energy development, habitat destruction or disturbance (e.g., vandalism to hibernacula, roost tree removal), and contaminants (USFWS 2015a).

8.3.4 Presence in Action Area

Forested habitat which could be used for roosting or foraging is present in the Action Area, and the species is assumed to be present.

No mist-netting or acoustic surveys were conducted specifically for MYSE. Structure checks were performed for all bridges and large culverts within the Action Area, and no evidence of bat use was found on any structures that are expected to be included in construction activities. All mines within 3 mi. of the proposed project are either known or presumed to be surface mines, and no caves or mines were observed during site visits. Furthermore, a small rock outcrop was also investigated and did not provide adequate roosting habitat for MYSE (too shady and damp) (Appendix C).

A review of NCNHP records, updated July 2018 and viewed August 10, 2018, indicates that the nearest MYSE hibernacula record is 11.5 mi. away (EO ID 32137) and represents the Bat Site Preserve with multiple observations from 1980 to 2014. No known MYSE roost trees occur within 150 ft. of the project area. The nearest mist net record (EO ID 34294) is from a location approximately 4.5 mi. west of the Action Area, and represents multiple individuals.

8.3.5 Conclusion of Effects – Northern Long-eared Bat

The majority of the proposed road widening will occur within existing NCDOT right of way, and will mainly occur in the existing median. With the exception of a bifurcated section of the interstate between the Blue Ridge Parkway and the French Broad River, the median contains no woody vegetation. Clearing in this area will be limited due to the presence of a jurisdictional stream (labeled stream SDX in the 2014 NCDOT). Areas outside the existing right of way that may require clearing are limited to existing interchanges, which are already cleared of most woody vegetation, and tend to be urbanized.

Although no MYSE roost tree surveys were conducted for this project, it is highly unlikely that MYSE would choose to roost in trees within this wooded area, or in any wooded areas immediately adjacent to the interstate due to elevated levels of disturbance caused by light and noise from passing vehicles.

Due to the fact that some tree clearing will be necessary on Parkway property, NPS prefers to exercise caution and assume presence of MYSE. NCDOT has agreed that no tree clearing shall be conducted between August 15 and May 15. In the event that any MYSE roost trees are documented within 0.25 mi. of the project area, regardless of the time of year, the NPS will seek consultation with the USFWS before work proceeds. This project commitment is described in Section 7.1.2.

The project is not anticipated to have direct or indirect effects to MYSE. Therefore, it has been determined that the project "May Affect, Not Likely to Adversely Affect" this species based on discountable effects.

9.0 FEDERALLY LISTED SPECIES NOT WITHIN ACTION AREA

The official species list for this project was based on federally listed species potential in all of Buncombe and Henderson Counties (Table 1 Section 1.2). The Action Area for the project is a smaller area than those counties' limits. Consequently, some of the species on the official species list occur outside the Action Area and the project will have no effect on those species. This section discusses the characteristics and current status of these fourteen federally protected species throughout their ranges. Biological Conclusions of "No Effect" are given for these species.

9.1 Blue Ridge Goldenrod

Status: Threatened
Family: Asteraceae
Listed: March 28, 1985
Critical Habitat: None designated

9.1.1 Species Characteristics

Blue Ridge goldenrod is a small perennial herb (four to eight in. tall). Its golden-yellow flowers appear from late July to September, and fruits form and ripen from July to October. Although there are many species of goldenrod, this one can be distinguished by its flat-topped flowers, small stature, smooth foliage, and toothed, non-clasping stem leaves (USFWS 1987).

9.1.2 Distribution and Habitat Requirements

Blue Ridge goldenrod, endemic to the Appalachian Mountains of North Carolina and Tennessee, occurs in the High Elevation Rocky Summit natural community at or above elevations of 4,600 ft. above mean sea level along cliffs, ledges, balds, and dry rock crevices of granite outcrops of the higher mountain peaks. This early pioneer herb grows in full sun or generally acidic soils of shallow humus or clay loams that are intermittently saturated. Roan Mountain bluet, Heller's blazing star, and spreading avens are a few of its common associate species (USFWS 1987).

9.1.3 General Threats to Species

The encroachment of woody vegetation such as ericaceous shrubs can eliminate the goldenrod through competition and shading (USFWS 1987).

9.1.4 Presence in Action Area

Suitable habitat for the Blue Ridge goldenrod does not exist within the Action Area. Elevations in the Action Area do not exceed 2,310 ft. above mean sea level. A review of the NCNHP records, updated July 2018, indicates no known Blue Ridge goldenrod occurrence within 1 mi. of the Action Area.

9.1.5 Conclusion of Effects – Blue Ridge Goldenrod

Since there will be no direct or indirect effects in any areas known to support Blue Ridge goldenrod, and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.2 Bunched Arrowhead

Status: Endangered
Family: Alismataceae
Listed: August 31, 1979
Critical Habitat: None designated

9.2.1 Species Characteristics

Bunched arrowhead is a small herbaceous plant (15 to 16 in. tall) that grows in saturated soils. It is the only *Sagittaria* species in the Southern Appalachians that does not have arrowhead-shaped leaves. Emergent leaves are broad and tapered at the tip and up to 12 in. long and one to 2 in. wide. The white flowers begin blooming in mid-May and continue through July. The fruits mature a few weeks after flowering (USFWS 2014b).

9.2.2 Distribution and Habitat Requirements

Bunched arrowhead, endemic to the southern Appalachian Mountains of North Carolina and upper Piedmont of South Carolina, is rooted in shallow water seepage areas of bogs, wooded swamps, and deciduous woodlands. This early-successional perennial herb occurs in Swamp Forest-Bog Complex (Typic Subtype) and Southern Appalachian Bog (Southern Subtype) natural communities. A known occurrence also occurs in a maintained power line right-of-way along the headwaters of a river. The plant requires a slight but continuous and steady flow of cool, clean water that saturates or floods but does not stagnate. The species typically occurs in sandy loam soils found underneath a 10-24 in. deep layer of muck, sand, and silt. Undisturbed occurrences are usually located just below the origin of the seep on gently sloping terrain at the bluff-floodplain ecotone. While shaded areas contain the most vigorous plants, it will also grow in either full sun or partial shade beneath red maple, black gum, and alder at the base of steep slopes (USFWS 2014b).

9.2.3 General Threats to Species

The primary factor determining the rarity of bunched arrowhead is the current rarity of its required habitat. The seepage habitat in which bunched arrowhead occurs is extremely threatened, and remaining bunched arrowhead populations are threatened by residential and industrial development, conversion to pasture, and invasive exotic species (USFWS 2014b).

9.2.4 Presence in Action Area

Suitable habitat for the bunched arrowhead exists in the project Action Area including several wetland seeps and a swamp forest-bog complex. Pedestrian surveys were conducted on June 27, 2013 in areas of suitable habitat. No individuals were found during these surveys. A review of NCNHP records, updated July 2018, indicates two bunched arrowhead element occurrences (EO 13932 last observed in 2015 and EO 1144 last observed in 2016) within 1 mi. of the Action Area. Due to the close proximity of these occurrences and the time since the previous surveys, repeat pedestrian surveys were completed at all wetland areas within the project Action Area within the upper Bat Fork drainage on June 28, 2017. No individuals of the species were located during these surveys.

9.2.5 Conclusion of Effects – Bunched Arrowhead

Since there were no individuals of this species located in the appropriate habitat within the Action Area during recent surveys, the project will have "No Effect" on this species.

9.3 Carolina Northern Flying Squirrel

Status: Endangered
Family: Sciuridae
Listed: July 1, 1985
Critical Habitat: None designated

9.3.1 Species Characteristics

There are two species of flying squirrels in the Southern Appalachians – the northern (*Glaucomys sabrinus*) and southern (*Glaucomys volans*). Northern flying squirrels are about one-third larger than the very common southern species. Also, northern flying squirrels are brown on their backs, and their fur fades to a buff white on the belly. Southern flying squirrels are grayer on their backs with bright white bellies, and a clearly defined (usually black) line separates the fur colors. The endangered Carolina northern flying squirrel is a subspecies of the northern flying squirrel (USFWS 1990a).

9.3.2 Distribution and Habitat Requirements

There are several isolated populations of the Carolina Northern flying squirrel in the mountains of North Carolina. This nocturnal squirrel prefers the ecotone between coniferous (red spruce, Fraser fir, or hemlock) and mature northern hardwood forests (beech, yellow birch, maple, hemlock, red oak, and buckeye), typically at elevations above 4,500 ft. above mean sea level. In some instances, the squirrels may be found on narrow, north-facing valleys above 4,000 ft. above mean sea level. Both forest types are used to search for food and the hardwood forest is used for nesting sites. Mature forests with a thick evergreen understory and numerous snags are most preferable. In winter, squirrels inhabit tree cavities in older hardwoods, particularly yellow birch (USFWS 1990a).

9.3.3 General Threats to Species

The limited and discontinuous range of this species makes it vulnerable to a number of natural and human-related impacts. Human impacts far outweigh natural threats and include habitat destruction and fragmentation or other alterations associated with the clearing of forests, introduced exotic pests, recreational and residential development, and pollution (heavy metals and acid rain) (USFWS 1990a).

9.3.4 Presence in Action Area

Suitable habitat for the Carolina northern flying squirrel does not exist within the Action Area. Elevations in the Action Area do not exceed 2,310 ft. above mean sea level. A review of the NCNHP records, updated July 2018, indicates no known Carolina northern flying squirrel occurrence within 1 mi. of the Action Area.

9.3.5 Conclusion of Effects – Carolina Northern Flying Squirrel

Since there will be no direct or indirect effects in any areas known to support Carolina Northern flying squirrel and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.4 Mountain Sweet Pitcher Plant

Status: Endangered
Family: Sarraceniaceae
Listed: September 30.1998
Critical Habitat: None designated

9.4.1 Species Characteristics

Mountain sweet pitcher plant is a carnivorous perennial herb with tall, hollow pitcher-shaped leaves and red sweet-smelling flowers. The hollow leaves contain liquid and enzymes. When insects fall into the pitchers, they are digested and the nutrients are incorporated into the plant's tissues. The unusual red flowers (yellow in rare cases) appear from April to June, with fruits ripening in August. Flowering plants reach heights of 29 in. (USFWS 1990b).

9.4.2 Distribution and Habitat Requirements

Mountain sweet pitcher plant, endemic to the Blue Ridge Mountains of North and South Carolina, is found along stream banks and in shrub/herb-dominated, seepage-fed mountain bogs (Southern Appalachian Bog- Southern Subtype). Both stream bank and bog habitats are usually situated along intermittently exposed to intermittently flooded level depressions associated with valley floodplains. These habitats, typically on soils of the Toxaway or Hatboro series, contain deep, poorly drained, saturated soils of loam, sand, and silt with a high organic matter content and medium to high acidity. A few occurrences of the pitcher plant also grow in cataract bogs, either in thin strips along the edges of waterfalls or on soil islands over granite rock faces, where sphagnum and other bog plant species line the sides. This early successional species relies on natural disturbance (*e.g.*, drought, water fluctuation, periodic fire, ice damage) to maintain its habitat by preventing the establishment of later successional woody seedlings (USFWS 1990b).

9.4.3 General Threats to Species

The most serious threat to mountain sweet pitcher plant is the destruction or degradation of its small wetland habitat. Collecting from wild populations continues to be a problem for carnivorous plants, even though cultivated sources are available for almost all species (USFWS 1990b).

9.4.4 Presence in Action Area

Suitable habitat for the mountain sweet pitcher plant exists in the Action Area. A review of NCNHP records, updated July 2018, indicates three areas of historic mountain sweet pitcher plant habitat (EO 17819, EO 825, and EO 8701 were last observed before 1987) within 1 mi. of the Action Area. EO 825 represents an extirpated population, and plants have since been reintroduced to the EO 825 location. EO 825, EO 10426, and EO 8701 are located at least 2,000 ft. outside of the Action Area. However, EO 17819 overlaps with the Action Area in Henderson County for about 1.5 mi. This area was surveyed for wetlands and streams between April 31 and May 9, 2013. The area consists of agricultural, residential, and forested areas. Only one wetland was found in the area, and it was overgrown with invasive species. The species was added to the list of protected species in Buncombe County in June 2018. Therefore, pedestrian surveys were conducted in areas of suitable habitat on August 13 and 14, 2018. No individuals were found during field activities within the survey window.

9.4.5 Conclusion of Effects – Mountain Sweet Pitcher Plant

Since there were no individuals of the species located in the appropriate habitat within Action Area during recent surveys, the project will have "No Effect" on this species.

9.5 Rock Gnome Lichen

Status: Endangered
Family: Cladonia
Listed: January 18, 1995
Critical Habitat: None designated

9.5.1 Species Characteristics

Rock gnome lichen occurs in dense colonies of narrow strap-like lobes that are about 0.04 in. across and generally one to 0.78 in. long. These lobes are blue gray on the terminal upper surface, and generally shiny white on the lower surface, grading to black near the base. The fruiting bodies are born on the tips of these lobes, are black, and have been found from July through September. The primary means of propagation appears to be asexual, with colonies spreading clonally (USFWS 1997).

9.5.2 Distribution and Habitat Requirements

Rock gnome lichen occurs in high elevation coniferous forests (particularly those dominated by red spruce and Fraser fir) usually on rocky outcrop or cliff habitats. This squamulose lichen only grows in areas with a great deal of humidity, such as high elevations above 5,000 ft. mean sea level where there is often fog, or on boulders and large outcrops in deep river gorges at lower elevations. Habitat is primarily limited to vertical rock faces where seepage water from forest soils above flows only at very wet times. The species requires a moderate amount of sunlight, but cannot tolerate high-intensity solar radiation. The lichen does well on moist, generally open sites with northern exposures, but requires at least partial canopy coverage on southern or western aspects because of its intolerance to high solar radiation (USFWS 1997).

9.5.3 General Threats to Species

One of the greatest threats to the rock gnome lichen is trampling and associated soil erosion and compaction from hikers, climbers and sightseers. The areas where the lichen is found, both at high elevation, and along streams, are both threatened by invasive insects, which can kill large areas of native trees often associated with rock gnome lichen. The removal of these trees could diminish the amount of shade on lichen sites, exposing the lichen to excess sunlight. Other threats include recreational and residential development, collection, and air pollution (USFWS 1997).

9.5.4 Presence in Action Area

Suitable habitat for the rock gnome lichen does not exist within the Action Area. There are no rocky outcrops or cliff habitats with a great deal of humidity and seepage that flows only during wet periods. Elevations in the Action Area do not exceed 2,310 ft. above mean sea level. A review of the NCNHP records, updated July 2018, indicates no known rock gnome lichen occurrence within 1.0 mi. of the Action Area.

9.5.5 Conclusion of Effects – Rock Gnome Lichen

Since there will be no direct or indirect effects in any areas known to support rock gnome lichen and due to the lack of EO records within or near the Action Area, the project will have “No Effect” on this species.

9.6 Rusty-patched Bumble Bee

Status: Endangered
Family: Apidae
Listed: March 21, 2017
Critical Habitat: None designated

9.6.1 Species Characteristics

Rusty-patched bumble bees live in relatively large colonies that include a single queen and female workers. All individuals of this species have entirely black heads while only males and workers bumble bees have a rusty, reddish patch on the center of their backs.

9.6.2 Distribution and Habitat Requirements

The species was historically distributed across 28 states in the eastern and upper Midwest of the United States, and in two Canadian provinces. It is now known from 13 states and one province. It is assumed that the species no longer occurs in North Carolina (USFWS 2017b).

9.6.3 General Threats to Species

Threats to the continued survival of the species include habitat loss and degradation, intensive farming, disease caused by pathogens and parasites, pesticides, and global climate change (USFWS 2017b).

9.6.4 Presence in Action Area

A review of NCNHP records, updated July 2018, indicates one historic element occurrence of rusty patched bumble bee (EO 37111 last observed in 1961).

9.6.5 Conclusion of Effects – Rusty patched Bumble Bee

USFWS does not and will not require surveys for rusty-patched bumble bee in North Carolina because it is assumed that the species does not occur in the state. Therefore, no Section 7 survey, conclusion, or consultation is required at this time.

9.7 Small Whorled Pogonia

Status: Threatened
Family: Orchidaceae
Listed: September 9, 1982
Critical Habitat: None designated

9.7.1 Species Characteristics

Small-whorled pogonia is a small perennial member of the Orchidaceae with long, pubescent roots and a smooth, hollow stem 3.8 to 10 in. tall terminating in a whorl of 5 or 6 light green, elliptical leaves that are somewhat pointed and measure up to 1.6 to 3.2 in.. The single flower is approximately 1 in. long, with yellowish-green to white petals and three longer green sepals. This orchid blooms in late spring from mid-May to mid-June. This plant is believed to be self-pollinating by mechanical processes. Populations of this plant are reported to have extended periods of dormancy and to bloom sporadically. This small spring ephemeral orchid is not observable outside of the spring growing season (USFWS 1992a)

9.7.2 Distribution and Habitat Requirements

Small whorled pogonia occurs in young as well as maturing (second to third successional growth) mixed-deciduous or mixed-deciduous/coniferous forests. It does not appear to exhibit strong affinities for a particular aspect, soil type, or underlying geologic substrate. In North Carolina, the

perennial orchid is typically found in open, dry deciduous woods and is often associated with white pine and rhododendron. The species may also be found on dry, rocky, wooded slopes; moist slopes; ravines lacking stream channels; or slope bases near braided channels of vernal streams. The orchid, often limited by shade, requires small light gaps or canopy breaks, and typically grows under canopies that are relatively open or near features like logging roads or streams that create long-persisting breaks in the forest canopy (USFWS 1992a).

9.7.3 General Threats to Species

The primary threat to the small whorled pogonia is habitat loss due to urban expansion, and to some extent, forestry practices. Habitat may also be degraded through recreational use and trampling. As with all rare orchids, the small whorled pogonia is vulnerable to collecting for commercial or personal use (USFWS 1992a).

9.7.4 Presence in Action Area

Suitable forested habitat for the small whorled pogonia exists in the project Action Area. Areas with mixed-deciduous or mixed-deciduous/coniferous forests with relatively open understories were surveyed throughout the Action Area between June 12, 2013 and June 27, 2013. Suitable habitat associated with the rest areas was surveyed on May 13, 2018. No individuals were found during any of these surveys. A review of the NCNHP records, updated July 2018, indicates no known small whorled pogonia occurrence within 1.0 mi. of the Action Area.

9.7.5 Conclusion of Effects – Small Whorled Pogonia

Since there were no individuals of the species located in the appropriate habitat within the Action Area during recent surveys, and due to the lack of EO records within or near the Action Area, the project will have “No Effect” on this species.

9.8 Spotfin Chub

Status: Threatened
Family: Cyprinidae
Listed: October 11, 1977
Critical Habitat: None within Action Area

9.8.1 Species Characteristics

The spotfin chub was first described from the North Fork Holston River in Smyth County, Virginia. This small (maximum size 3.6 in.) cyprinid (minnow) is described as having a slightly compressed, elongate body with a color pattern of olive green above the lateral line and silver on the lower sides bordered mid-dorsally and dorso-laterally by gold and green stripes (Jenkins and Burkhead 1984). The common name, spotfin chub, is derived from the distinctive, prominent black spot on the lower part of the caudal fin. This species has also been referred to as the turquoise shiner due to the brilliant metallic blue color above the lateral line in nuptial (breeding) males (USFWS 1983).

9.8.2 Distribution and Habitat Requirements

The spotfin chub is endemic to the Tennessee River drainage in Alabama, Georgia, North Carolina, Tennessee, and Virginia. The historic range of this species encompassed 12 tributary systems in four physiographic provinces: Blue Ridge (French Broad River and Little Tennessee River systems), Ridge and Valley (Clinch River, Powell River, Holston River (North and South Forks) and Chickamauga Creek systems), Cumberland Plateau (Emory River and Whites Creek systems) and Interior Low Plateau (Shoal Creek, Little Bear Creek and Duck River systems). Presently it is

known to survive in only four isolated tributary systems (Duck, Little Tennessee, Emory and North Fork Holston River systems) (USFWS 1983).

Habitat for this species has been described as moderate to large streams, 49 to 230 ft. in width. These streams should have, clear water, cool to warm temperatures, and pools alternating with riffles. Specimens of spotfin chub have been taken from a variety of substrates, but rarely from substantially silted substrates.

9.8.3 Threats to Species

Many of the same factors (described above) that have contributed to the decline of the freshwater mussels including the Appalachian elktoe have contributed to the decline of the spotfin chub as well. Jenkins and Burkhead (1984) and USFWS (1983) cite impoundments, channelization, pollution, and turbidity or siltation as likely factors that resulted in a decline of the species. Overcollection has also been suggested to be a factor, as a massive application of ichthyocide wiped out the entire Abrams Creek population, and seining efforts in the North Fork Holston River sharply depleted populations (USFWS 1983). The recovery plan for this species lists all the factors that have contributed to declines in each of the historically known populations (USFWS 1983).

9.8.4 Presence in Action Area

Extensive fish survey work has been done in the French Broad River Basin. Spotfin chub has not been collected in these surveys, and it is thought to have been extirpated from the French Broad River Basin in North Carolina. A review of the NCNHP records, updated July 2018, indicates no known spotfin chub occurrence within 1 mi. of the Action Area.

9.8.5 Conclusion of Effects – Spotfin Chub

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.9 Spreading Avens

Status: Endangered
Family: Rosaceae
Listed: October 11, 1997
Critical Habitat: None designated

9.9.1 Species Characteristics

Spreading avens is a perennial herb in the rose (Rosaceae) family. It has basal rosettes of leaves with large terminal lobes and small lateral lobes arising from horizontal rhizomes. Rosettes, which usually have no more than two flowering stems each, can measure up to 35 sq. in.. New plants can be produced through sexual or asexual means. Large bright yellow flowers are born in an indefinite cyme on stems that are 1.6 to 2.3 ft, tall. Flowering occurs from June through September and fruits (achenes) are produced from August through October (USFWS 1993).

9.9.2 Distribution and Habitat Requirements

Spreading avens occurs in areas exposed to full sun on high elevation cliffs, outcrops, and bases of steep talus slopes. This perennial herb also occurs in thin, gravelly soils of grassy balds near summit outcrops. The species prefers a northwest aspect, but can be found on west-southwest through north-northeast aspects. Forests surrounding known occurrences are generally dominated by either red spruce-Fraser fir, northern hardwoods with scattered spruce, or high-elevation red oaks. Spreading avens typically occurs in shallow, acidic soil (such as the Burton

series) in cracks and crevices of igneous, metamorphic, or metasedimentary rocks. Soils may be well drained but almost continuously wet, with soils at some known occurrences subject to drying out in summer due to exposure to sun and shallow depths. Known populations occur at elevations ranging from 4,296 to 6,268 ft. above mean sea level. Blue Ridge goldenrod, Heller's blazing star, and Roan Mountain bluet are a few of its common associate species (USFWS 1993).

9.9.3 General Threats to Species

Being confined to small areas on a few rocky mountain summits, this species is extremely vulnerable to such seemingly minor threats as trampling by hikers, climbers, and sightseers, as well as to more pervasive threats such as acid precipitation, and other forms of air pollution. An exotic insect, the balsam woolly adelgid, contributes to the decline of the fir forests adjacent to the cliffs where spreading avens grows. Although spreading avens does not grow beneath dense forest, the death of the adjacent forests results in drier and hotter conditions, as well as increased soil erosion. These factors threaten the last remaining Spreading avens populations (USFWS 1993).

9.9.4 Presence in Action Area

There is no suitable habitat for spreading avens within the Action Area. There are no areas exposed to full sunlight at or above 4,200 ft. above mean sea level within the Action Area. Elevations in the Action Area do not exceed 2,310 ft. above mean sea level. A review of the NCNHP records, updated July 2018, indicates no known spreading avens occurrence within 1 mi. of the Action Area.

9.9.5 Conclusion of Effects – Spreading Avens

Since there will be no direct or indirect effects in any areas known to support spreading avens and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.10 Spruce-fir Moss Spider

Status: Endangered
Family: Dipluridae
Listed: February 6, 1995
Critical Habitat: None within Action Area

9.10.1 Species Characteristics

Spruce-fir moss spiders belong to the arachnid family commonly referred to as tarantulas, which are identified by having two pairs of book lungs and by the articulation of the cheliceral fangs, which open and close along a plane running parallel to the long axis of the body. Coloration of the species ranges from light brown, to yellow-brown, to a darker reddish brown. No markings are present on the abdomen. The most reliable field identification characteristics for the spruce-fir moss spider are chelicerae that project forward well beyond the anterior edge of the carapace, a pair of very long posterior spinnerets, and the presence of a second pair of book lungs, which appear as light patches posterior to the genital furrow. (USFWS 1998b).

9.10.2 Distribution and Habitat Requirements

This species is known only from spruce-fir forests in the Appalachian mountains of North Carolina and Tennessee. The spruce-fir moss spider occurs in well-drained moss and liverwort mats growing on rocks or boulders. These mats are found in well-shaded areas in mature, high elevation (>5,000 ft) Fraser fir and red spruce forests. The spruce-fir moss spider is very sensitive to desiccation and requires environments of high and constant humidity. The need for humidity

relates to the moss mats, which cannot become too parched or else the mats become dry and loose. Likewise, the moss mats cannot be too wet because large drops of water can also pose a threat to the spider. The spider constructs its tube-shaped webs in the interface between the moss mat and the rock surface. Some webs have been found to extend into the interior of the moss mat (USFWS 1998b).

9.10.3 General Threats to Species

The biggest threat to the continued existence of spruce-fir moss spider is habitat loss (USFWS 1998b).

9.10.4 Presence in Action Area

Suitable habitat for the spruce-fir moss spider does not exist within the study area. Elevations in the study area do not exceed 2,310 ft. above mean sea level. A review of the NCNHP records, updated July 2018, indicates no known spruce-fir moss spider occurrence within 1.0 mile of the Action Area.

9.10.5 Conclusion of Effects – Spruce-fir Moss Spider

Since there will be no direct or indirect effects in any areas known to support spruce-fir moss spider and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.11 Swamp Pink

Status: Threatened
Family: Liliaceae
Listed: September 9, 1988
Critical Habitat: None designated

9.11.1 Species Characteristics

Swamp pink is a smooth perennial herb in the lily family (Liliaceae) with a stout hollow stem and a basal rosette of evergreen leaves. This hollow-stemmed flower stalk can grow from 8 to 35 in. tall during flowering and up to 5 ft. tall during seed maturation. Leaves are oblanceolate with parallel veins, 3.5 to 10 in. long and 0.8 to 1.6 in. wide with an acute tip and attenuated at the base. Leaves are a bright green during the summer, turning reddish-brown during the winter. During the winter, leaves lie flat or are slightly raised from the ground, with the emergent flowerhead for the next season visible as a large button in the center of the basal rosette (USFWS 1991)

9.11.2 Distribution and Habitat Requirements

Swamp pink occurs in clonal clumps in a variety of groundwater influenced wetland habitats including southern Appalachian bogs and swamps, Atlantic white cedar swamps, swampy forests bordering meandering small streams, boggy meadows, headwater wetlands, and spring seepage areas. The perennial herb requires a constantly saturated, but not flooded, water supply. The plant often grows on hummocks formed by trees, shrubs, and sphagnum moss, and exhibits varying degrees of shade tolerance. Swamp pink occurs in acidic soils that contain a very thin layer of decomposed organic matter over a dark silt loam and a subsoil of sand, loam, and gravel (USFWS 1991).

9.11.3 General Threats to Species

Habitat loss or degradation pose the biggest threat to swamp pink. Trampling and collecting also threaten the species (USFWS 1991).

9.11.4 Presence in Action Area

Suitable habitat for swamp pink exists in the project Action Area including constantly saturated wetlands with non-flooded areas, and wetland seeps. Pedestrian surveys were conducted, on May 29, 2013, in areas of suitable habitat. No individuals were found during field activities within the survey window. A review of the NCNHP records, updated July 2018, indicates one element occurrence of swamp pink (EO 15190, last observed in 2016) within 1 mi. of the Action Area. Twelve flowering individuals were observed (nonflowering not counted).

9.11.5 Conclusion of Effects – Swamp Pink

Since there will be no direct or indirect effects in any areas known to support swamp pink and there were no individuals of the species located in the appropriate habitat within Action Area during recent surveys, the project will have “No Effect” on this species.

9.12 Tan Riffleshell

Status: Endangered
Family: Unionidae
Listed: September 26, 1977
Critical Habitat: None designated

9.12.1 Species Characteristics

Two subspecies of *Epioblasma florentina* are currently recognized based on differences in shell morphology; the tan riffleshell (*Epioblasma florentina walkeri*), described by Wilson and H. W. Clark (1914) from the East Fork of the Stones River, Rutherford County, Tennessee and the yellow blossom (*E. florentina florentina)* described from the Tennessee River in Florence, Alabama by Issac Lea (1857). These two purported subspecies represent two extremes of a cline, with the yellow blossom being the “big river form” and the tan riffleshell the “headwater form”. The yellow blossom form occurring in big rivers is presumed extinct and the tan riffleshell form occurring in head water streams is very restricted. In 1976, the USFWS listed the yellow blossom (*E. florentina*) as endangered. While Turgeon et al. (1988) did not recognize the separate subspecies, the USFWS listed the tan riffleshell as a subspecies and endangered in 1977.

The tan riffleshell is a relatively small mussel, seldom exceeding 2.36 in. in length. Its periostracum is a dull brownish green or yellowish green in color with numerous faint green rays evenly distributed over the entire valve surface; the nacre is a bluish white. Its shell outline is irregularly elliptical or obovate with inequilateral valves, subinflated, and rather solid. Both valves contain two small triangular pseudocardinal teeth. Lateral teeth are double in the left valve, single or sometimes double in the right; they are short and curved. Anterior muscle scars are well-impressed, while posterior muscle scars are shallow; the pallial line is distinct only anteriorly.

The tan riffleshell shows sexual dimorphism in many features. Males have a slightly protruding posterior end while females have a pronounced posterior marsupial swelling defined by anterior and posterior sulchi and are often serrated along the ventral margin. The posterior ridge of the male shell appears faintly doubled, ending in a slight biangulation posteriorly while it is scarcely visible in females. In male shells the umbo is quite full and elevated and located slightly anterior of middle while in females you find it in the anterior third of the shell. Additionally, the posterior end of female shells is especially thin and iridescent.

Like many other freshwater mussels, life history information is limited for this species. It is assumed that their reproductive cycle is like that of other native freshwater mussels. Males

release sperm into the water column, and the sperm are then taken in by the female through their siphons during feeding and respiration. The females retain the fertilized eggs in their gills until the larvae (glochidia) fully develop. The mussel glochidia are released into the water, and within a few days they must attach to the appropriate species of fish, which they parasitize for a short time while they develop into juvenile mussels. They then detach from their fish host and sink to the stream bottom where they continue to develop, provided they land in a suitable substrate with the correct water conditions (USFWS 2002b). Rogers et al. (2001), working with the Indian Creek population in southwest Virginia, reported collecting gravid females of the tan riffleshell from February through August with glochidia being released principally in May and June. A fecundity estimate of almost 20,000 glochidia from one female was made. Maximum age of individuals from this population was estimated at 11 years based on shell thin sections (Rogers et al. 2001).

Laboratory tests of the tan riffleshell glochidia resulted in identification of five species of fish as suitable hosts (Table 17) (Watson and Neves 1996; Rogers et al. 2001). Of the 16 species tested, it was the benthic, riffle-dwelling species that were successful fish hosts (Rogers et al. 2001).

Table 17. Laboratory Identified Fish Hosts for Tan Riffleshell

Common Name	Scientific Name
Banded sculpin	*Cottus bairdi*
Mottled sculpin	*Cottus carolinae*
Greenside darter	*Etheostoma blennioides*
Fantail darter	*Etheostoma flabellare*
Redline darter	*Etheostoma ruflineatum*

9.12.2 Distribution and Habitat Requirements

Historically the tan riffleshell was wide spread in the headwaters of the Tennessee and Cumberland River drainages. Recent populations of the tan riffleshell have been reported from the Duck River (Tennessee), Hiwassee River (Tennessee), Middle Fork Holston River (Virginia), Clinch River (Virginia), Indian Creek (Virginia), and the Big South Fork Cumberland River (Tennessee) (Parmalee and Hughes 1994, Rogers et al. 2001, Jones et al. 2004, Jones et al. 2006). The tan riffleshell is known in North Carolina from two museum lots from the French Broad River, Asheville, Buncombe County (identifications by D. H. Stansbery and confirmed by J. W. Jones).

Extant populations of the tan riffleshell in the Clinch (Virginia) and Hiwassee (Tennessee) River drainages are found in less than 3 ft. of flowing water in a substrate of coarse sand, gravel, and some silt (Parmalee and Hughes 1994).

9.12.3 Threats to Species

Threats to the tan riffleshell are similar to those described for the Appalachian elktoe and have contributed to the decline of this species throughout its range. The remaining tan riffleshell 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.

9.12.4 Presence in Action Area

Extensive mussel survey work has been done in the French Broad River Basin. Tan riffleshell has not been collected in these surveys, and it is thought to have been extirpated from the French Broad River Basin in North Carolina. A review of the NCNHP records, updated July 2018, indicates no known tan riffleshell occurrence within 1 mi. of the Action Area.

9.12.5 Conclusion of Effects – Tan Riffleshell

The tan riffleshell was not found during mussel surveys conducted for this project. Records in this portion of the French Broad River Basin are historic, and USFWS (2017b) lists the species as Historic and Obscure in Buncombe County.

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.13 Virginia Spiraea

Status: Threatened
Family: Rosaceae
Listed: June 15, 1990
Critical Habitat: None designated

9.13.1 Species Characteristics

Virginia spiraea is a clonal shrub with a modular growth form. It grows from 2 to 10 ft. tall and usually has arching and profusely branching stems. The alternate leaves are ovate to lanceolate, 1.2 to 6 in. long and 0.8 to 2 in. wide and mucronate. They have an acute base and are glaucous beneath and may be darker green above. Margins are entire to completely serrate with coarse to fine single teeth that are occasionally curved. Yellowish-green to clear pale white flowers are produced on a 2 to 8.7 in. corymb from late May to late July (USFWS 1992c).

9.13.2 Distribution and Habitat Requirements

Virginia spiraea occurs in flood-scoured, high-gradient sections of rocky river banks of second and third order streams, often in gorges or canyons. This perennial shrub grows in sunny areas on moist, acidic soils, primarily over sandstone. The shrub tends to be found in thickets with little arboreal or herbaceous competition along early successional areas that rely on periodic disturbances such as high-velocity scouring floods to eliminate such competition. Virginia spiraea also occurs on meander scrolls and point bars, natural levees, and other braided features of lower stream reaches, often near the stream mouth. Scoured, riverine habitat sites are found where deposition occurs after high water flows, such as on floodplains and overwash islands, rather than along areas of maximum erosion. Occurrences in depositional habitats are found among riparian debris piles, on fine alluvial sand and other alluvial deposits, or between boulders (USFWS 1992c).

9.13.3 General Threats to Species

Due to its specific habitat requirements, Virginia spiraea is vulnerable to alterations of streamflow patterns. Impoundments, road construction, unmanaged recreational use of river corridors, industrial development, lack of watershed management, and uncontrolled development of river corridors have already threatened and exterminated several populations of this species. Another threat to Virginia spiraea is competition from exotic invasive plants (USFWS 1992c).

9.13.4 Presence in Action Area

A review of the NCNHP records, updated July 2018, indicates no known Virginia spiraea occurrence within 1 mi. of the Action Area.

9.13.5 Conclusion of Effects – Virginia Spiraea

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.14 White Fringeless Orchid

Status: Threatened
Family: Orchidaceae
Listed: October 13, 2016
Critical Habitat: None designated

9.14.1 Species Characteristics

White fringeless orchid is a perennial herb that grows up to 24 in tall. It has a single, light-green stem rising from a tuber. The leaves have smooth edges and tend to be long and narrow, with leaves lower on the plant being larger. The plant bears white flowers in a loose cluster at the end of the stem, and it flowers from late July through September with small fruit maturing in October (USFWS 2015b)

9.14.2 Distribution and Habitat Requirements

White fringeless orchid grows in wet, boggy areas at the heads of streams and on sloping areas kept moist by groundwater seeping to the surface. It is often associated with Sphagnum in partially, but not fully, shaded areas. Other plants commonly found with it include: cowbane (*Oxypolis rigidior*), grass-of-Parnassus (*Parnassia asarifolia*), primrose-leaf stemless white violet (*Viola primulifolia*) and other orchids, particularly green wood orchid (*Platanthera clavellata*) and yellow-fringed orchid (*Platanthera ciliaris*). The species appears to have been extirpated from North Carolina (Henderson and Cherokee Counties) (USFWS 2015b).

9.14.3 General Threats to Species

Habitat alteration or loss are the biggest threats to white-fringeless orchid. Utility and road right-of-way maintenance, timber harvesting, invasive species encroachment, vegetation succession in the absence of disturbance, and prolonged drought can all lead to an adverse modification of habitat. Illegal collection/poaching also pose a threat to the species (USFWS 2015b).

9.14.4 Presence in Action Area

A review of NCNHP records, updated July 2018, indicates one historic white fringeless orchid element occurrence (EO 11656, last observed before 1992) within 1 mi. of the Action Area at Bat Fork Bog.

9.14.5 Conclusion of Effects – White Fringeless Orchid

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.15 White Irisette

Status: Endangered
Family: Iridaceae
Listed: September 26, 1991
Critical Habitat: None designated

9.15.1 Species Characteristics

The white irisette is a small perennial herb that grows in a dichotomously-branching pattern, reaching heights of approximately 4.3 to 7.9 in. The basal leaves, usually pale to bluish green, are from one-third to one-half the height of the plant. They are long-attenuate, with an acuminate apex. The tiny white flowers are 0.3 in. long and appear from late May through July in clusters of four to six at the ends of winged stems. The stems have from three to five nodes, each with one to three winged peduncles 1.6 to 2.8 in. long and 0.02 to 0.04 in. wide. There are successively

shorter internodes between the dichotomous branches. Individual plants may have 10 or more stems arising from the fibrous roots. The fruit is a round, pale to medium brown capsule containing three to six round or elliptical black seeds. The dichotomous branching pattern and white flowers combine to distinguish this herb from other species within the genus (USFWS 1995).

9.15.2 Distribution and Habitat Requirements

White irisette, endemic to the upper Piedmont of North and South Carolina, is generally found on the southeast to southwest aspect of gentle to very steep, mid-elevation mountain slopes in thin-canopied, dry-mesic Basic Oak Hickory Forests that are mature, successional, or recently logged. Occurrences are also found in open, disturbed sites such as clearings, woodland edges, roadside embankments/rights-of-way, and power line rights-of-way. Known populations occur at elevations between 1,312 and 3,280 ft. above mean sea level. The perennial herb prefers rich, basic soils, probably weathered from amphibolite, which are intermittently saturated with rain but well drained. The species occurs in a variety of soils, including the Ashe-Cleveland association; the Evard-Cowee complex; and Brevard, Cowee, Fannin, Greenlee, and Hayesville series. It may grow on shallow soil sites where down slope runoff removed the usual deep litter, humus, or mineral soil layers. Partial shade to direct sun is preferred, and some form of disturbance (*e.g.*, mowing, clearing, grazing, periodic fire) is necessary to maintain its relatively open habitat (USFWS 1995).

9.15.3 General Threats to Species

White irisette is threatened by loss of habitat though activities such as residential development, road construction, and introduction of invasive species. Suppression of natural disturbances such as fire and the extirpation of bison and elk may also contribute to low population numbers (USFWS 1995).

9.15.4 Presence in Action Area

Suitable habitat for the white irisette exists in the project Action Area including open, disturbed sites such as clearings, woodland edges, roadside embankments, and power line rights-of-ways. Pedestrian surveys of suitable habitat were conducted on July 12, 2013. No individuals were found during the survey. A known population was visited and observed on June 25, 2013 (EO 8817). A review of NCNHP records, updated July 2018, indicates no known white irisette occurrences within 1 mi. of the Action Area.

9.15.5 Conclusion of Effects – White Irisette

Since there will be no direct or indirect effects in any areas known to support white irisette and due to the lack of EO records within or near the Action Area, the project will have “No Effect” on this species.

10.0 DETERMINATION OF EFFECTS

As presented in Table 18, FHWA, made the determinations of effect for federally listed and proposed species under the ESA for the I-26 Widening project.

Table 18. Federally Protected Species in Buncombe and Henderson Counties

Common Name	Scientific name	Federal Status	Listing Status		Species Present in Action Area	Determination of Effect
			Buncombe	Henderson		
Appalachian elktoe	*Alasmidonta raveneliana*	E	Current	Current	Yes	MALTAA
Blue Ridge goldenrod	*Solidago spithamaea*	T	Current	NL	No	No Effect
Bog turtle	*Glyptemys muhlenbergii*	T (S/A)	Current	Current	Yes	NR
Bunched arrowhead	*Sagittaria fasciculata*	E	Current	Current	No	No Effect
Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	E	Current	Current	No	No Effect
Gray bat	*Myotis grisescens*	E	Current	Probable/ Potential	Yes	MALTAA
Indiana bat	*Myotis sodalis*	E	NL	NL	Yes^	MANLTAA
Mountain sweet pitcher plant	*Sarracenia rubra ssp. jonesii*	E	Current	Current	No	No Effect
Northern long-eared bat	*Myotis septentrionalis*	T	Current	Current	Yes	MANLTAA
Rock gnome lichen	*Gymnoderma lineare*	E	Current	NL	No	No Effect
Rusty-patched bumble bee*	*Bombus affinis*	E	Historic	Historic	No	NR
Small whorled pogonia	*Isotria medeoloides*	T	NL	Current	No	No Effect
Spotfin chub (=turquise shiner)	*Erimonax monachus*	T	Historic	NL	No	NR
Spreading avens	*Geum radiatum*	E	Current	NL	No	No Effect
Spruce-fir moss spider	*Microhexura montivaga*	E	Current	NL	No	No Effect
Swamp pink	*Helonias bullata*	T	NL	Current	No	No Effect
Tan riffleshell	*Epioblasma florentina walkeri (=E. walkeri)*	E	Historic and Obscure	NL	No	NR
Virginia spiraea	*Spiraea virginiana*	T	Historic	NL	No	NR
White fringeless orchid	*Platanthera integrilabia*	T	NL	Historic	No	NR
White irisette	*Sisyrinchium dichotomum*	E	NL	Current	No	No Effect

NL = Not listed for county, E = Endangered, T = Threatened, T(S/A) = Threatened due to similarity of appearance

^ = MYSO does not appear on the USFWS list of protected species for Buncombe or Henderson Counties, but NPS recorded calls they attributed to MYGR on Parkway property
* = USFWS does not and will not require surveys for Rusty-patched bumble bee in North Carolina because USFWS assumes the state is unoccupied by rusty-patched bumble bee

Current - the species has been observed in the county within the last 50 years
Historic - the species was last observed in the county more than 50 years ago
Obscure - the date and/or location of observation is uncertain
Probable/Potential - the species is considered likely to occur in this county based on the proximity of known records (in adjacent counties), the presence of potentially suitable habitat, or both

NR = not required, MALTAA = may affect, likely to adversely affect, MANLTAA = may affect, not likely to adversely affect.

FHWA, as the lead on this consultation document, has determined that the project will likely adversely affect MYGR and Appalachian elktoe. FHWA has determined the project may affect but is not likely to adversely affect MYSO and MYSE.

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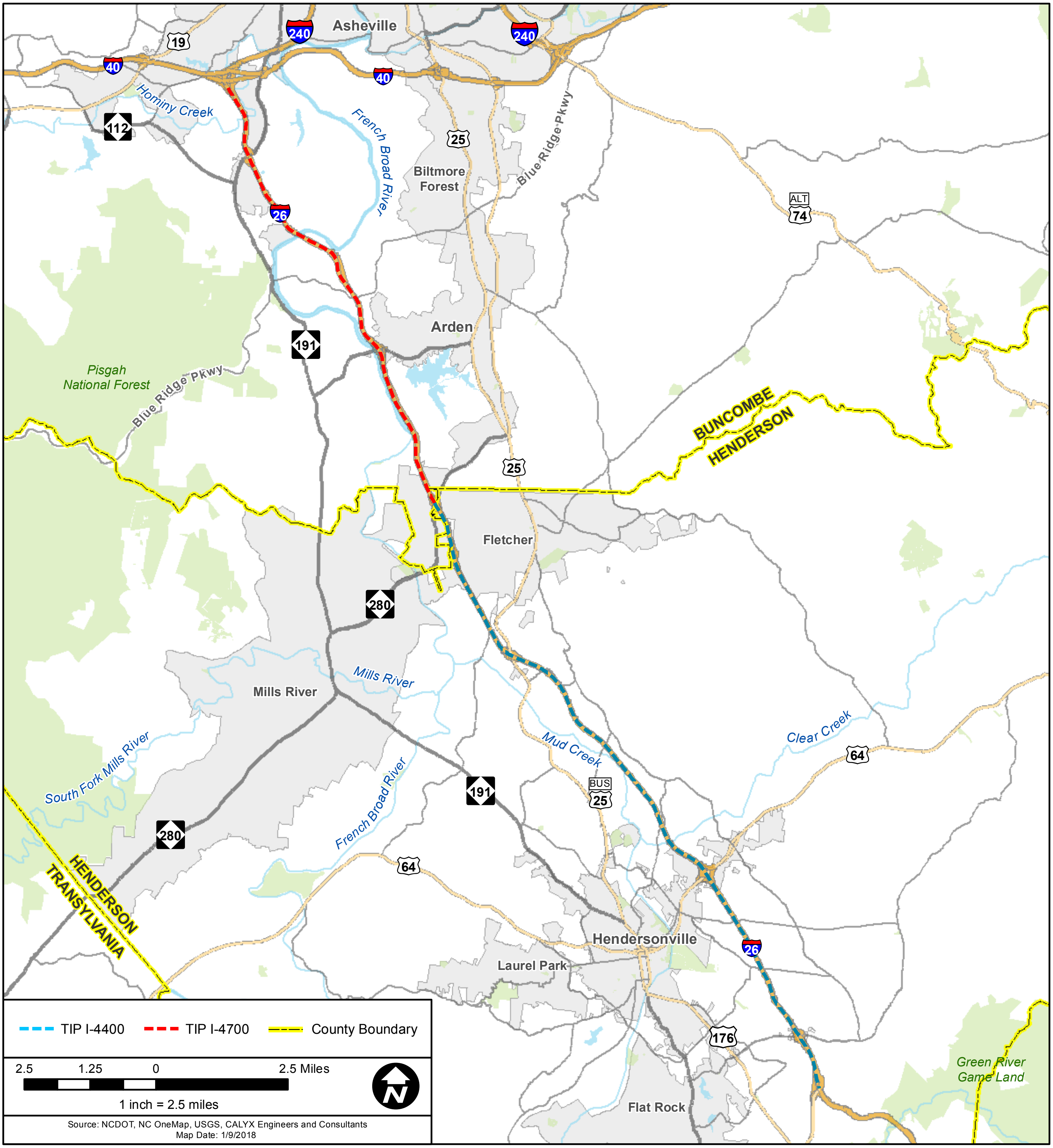
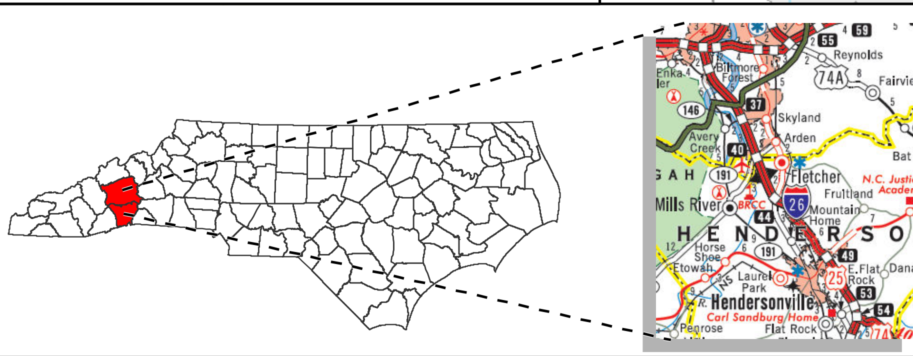
Appendix A: Figures





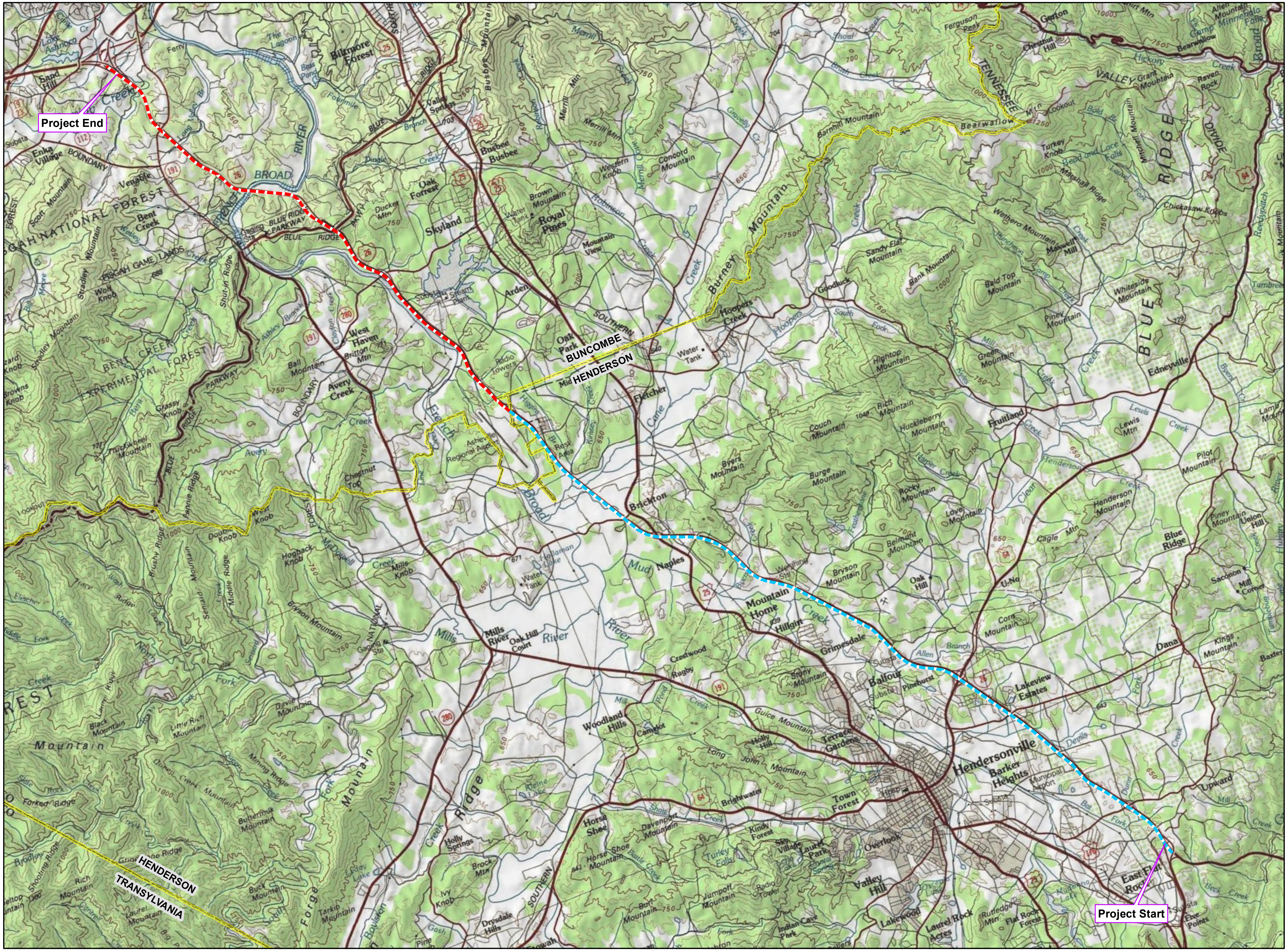
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Figure 1 - Project Vicinity

Biological Assessment

I-26 Widening (TIP Nos. I-4400/I-4700)

Buncombe &
Henderson Counties, NC



Legend

- TIP I-4400
- TIP I-4700
- County Boundary

Figure 2

Landscape Position Map

Biological Assessment
I-26 Widening
TIP Projects I-4400/I-4700

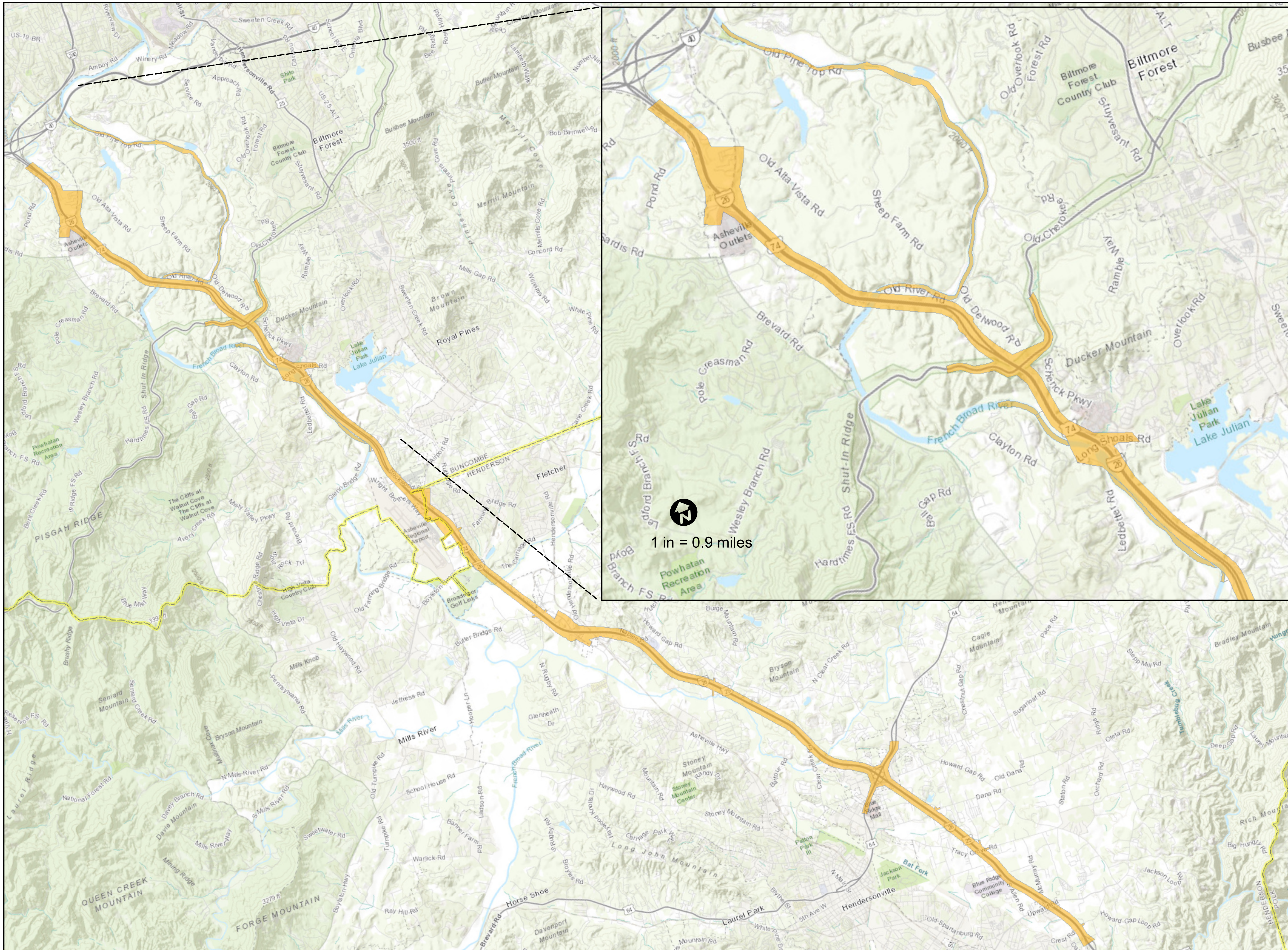
Buncombe &
Henderson Counties, NC

Map Date: 1/9/2018

1.5 0.75 0 1.5
Miles
1 inch = 1.5 miles

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below.

Sources: ESRI, NCDOT, Calyx Engineers and Consultants



Legend

- County Boundary
- Action Area

Figure 3

Action Area

Biological Assessment
I-26 Widening
TIP Projects I-4400/I-4700

Buncombe &
Henderson Counties, NC

Map Date: 5/21/2018

1.5 0.75 0 1.5
Miles
1 inch = 1.5 miles

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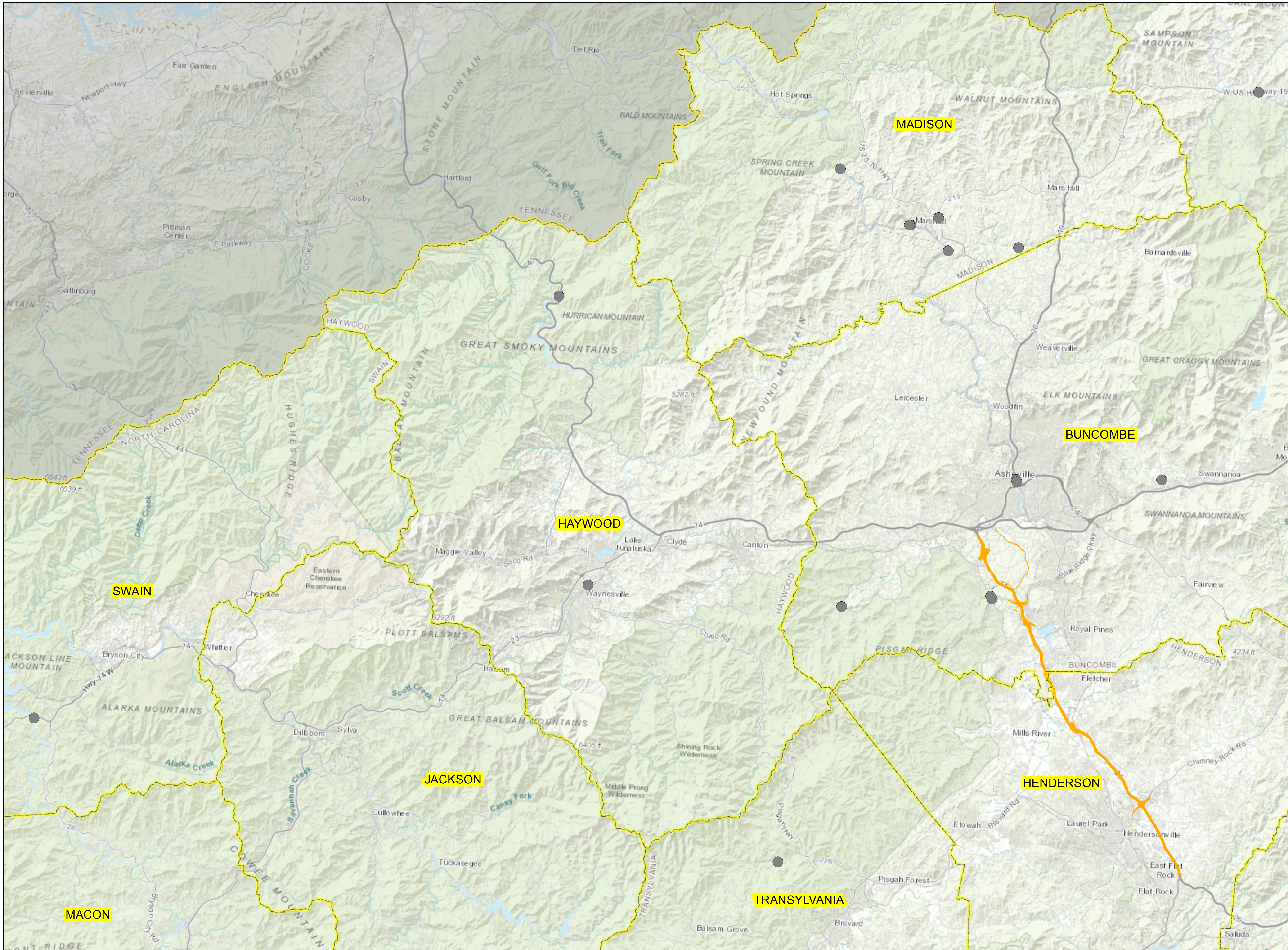

Legend

- Gray Bat Occurrence
- Action Area
- County Boundary

Figure 4

NC Gray Bat Occurrences

Biological Assessment
I-26 Widening
TIP Projects I-4400/I-4700

Buncombe &
Henderson Counties, NC

Map Date: 5/21/2018

5 2.5 0 5
Miles
1 inch = 5 miles

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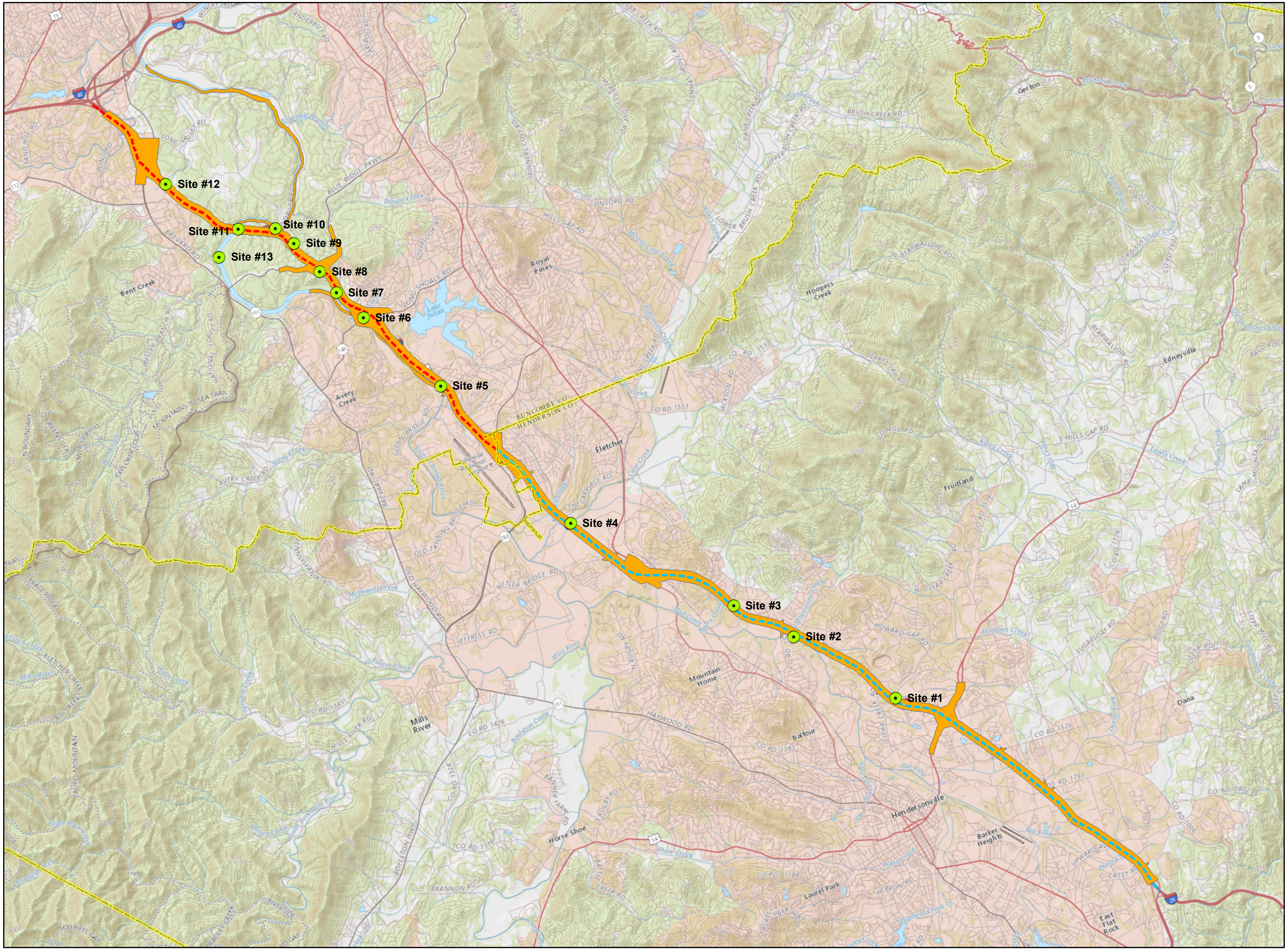
Sources:
ESRI, NCDOT, Calyx Engineers and Consultants
NCNHP (Tier 2 Data; released October 2017)



Legend

- Detector Locations
- TIP I-4400
- TIP I-4700
- Action Area
- County Boundary

Figure 5

Acoustic Detector Locations

Biological Assessment
I-26 Widening
TIP Projects I-4400/I-4700

Buncombe &
Henderson Counties, NC

Map Date: 5/21/2018

1.5 0.75 0 1.5
Miles
1 inch = 1.5 miles

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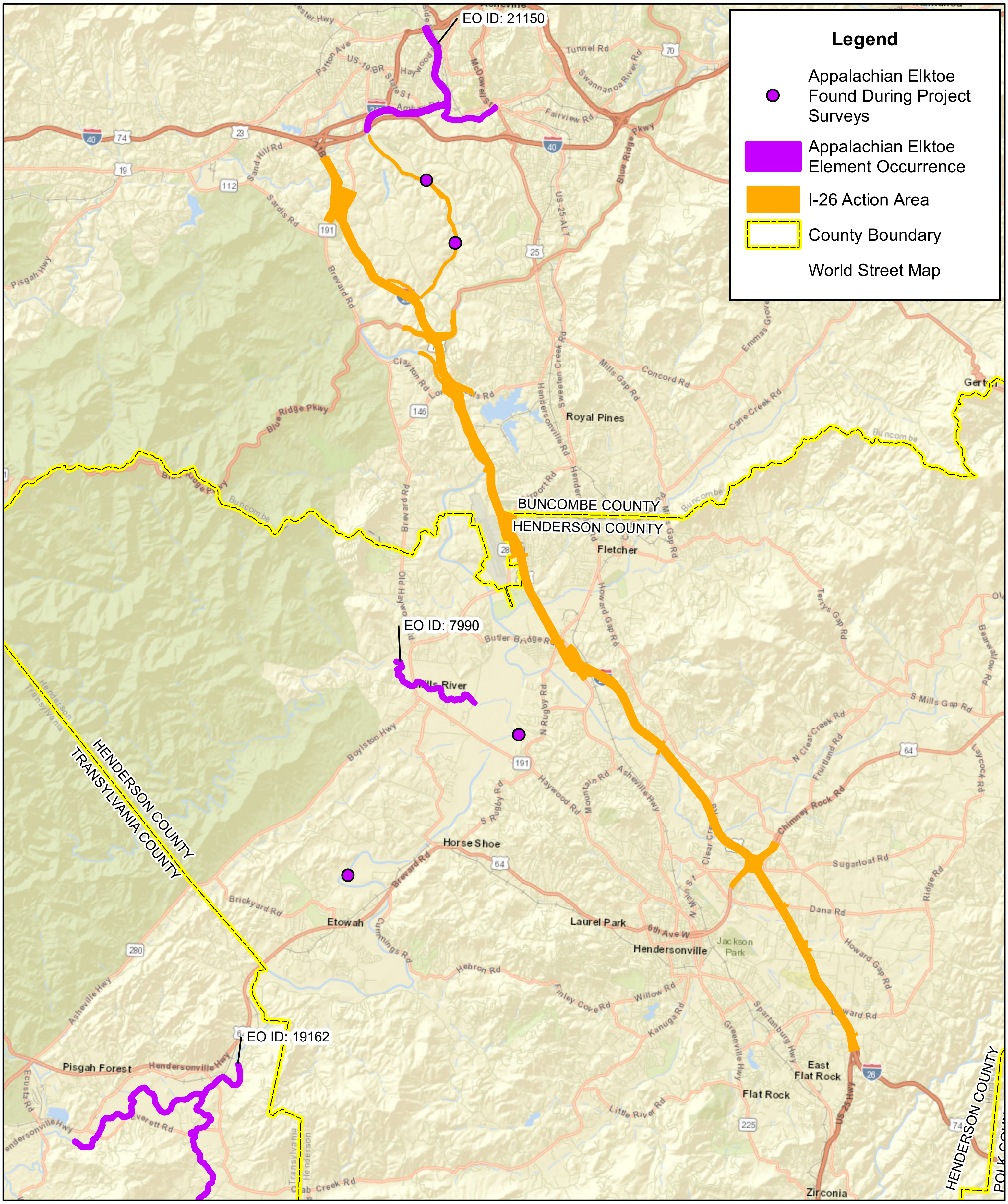

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Sources:
NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 3 miles

0 1 2 3 4
Miles

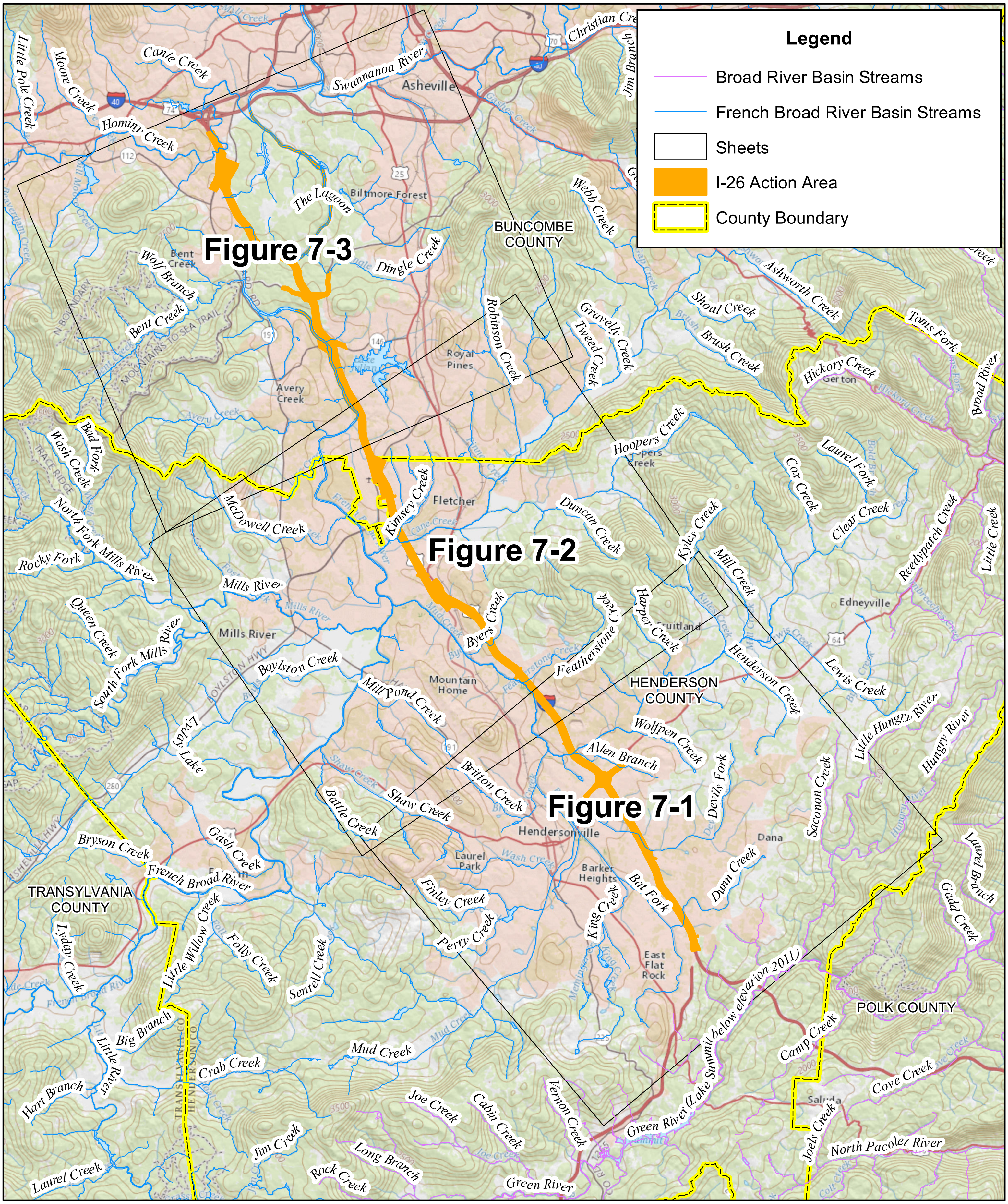
Map Date: 1/3/2018

Appalachian Elktoe Presence in Vicinity of Action Area

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)
Buncombe & Henderson Counties, NC

Figure

6



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Sources:
NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 3 miles

0 1 2 3 4 5
Miles

Map Date: 2/27/2018

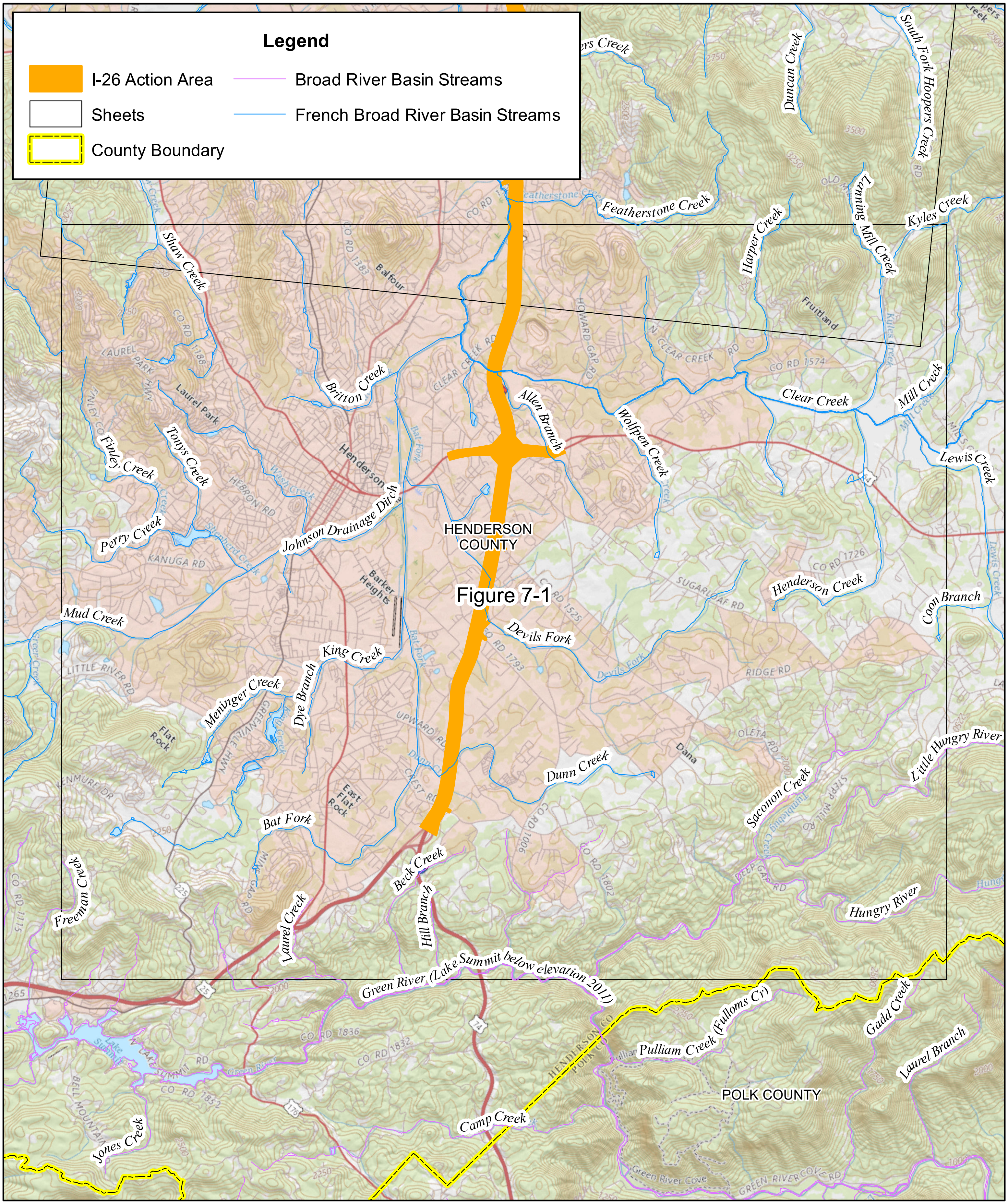
Action Area Streams

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)

Buncombe & Henderson Counties, NC

Figure

7



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Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 1 miles

0 0.5 1 1.5 2
Miles

Map Date: 2/27/2018

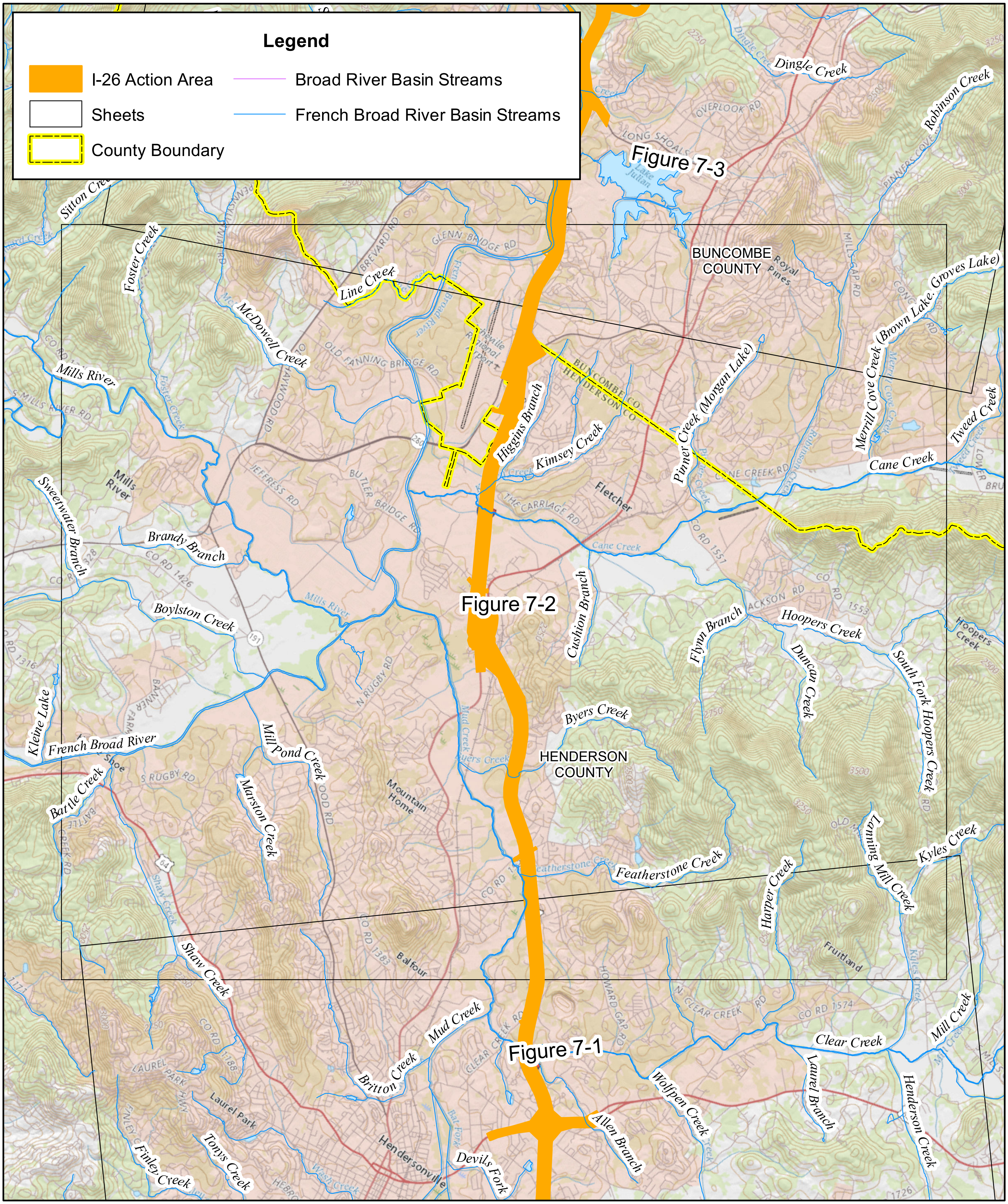
Action Area Streams

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)

Buncombe & Henderson Counties, NC

Figure

7-1



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Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 1 miles

0 0.5 1 1.5 2
Miles

Map Date: 2/27/2018

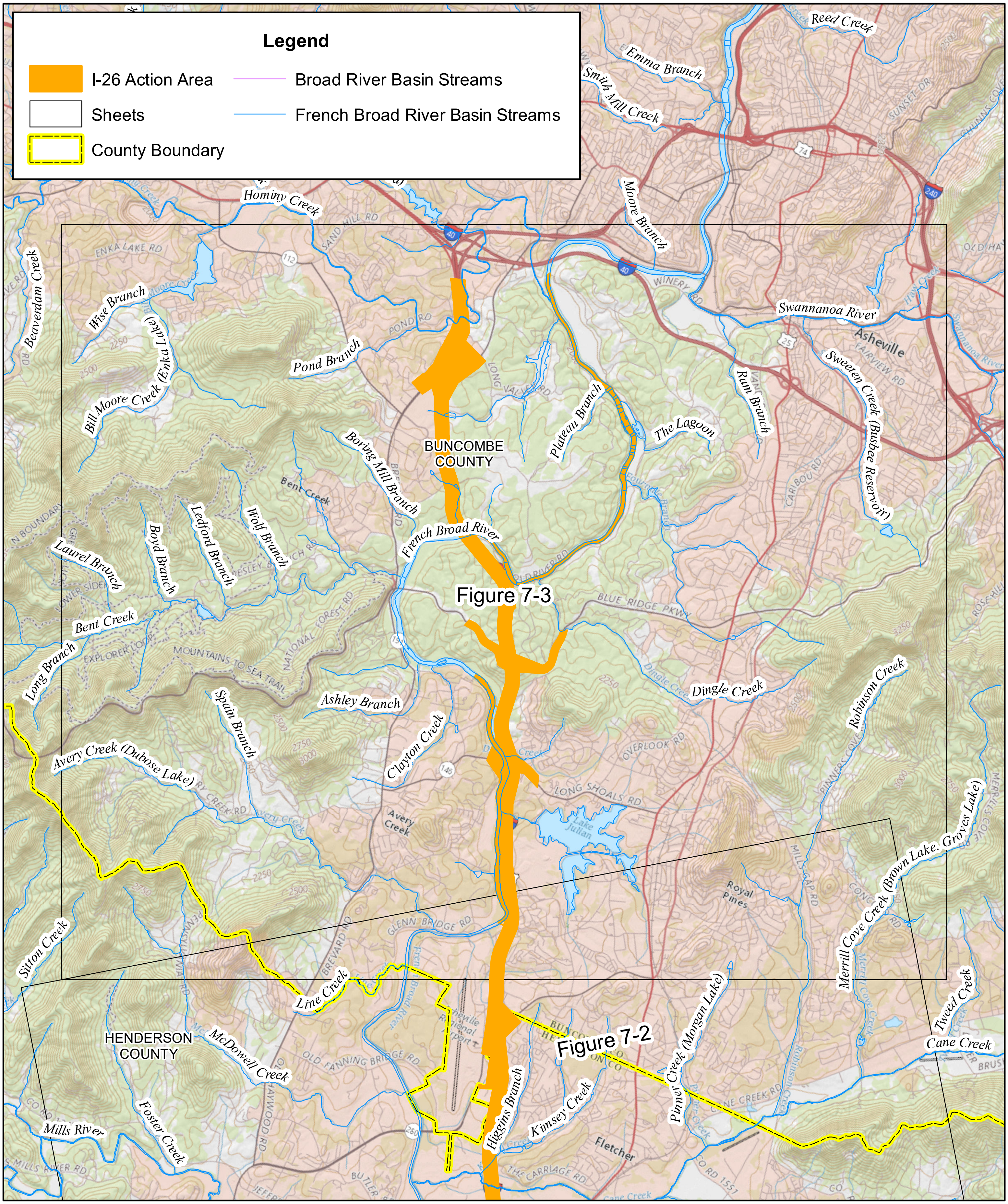
Action Area Streams

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)

Buncombe & Henderson Counties, NC

Figure

7-2



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NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 1 miles

0 0.5 1 1.5 2
Miles

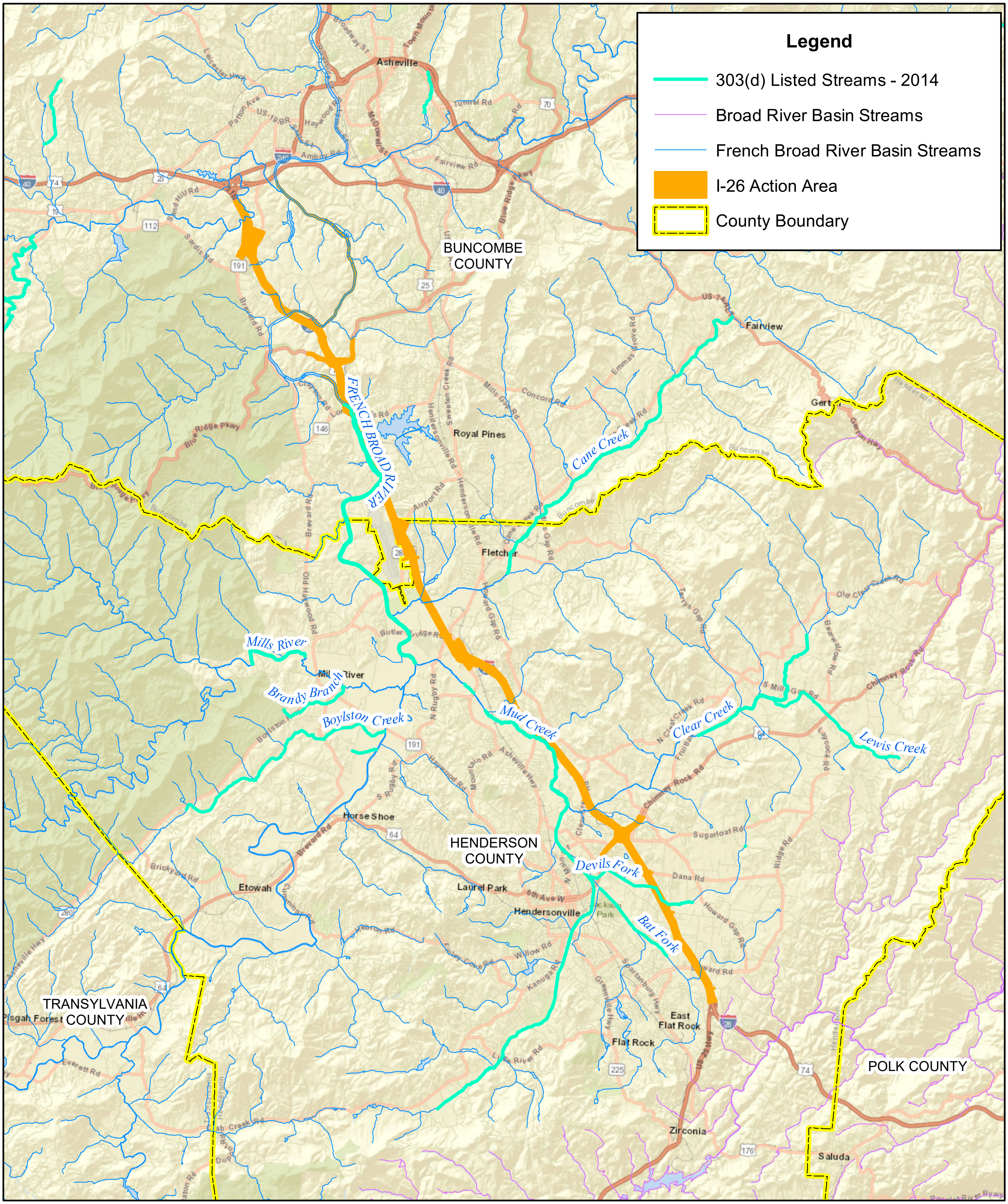
Map Date: 2/27/2018

Action Area Streams

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)

Buncombe & Henderson Counties, NC

Figure
7-3



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Sources:
NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 3 miles

0 1 2 3 4 5
Miles

Map Date: 2/27/2018

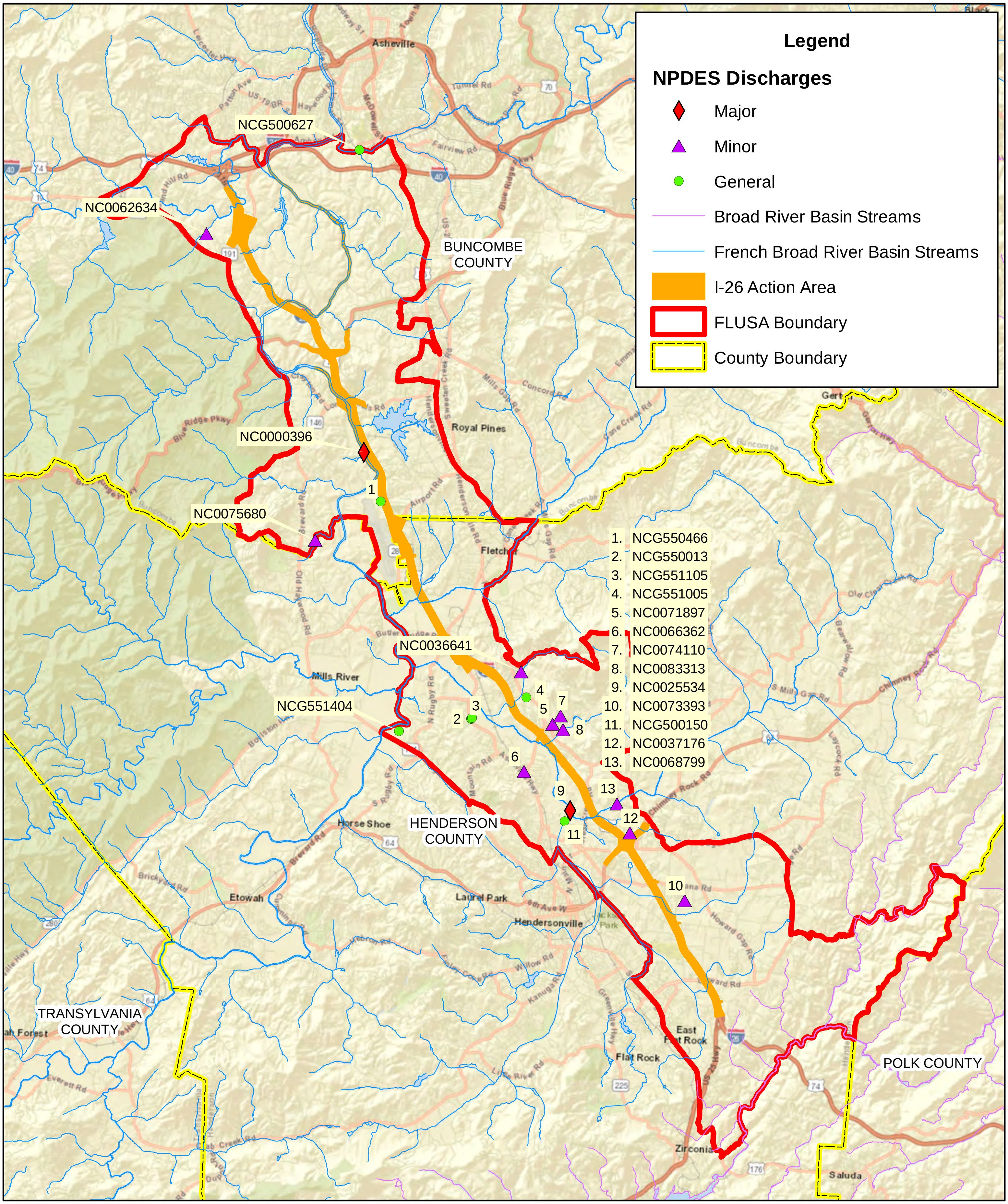
303(d) Listed Streams

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)

Buncombe & Henderson Counties, NC

Figure

8



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Sources:
NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 3 miles

0 1 2 3 4 5
Miles

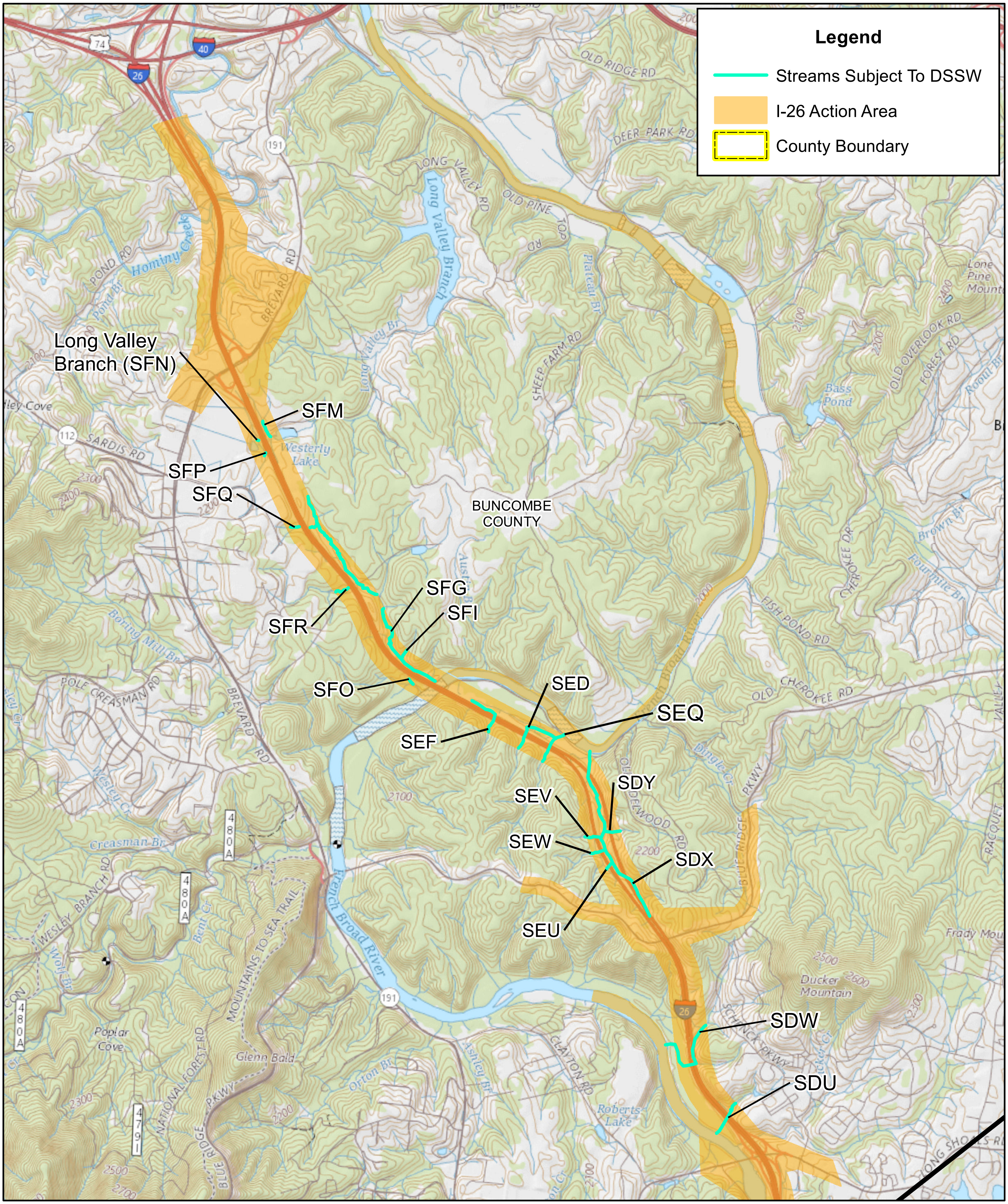
Map Date: 1/3/2018

National Pollutant Discharge Elimination System Discharges

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)
Buncombe & Henderson Counties, NC

Figure

9



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Sources:
NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 1 miles

0 0.5 1
Miles

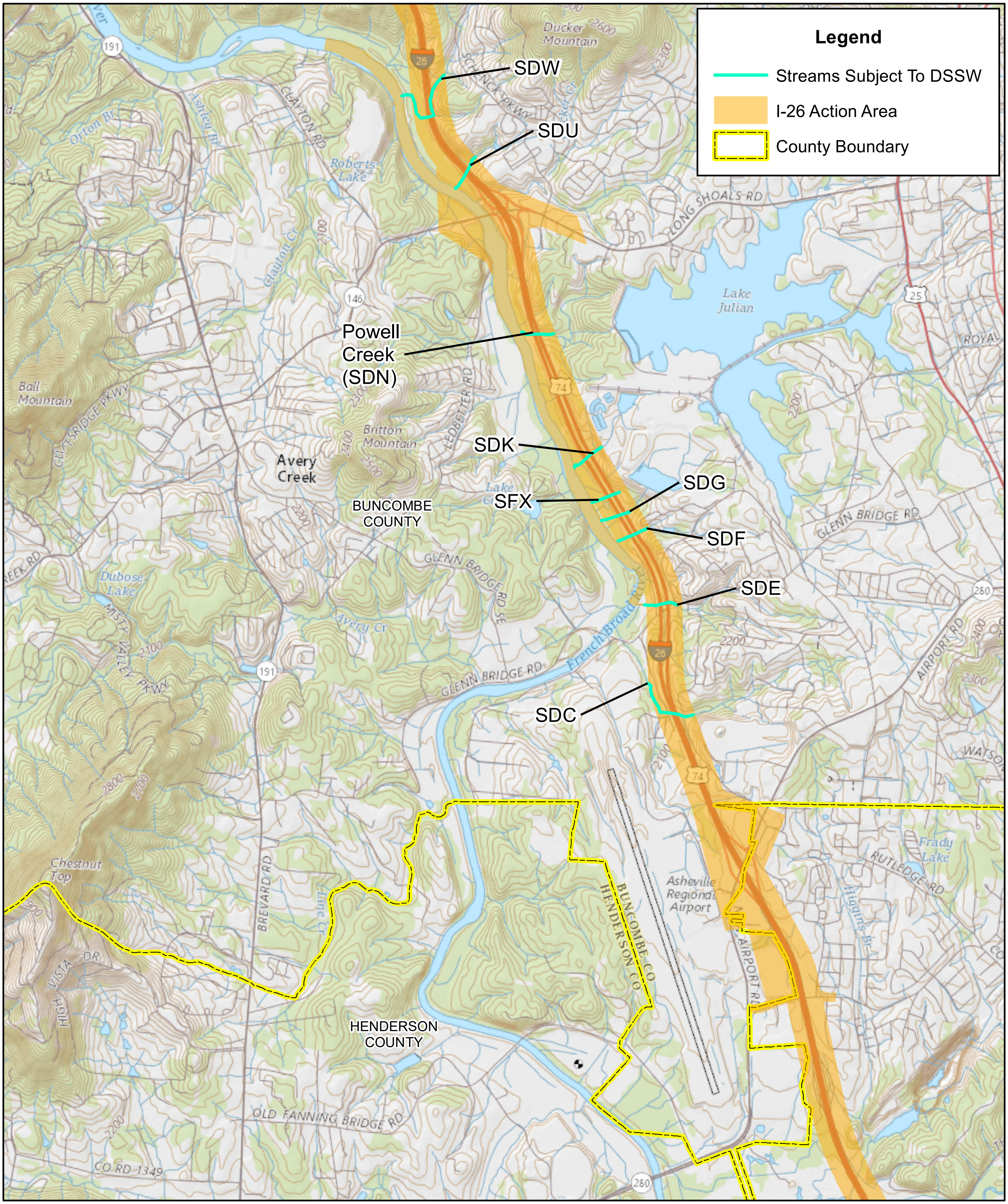
Map Date: 5/17/2018

Streams Subject To Design Standards In Sensitive Watersheds (DSSW)

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)
Buncombe & Henderson Counties, NC

Figure

10-1



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Sources:
NCDOT
Three Oaks Engineering
CALYX Engineers and Consultants
Basemap: ESRI

1 inch = 1 miles

0 0.5 1
Miles

Map Date: 5/17/2018

Streams Subject To Design Standards In Sensitive Watersheds (DSSW)

Biological Assessment
I-26 Widening (TIP Nos. I-4400/I-4700)
Buncombe & Henderson Counties, NC

Figure

10-2

Appendix B: Gray Bat Acoustic Survey Report

FEDERALLY PROTECTED BAT SPECIES ACOUSTIC SURVEY REPORT

I-26 Widening
Buncombe and Henderson Counties, North Carolina
Federal Aid Project No. NHF-26-1(622)23/MNHF-026-1(86)9
WBS 34232.1.1/36030.1.1

TIP I-4400/I-4700

Prepared for

The North Carolina Department of Transportation
Environmental Analysis Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

November 2017

FEDERALLY PROTECTED BAT SPECIES ACOUSTIC SURVEY REPORT

I-26 Widening
Buncombe and Henderson Counties, North Carolina
Federal Aid Project No. NHF-26-1(622)23/MNHF-026-1(86)9
WBS 34232.1.1/36030.1.1

TIP I-4400/I-4700

Prepared for

The North Carolina Department of Transportation
Environmental Analysis Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

Prepared by

CALYX ENGINEERS + CONSULTANTS

CALYX Engineers + Consultants
6750 Tryon Road, Cary, NC 27518
919.836.4800

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Table of Contents

1.0 PROJECT DESCRIPTION

The North Carolina Department of Transportation (NCDOT) obtained the services of CALYX Engineers and Consultants, Inc. (CALYX) to perform protected bat surveys for the proposed widening of I-26 (STIP Project No. I-4400/I-4700). NCDOT, in cooperation with FHWA proposes to improve an approximate 20-mile segment of Interstate 26 (I-26), primarily by widening the roadway and realigning interchanges. The project is located in Henderson and Buncombe Counties, beginning just south of Hendersonville and terminating just south of Asheville (Appendix A, Figure 1). Although I-26 is an east to west interstate corridor, it primarily runs south to north through the study area and is described this way throughout the document. Figure 1 (Appendix A) shows the general project vicinity. The proposed project is included in the 2017 – 2027 STIP as project numbers I-4400 and I-4700. STIP Project I-4400 proposes to widen I-26 from US 25 (Exit 54) north to NC 280 (Exit 40). STIP Project I-4700 proposes to widen I-26 from NC 280 north to the I-40/I-240 interchange.

For purposes of this scope of work, the project footprint is defined as the study area to be depicted in the Final EIS, approximately 1,400 feet wide, centered on the existing roadway, with expansions around interchanges and the Blue Ridge Parkway crossing of I-26. Figure 2 (Appendix A) depicts the project footprint.

The study area lies in the Southern Blue Ridge Mountain physiographic region of North Carolina. Topography in the project vicinity ranges from very steep, rolling intermountain hills and narrow valleys to wide valleys and stream floodplains associated with the French Broad River. Elevations in the study area range from approximately 2,000 to 2,310 feet above mean sea level. Land use in the project vicinity is primarily urban and suburban, particularly in the northern half of the project, with mixed agricultural and natural areas elsewhere.

2.0 SPECIES INFORMATION

As of April 28, 1976 the U.S. Fish and Wildlife Service (USFWS) listed gray bat (*Myotis grisescens;* MYGR) as "Endangered" under the Endangered Species Act. As of June 8, 2017 (date accessed), MYGR was listed as "current" in Buncombe County and "probable/potential" in Henderson County (USFWS 2017a). This species is known or presumed to occur in these counties only during summer months.

2.1 Nearby Records

Buncombe County contains three records for MYGR; one historic (1968) and two current (2003, 2016). The historic record represents a capture from a residence in the Asheville area. In 2003, a juvenile male was caught by mist netting near South Hominy Creek, and in 2016 a juvenile female was captured while roosting at a bridge over the French Broad River, approximately one mile west of the action area. Since then, this roost site has been monitored, and has been determined to be a maternity roost, supporting up to an estimated 800 individuals (Katherine Caldwell, NCWRC, personal communication). It is important to note that, prior to the identification of this roost, there were no documented maternity roosts for this species in North Carolina. Another adult male was captured in a mist net during the summer of 2017 in the Bent Creek area, approximately 1.5 mi from the action area, but this record has not yet been incorporated into the NCNHP database (personal communication, Katherine Caldwell, NCWRC). No hibernacula for this species have been documented in North Carolina (NCNHP 2017).

2.2 Natural History

Summer maternity roosts are typically located within 1 km of a river or reservoir over which the bats forage (Tuttle 1979), and are rarely located more than 4 km away from foraging areas (Tuttle 1976a). However, individuals may travel up to 35 kilometers between prime feeding areas over lakes or rivers and occupied caves (LaVal et al. 1977, Tuttle and Stevenson 1977, Tuttle and Kennedy 2005). Forested areas along the banks of streams and lakes serve as corridors for travel and as protective feeding cover for newly volant young (Tuttle 1979, Brady et al. 1982).

3.0 ACOUSTIC SURVEY METHODS

This section describes the methods used to perform surveys. All survey methods were developed in coordination with NCDOT, the Asheville USFWS Ecological Services Field Office and the North Carolina Wildlife Resources Commission (NCWRC). MYGR were known to be present within the project vicinity, so acoustic surveys were not designed to determine presence/absence. Alternatively, acoustic surveys served the purpose of determining areas of highest MYGR activity, and seasonal patterns of activity, if possible.

Qualifications of CALYX biologists who performed the work for this project are included in Appendix B.

3.1 Sample Data Collection

During project development, traffic noise was identified as a potential concern as it was unknown what influence it would have on data collection. Prior to the start of formal data collection, a trial was conducted to determine the most efficient detector setup to maximize results. Two detectors were deployed side by side at the foot of the I-26 westbound bridge over the French Broad River (Site 11 in Figure 3). One detector was deployed with a microphone height of 12 feet, the second with a microphone height of 20 feet (See Photo 1, below). Another detector (11-2) was placed approximately 800 feet west of the I-26 bridges in an open area of the riverbank. One additional detector (11-3) was placed approximately 600 feet east of the bridges in a field, set back from the riverbank. Each of these detectors had a microphone placed at a height of 12 feet. Figure 3 in Appendix A shows the location of the trial detectors.

Data was analyzed by CALYX biologists and reviewed by USFWS and NCWRC biologists to determine whether different/better results (i.e., call quality, number of noise files versus other files, etc.) were achieved by the varying setups. The pair of detectors immediately adjacent to the bridge recorded more bat calls than the other test site detectors. Furthermore, of that detector pair, the detector with the 12 foot microphone recorded more bat calls and fewer noise files than the detector with the microphone set at 20 feet. This provided a degree of confidence that detectors throughout the project limits, although potentially in close proximity to traffic, would be able to collect sufficient numbers of bat calls despite the volume of nearby traffic.

Photo 1. Test detectors at 12' (left) and 20' (right) heights

3.2 Detector Locations

With regard to bat acoustic analysis, “clutter” is defined as anything that serves as a surface to reflect sound. This could be anything from grass, leaves, tree limbs, and water, to a human body, bridge, or even the detector itself. Bats produce differing echolocation calls depending on the type and amount of clutter. MYGR typically forage in areas of low clutter, over large streams and rivers. Low clutter detector locations typically produce recordings with longer call sequences where the individual pulses are complete, lower in slope, lower in frequency, and less likely to be confused with other species (more distinct), and therefore, increasing the chances of correct identification. So, the project goal was to choose detector locations in these area, with low amounts of clutter near the microphone.

In general, quality habitat is more abundant in the northern half of the project (I-4700), and this section of the project is also closer in proximity to the French Broad River, which is where MYGR are most likely to be active. Given that detectors were deployed to try to determine, without telemetry, bat movement and presence that would be affected by the project, the southern end of the project was less of a priority. Therefore, USFWS and NCWRC requested that acoustic surveys focus on the northern portion of the proposed project study area. Based on the known location of the maternity colony just west of the project, and because MYGR typically use large streams and rivers for foraging and commuting, most of the acoustic detector sites were established at strategic locations along the French Broad River. Detector sites were also established in a few specific areas where general information on bat activity was needed, and in an effort to determine whether MYGR were present outside their typically preferred habitat. In total, 12 detector locations (Sites 1-12) were originally established in the highest quality MYGR foraging/commuting habitat within the study area. One additional detector site (Site 13) was established toward the end of the survey period to provide supplemental data. Ten of these detector sites were located in the northern portion of the study area (I-4700), with the remaining three occurring at the highest quality MYGR habitat locations in the southern half of the study area (I-4400). Figures 4A-4K in Appendix A show the locations of the detector sites.

3.3 Acoustic Equipment

The majority of the sites were monitored using Titley Scientific AnaBat Express passive monitoring devices using the latest firmware version (V5506L) with weatherproof directional microphones. After repeated failure of one unit, it was replaced with a Titley Scientific AnaBat SD2 detector using the latest firmware version (v4062g) with a stainless-steel, omni-directional microphone enclosed in a Titley Scientific weatherhead (PVC tube, with a 45 degree bend). This configuration results in a cone of detection that is similar to a directional microphone. All acoustic equipment and deployment techniques met the requirements outlined in the USFWS 2017 Range-wide Indiana Bat Summer Survey Guidelines (USFWS 2017b). All detectors were serviced by Titley Scientific or purchased brand new during the spring of 2017. Specific information about the detectors utilized at each site is presented in the acoustic data forms in Appendix B.

3.4 Detector Placement and Setup

Detector placement and setup generally followed methodologies as outlined by the USFWS 2017 Range-Wide Indiana Bat Summer Survey Guidelines (USFWS 2017b). The exact physical location, and height and orientation of the microphone was determined in the field by a qualified CALYX biologist and all sites were located using a handheld GPS unit. Detectors that were located near roadways were placed as far away from vehicles as possible while still utilizing forest edge habitat. In these cases, CALYX biologists placed the detectors in locations and orientations that would minimize noise from passing vehicles. This was accomplished by orienting microphones away from traffic, placing microphones downslope at a lower elevation than passing cars, or using other landscape features to block traffic noise. The microphones were elevated a minimum of 12 feet from the ground or water surface to avoid the possibility of sound echoing off those surfaces toward the microphone. Microphone height was adjusted on a site by site basis, depending on height and thickness of understory vegetation.

Detectors were generally programmed to record nightly beginning 30 minutes prior to sunset, and recording until 30 minutes after sunrise. Medium microphone sensitivity settings and data division ratios of 8 or 16 were chosen. Upon deployment of any detector, verification was made that the detector was functioning properly by performing a test of the system per the AnaBat Express Bat Detector User Manual Version 1.8 (Titley Scientific 2017a) or AnaBat SD2 Compact Flash Bat Detector User Manual (Titley Scientific 2017b). Photographs and site-specific information for each detector site and setup are recorded on the acoustic data forms presented in Appendix B.

3.5 Proposed Deployment Schedule

Survey activities were proposed for a 12-week period beginning Thursday May 4th, 2017 and ending Thursday July 27th, 2017. A rotating schedule for deployment was created which ensured uniform collection of acoustic data throughout the season. The three (3) sites located in the southern half of the project (I-4400) were each scheduled to be surveyed twice, whereas the nine (9) original sites located in the northern half of the project (I-4700) were each scheduled for three deployments. This distribution of detector sites satisfied USFWS's request to focus acoustic efforts on the northern portion of the project, and provide adequate data for the southern portion of the project. Table 1 illustrates the proposed acoustic survey plan.

Table 1. Proposed Detector Deployment Schedule

		Deployment Week											
	Detector Site	1	2	3	4	5	6	7	8	9	10	11	12
I-4400	1				■				■				
	2					■				■			
	3						■				■		
I-4700	4			■				■				■	
	5	■				■				■			
	6		■				■				■		
	7			■				■				■	
	8				■				■				■
	9	■				■				■			
	10		■				■				■		
	11			■				■				■	
	12				■				■				■

■ = Proposed deployment at site

3.6 Acoustic Analysis – Autoclassifier

All recorded call files were processed with EchoClass version 3.1 and BCID East version 2.7d; both USFWS approved automated identification programs. Default species suites were used for both programs. Maximum likelihood estimates (MLE), identifications by file, and identifications by night were output by both programs. Independently, two CALYX biologists manually vetted all calls identified as *Myotis* (any species) by both programs as well as all calls identified as MYGR by either program. The exception to this is call data collected from Site 11. Due to the volume of calls identified as MYGR by the software, it was agreed upon by USFWS, NCWRC, NCDOT, and CALYX that only five percent of call files (or a total of 50 calls, whichever was greater) from each week would be manually vetted for Site 11. Representative sonograms of each manually vetted call file were viewed using Titley Scientific AnalookW (version 4.1z) to review call characteristics including pulse spacing, characteristic frequency, slope, and changes over time through the call file.

Calls were generally examined to reach a yes/no determination for MYGR identification, and were not attempted to be identified to other species. If both biologists independently determined that a particular call was likely attributable to MYGR (a "yes"), the call was considered to be "confirmed" as MYGR. In 2016, Blue Ridge Parkway staff recorded calls they believed to be consistent with Indiana bat (*Myotis sodalis*; MYSO). Therefore, as part of this acoustic analysis, calls identified as MYSO by either program at all detector sites were also vetted. Furthermore, in an effort to focus specifically on MYSO on Parkway property, CALYX biologists manually vetted all remaining *Myotis* (any species) calls not attributable to MYGR from the Parkway detector to determine if any calls could be identified as MYSO.

4.0 RESULTS

This section describes the results of the acoustic surveys. CALYX biologists visited the project site each week to download data, replace batteries, and relocate detectors to the predetermined detector sites. CALYX provided periodic updates to NCDOT, NCWRC, and USFWS as results

become available. CALYX analyzed acoustic data as efficiently as possible to determine "real time" results.

Overall, acoustic surveys were performed for a 13-week period between May 4, 2017 and August 2, 2017. During the survey period, 322 acoustic nights of data were collected, processed and vetted from the 13 different locations established throughout the project study area.

4.1 Data Analysis

Surveying for bats using acoustic methods can be challenging for a variety of reasons. Acoustic detectors are limited in their ability to detect and record bats, distinguish bat calls from other sounds, and withstand environmental factors. Acoustic analysis software is also limited in its ability to distinguish bat calls from other sounds, and correctly identify bats to species. In addition to a variety of environmental and technical factors that may interfere with the software's ability to identify the species, individual bats may change their calls depending on their activity and specific location within their environment. There is no foolproof method to accurately identify bat species acoustically. In fact, it is impossible to be definitive about *Myotis* species identification (and in some cases other North American bat species), unless the bat is in hand. Vetting of individual call files by professionals who are trained and experienced with acoustic analysis can further eliminate the possibility of incorrect species identification. However, at best, it can only be concluded that a given call sequence from an individual bat may likely be attributable to a particular species based on comparison with a known call sequence from a bat flying in a similar situation.

That said, it is possible to definitively identify high quality calls to the genus *Myotis*, and MYGR are one of the more readily identifiable species of *Myotis* based on calls. In addition, we can feel fairly confident about identification when there is agreement between software programs and the biologists independently vetting the calls.

In order to minimize the many challenges inherent to species identification based on acoustic data, CALYX biologists were diligent about monitoring site conditions, detector setups, detector function, and subsequent data collected to ensure call files of the best possible quality were being recorded. Throughout the life of the project, adjustments were made to the proposed deployment schedule for various reasons. These included detector failure, insufficient data collection, excessive noise, or lack of call quality/quantity. Due to an abundance of MYGR calls recorded during the testing phase and proximity to a bridge pair that will be replaced as part of the proposed project, Site 11 became a permanent detector site beginning week 3. As a result of excessive noise files and minimal overall bat activity, Sites 9 and 12 were only surveyed twice and then decommissioned. Site 13 was established as a permanent location during Week 9 as a way to investigate the amount of MYGR activity between the maternity roost and Site 11. Additionally, Sites 3, 6, and 7 required redeployments at various times throughout the project due to detector failures or malfunctions, resulting in an additional week of surveys (Week 13) being added to the schedule.

The final deployment schedule is presented in Table 2, below. A summary of the data collection results is also shown. The number of calls identified as MYGR by manual double vetting (two people reviewing calls) is indicated. As previously mentioned, it is important to note that based on the volume of call files identified as MYGR by both software programs at Site 11, USFWS and NCWRC advised that only a portion of the calls should be vetted. Therefore, for all weeks at site 11, for calls identified by either software program as MYGR, CALYX biologists vetted 5% of the calls or a minimum of 50 calls, whichever was greater. The same process was used for data from week 10 at Site 13. For detailed results from each detector site refer to the acoustic data forms

and Table 1 in Appendix B. (In Appendix C, Table 1, note that the number of vetted calls is not a total of all calls identified by both BCID and Echoclass. Overlapping calls were considered when calculating the values in the "Vetted" column. It is important to note that study methodologies dictated that any calls identified by both software programs as Myotis be vetted. No non-MYGR Myotis calls identified by the software programs were attributed to MYGR as a result of manual vetting. These calls were either unidentifiable, attributed to red bats (*Lasiurus borealis*), or were determined to be a non-MYGR *Myotis* species. Therefore, these values are not included in Table 2, below, or Appendix B, Table 1.) Furthermore, Figures 4A-4K in Appendix A also show the number of calls vetted at each site, for each week, and the number of calls ultimately attributed to MYGR (i.e. "confirmed").

Table 2. Final Deployment Schedule and Results

		Deployment Week												
	Detector Site	1	2	3	4	5	6	7	8	9	10	11	12	13
I-4400	1				0				2					
	2					3				1				
	3						0*	1			3			
I-4700	4			0				1				1		
	5	3				87				77				
	6		4				7				0**			69
	7			0				2				0**	3	
	8				2				2				7	
	9	0				0								
	10		7				5				30			
	11[1]			157	124	163	181	91	99	35	38	123	45	64
	12				1				0					
	13[1]									58	28[1]	9	9	

- (green) No MYGR call ID by either software
- (blue) MYGR call ID by BCID only
- (orange) MYGR call ID by EchoClass only
- (magenta) MYGR call ID by BCID and EchoClass
- (yellow) MYGR call ID by BCID, EchoClass, and Vetting
- # Number of MYGR calls identified by double vetting
- (hatched) Failed deployment
- * Detector fell over; some data recorded each night
- ** Detector electronic failure; no data recorded
- [1] CALYX biologists vetted 5% of the calls or a minimum of 50 calls, whichever was greater

After processing all recorded call files through BCID East and EchoClass, MYGR calls were identified by one or both software programs at 12 of the 13 detector sites. Site 9 is the only location where MYGR calls were not recorded. Likewise, vetting revealed MYGR calls at all sites where MYGR were identified by one or both software programs.

The detector sites located immediately adjacent to the French Broad River (sites 5, 6 10, 11, 13) produced the largest number of MYGR calls.

Based on the results of software call analysis and manual vetting, site 11 consistently produced the highest amount of general bat activity, and specifically of MYGR activity within the project

study area. Site 11 is of particular concern since the dual spans at this location are slated for replacement as part of the proposed project. Comprehensive data for site 11 is included in Table 1 of Appendix C, and the data sheet for the site is also included in Appendix C. Table 3, below, presents a condensed version of the data for all weeks of data collection at site 11.

Table 3. Acoustic Data Summary for Detector Site 11

Week		Number of MYGR Calls Identified			
Start Date	**End Date**	**BCID**	**EchoClass**	**Vetted***	**Confirmed**
Week 3		2,484	756	176	157
20170518	20170524				
Week 4		1,960	747	135	124
20170525	20170531				
Week 5		2,766	1,196	200	163
20170601	20170607				
Week 6		2,580	1,734	216	181
20170608	20170614				
Week 7		1,469	969	122	91
20170615	20170621				
Week 8		1,590	1,103	136	99
20170622	20170628				
Week 9		496	197	50	35
20170629	20170705				
Week 10		781	91	50	38
20170706	20170712				
Week 11		641	2,376	151	123
20170713	20170719				
Week 12		890	170	55	45
20170720	20170726				
Week 13		1,222	337	79	54
20170720	20170726				
TOTALS		**16,879**	**9,676**	**1,370**	**1,110**

*for calls identified by either software program as MYGR,
CALYX biologists vetted 5% of the calls or a minimum of 50 calls,
whichever was greater

Based on the results of acoustic surveys, MYGR appeared to be most active at detector site 11 during weeks 5 and 6. These weeks correspond to the time of year when females are traditionally about to give birth. The time period with the least MYGR activity were weeks 9 and 10, traditionally when the females are nursing pups.

BCID creates an output file that indicates the number of calls, per species, per night, per hour for each week of data collection. Chart 1, below, provides a visual representation of seasonal MYGR activity at detector site 11 based on traditional phases of MYGR reproduction. The chart averages nightly MYGR calls for each of three important time periods throughout the summer: 1) when

females are pregnant, 2) when females are nursing pups, and 3) when pups are volant ant feeding on their own.

Based on the results of this analysis, it appears that, in general, MYGR are very active at this location throughout the summer. Activity peaks in the hours approaching sunrise. After pups are volant, there is also a peak of activity immediately after sunset.

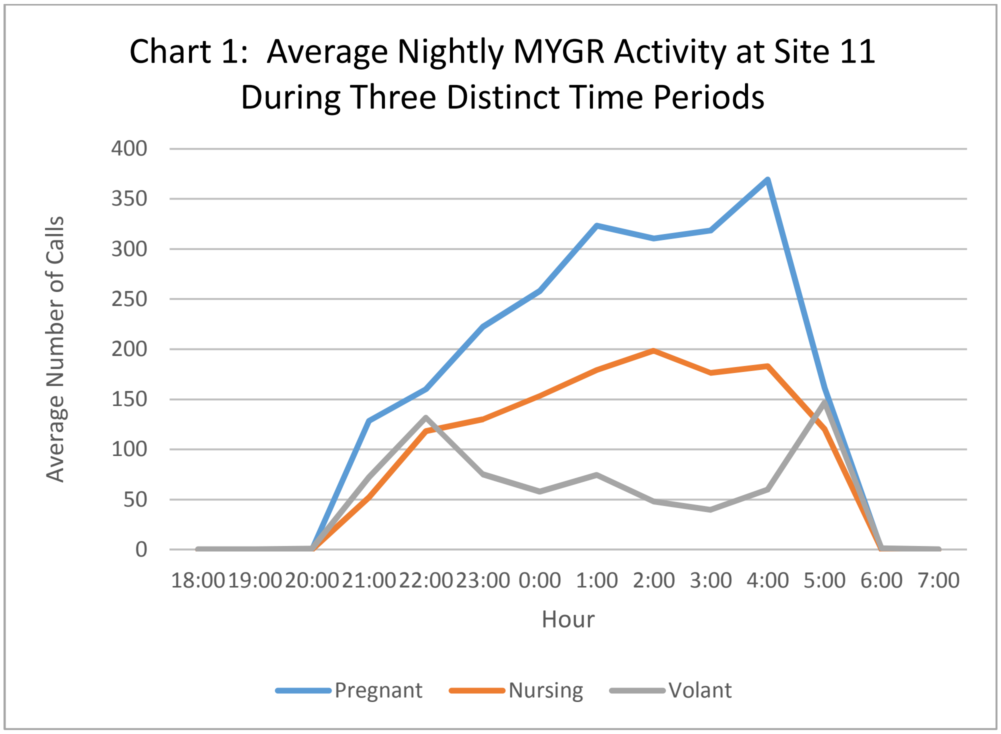
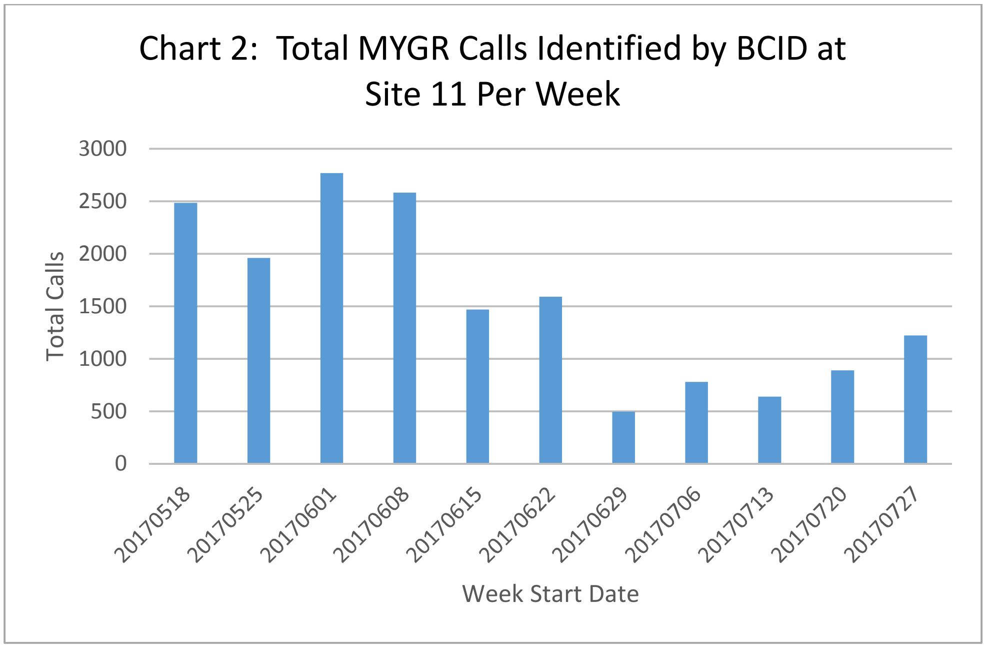


Chart 2 shows the total number of MYGR calls identified by BCID at Site 11 by week. This analysis reveals higher activity levels at the beginning of the season through mid-June. Around the time when females typically begin to give birth, (mid-June) activity at this Site begins to drop. However, activity remains consistent through the end of the season.



It is important to note that variation in number of calls from week to week could potentially be affected by local weather conditions. Rain, high winds, or unusually cool temperatures can all affect bats' ability or desire to forage. Furthermore, MYGR may utilize the area at Site 11 for foraging based on prey availability, so if insect numbers drop for a particular period of time, that may be reflected in overall number of calls for that period.

As described in Section 3.6, calls identified as MYSO by either program at all detector sites were also vetted. Furthermore, in an effort to focus specifically on MYSO on Parkway property, CALYX biologists manually vetted all calls identified as *Myotis* (any species) by both programs from the detector placed on Blue Ridge Parkway property (Site 8) to determine if any calls were attributable to MYSO. No calls identified by the software programs as MYSO or non-MYSO *Myotis* species could be confidently attributed to MSYO.

4.2 Representative Call Images

Appendix D shows sonograms of one representative call file qualitatively determined to have the characteristics of MYGR which was prepared to illustrate call characteristics, including pulse spacing, characteristic frequency, slope, and changes over time through the call file. In addition, a representative sonogram for a call file used to qualitatively justify files as not belonging to MYGR was also prepared. Sonograms were prepared in AnalookW, version 4.2n. Two screen shots of each file are shown, the first at the F2 time scale, uncompressed, in the "frequency only" view and the second at the F7 time scale, compressed, in the "frequency and slope" view. The uncompressed screen shots are shown with filtering turned off. The F7/compressed screen shots are shown after filtering (filters used are listed in the caption under each screen shot) and selected manual cleaning in order to isolate the most representative pulses for measuring. A scan was then run on the measures in the F7/compressed view in order to output characteristics of the pulses shown. These parameters are provided as a third screen shot for each file.

5.0 REFERENCES

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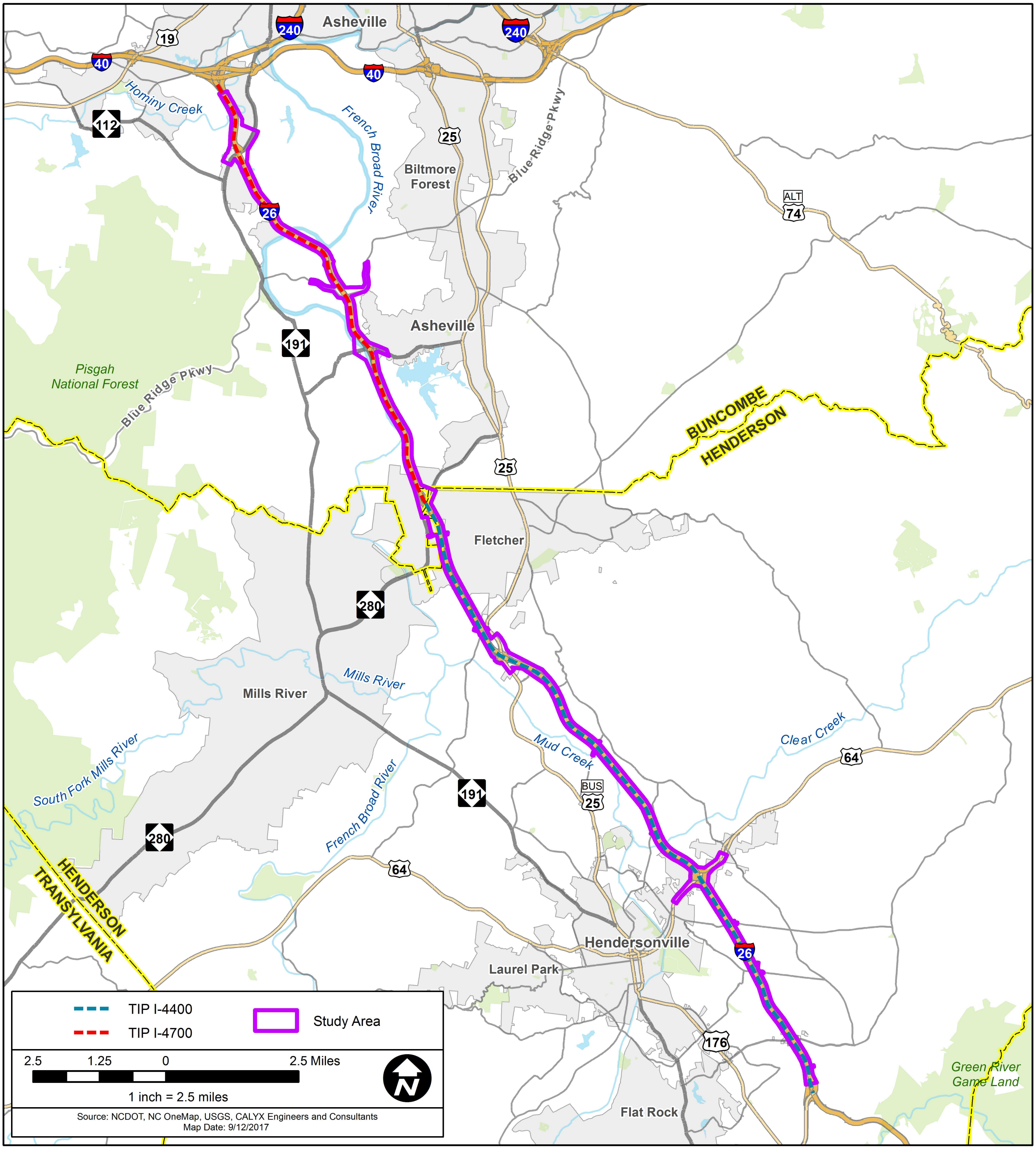
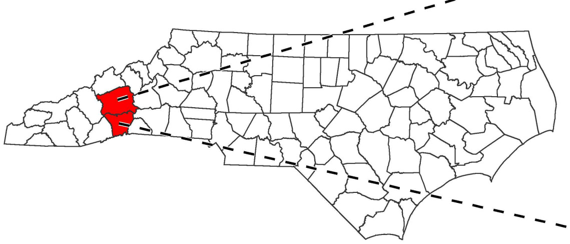
APPENDICES

Appendix A

Figures





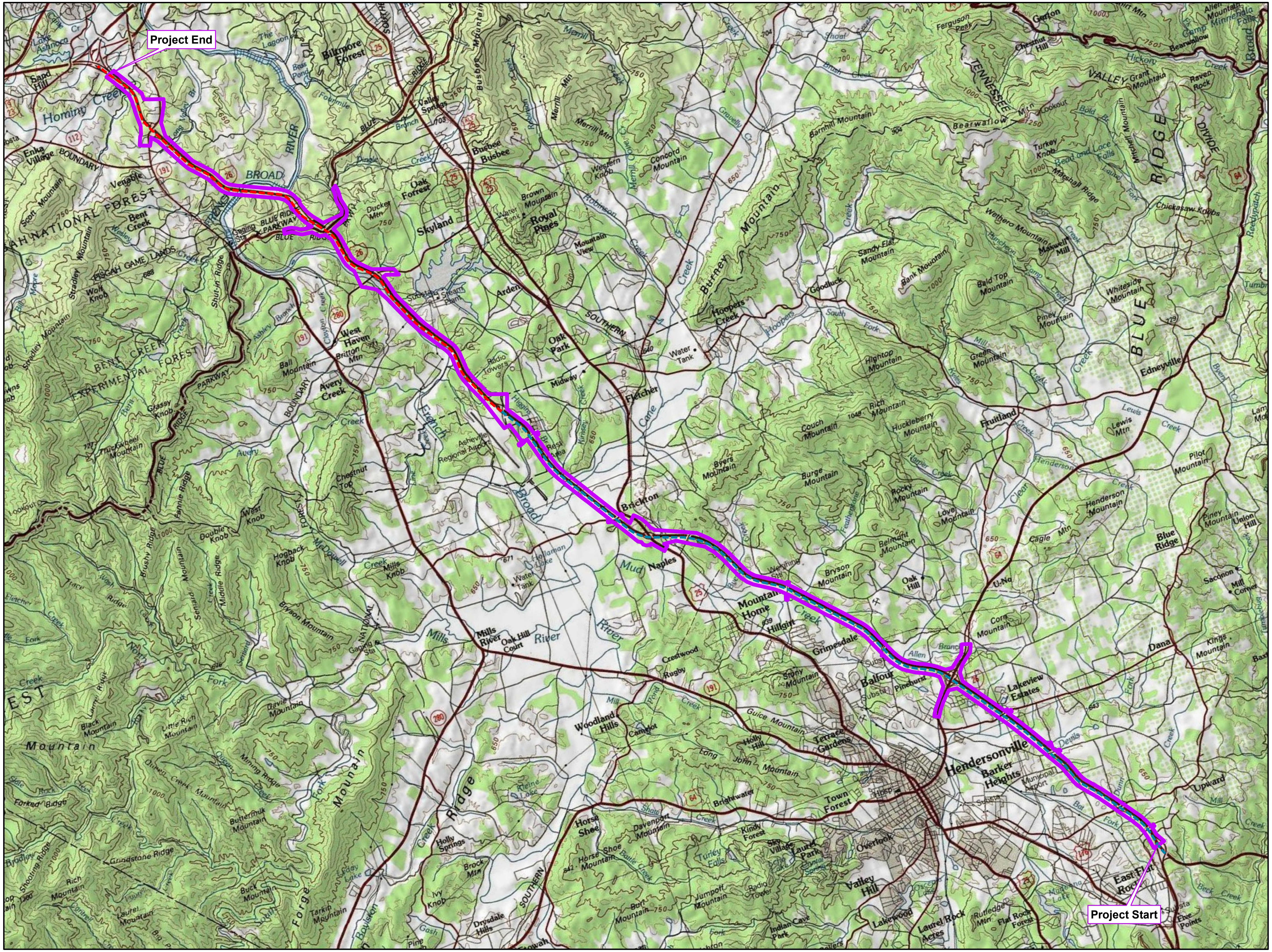
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Widening

TIP Project I-4400/I-4700

Buncombe &
Henderson Counties, NC

Figure 1 - Project Vicinity



Legend

- TIP I-4400
- TIP I-4700
- StudyArea

Figure 2

Project Footprint

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

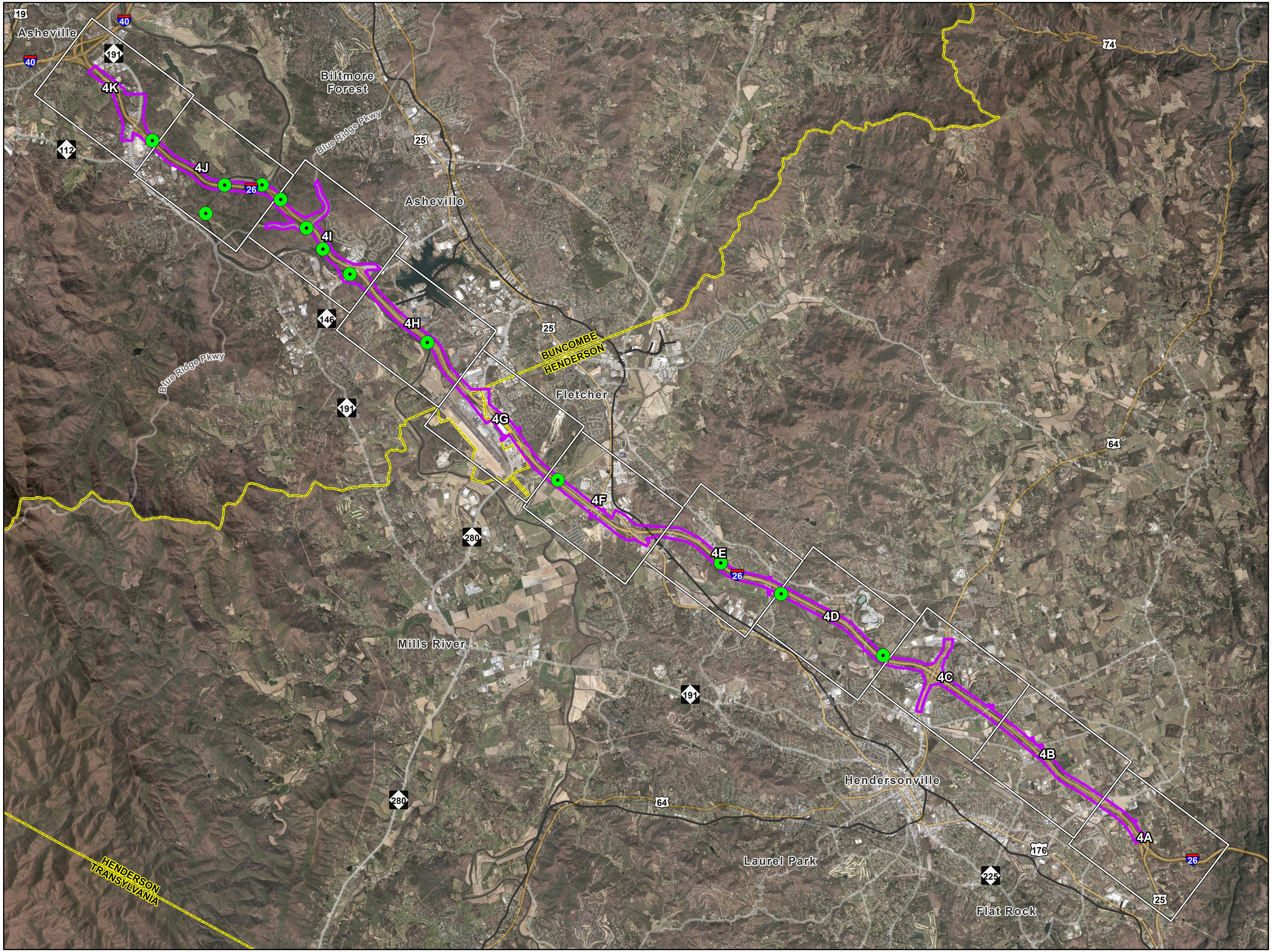
1.5 0.75 0 1.5

Miles

1 inch = 1.5 miles

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below. Streams and Wetlands: All features located in the field were recorded using a mapping grade Trimble GeoXT or GeoXH GPS receiver with supposed sub-meter accuracy.

Sources: ESRI, Calyx Engineers and Consultants



Legend

- Detector Site
- Railroad
- Map Tile
- StudyArea
- County Boundary

Figure 4

Detector Locations Overview

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/8/2017

1.5 0.75 0 1.5

Miles

1 inch = 1.5 miles

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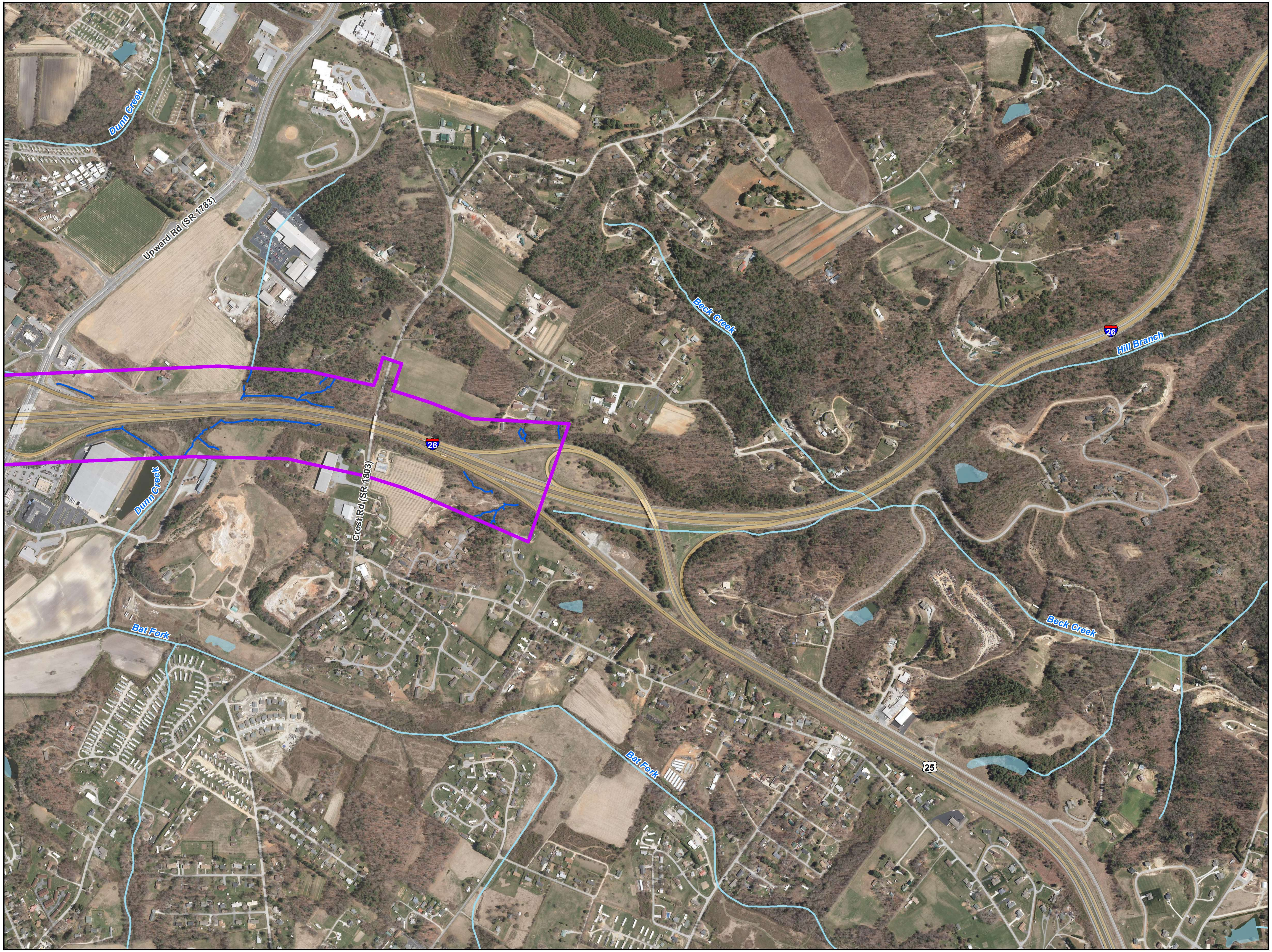
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure

4A

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

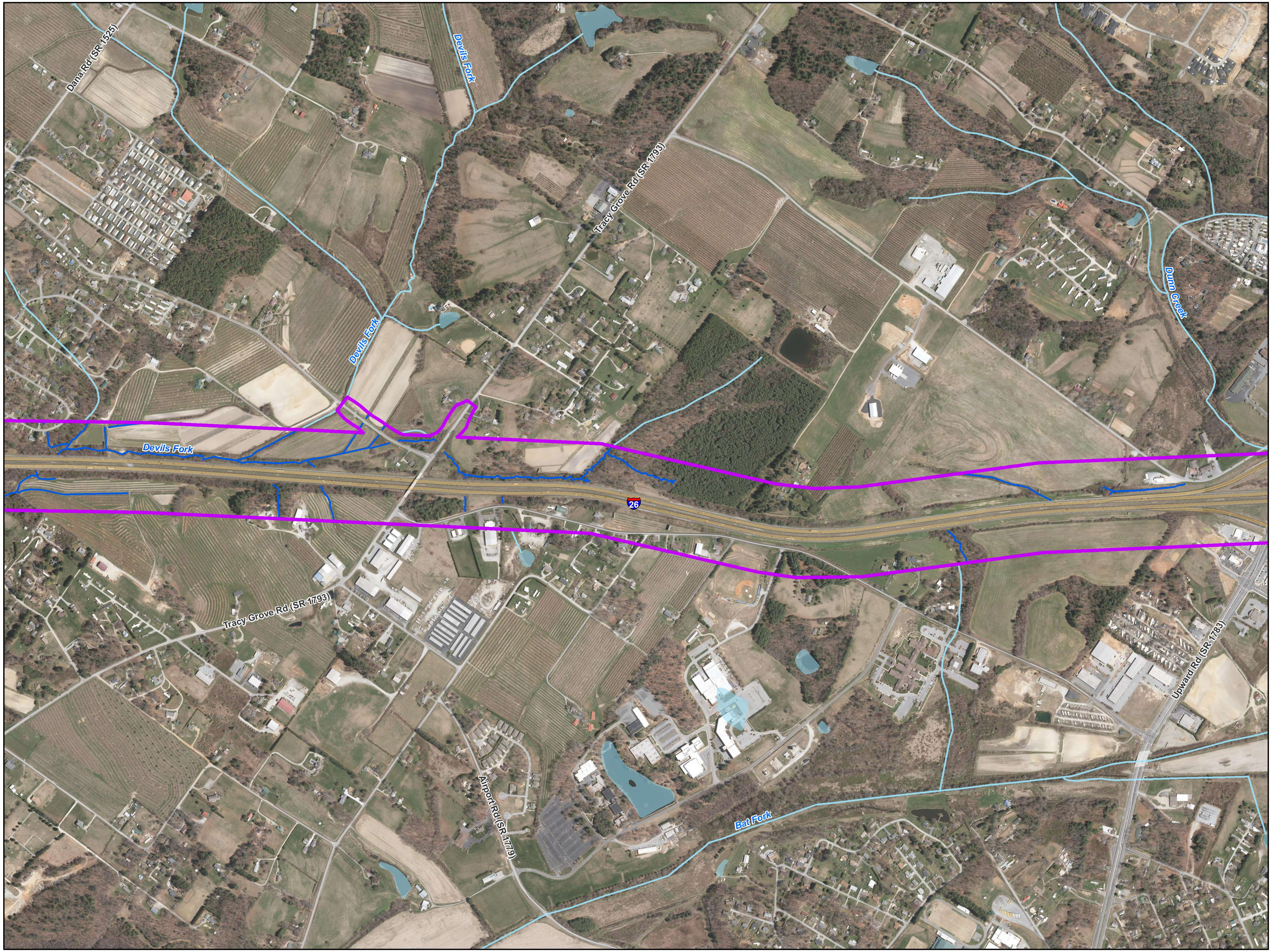
Feet

1 inch = 800 feet

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below. Streams and Wetlands: All features located in the field were recorded using a mapping grade Trimble GeoXT or GeoXH GPS receiver with supposed sub-meter accuracy.

Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4B

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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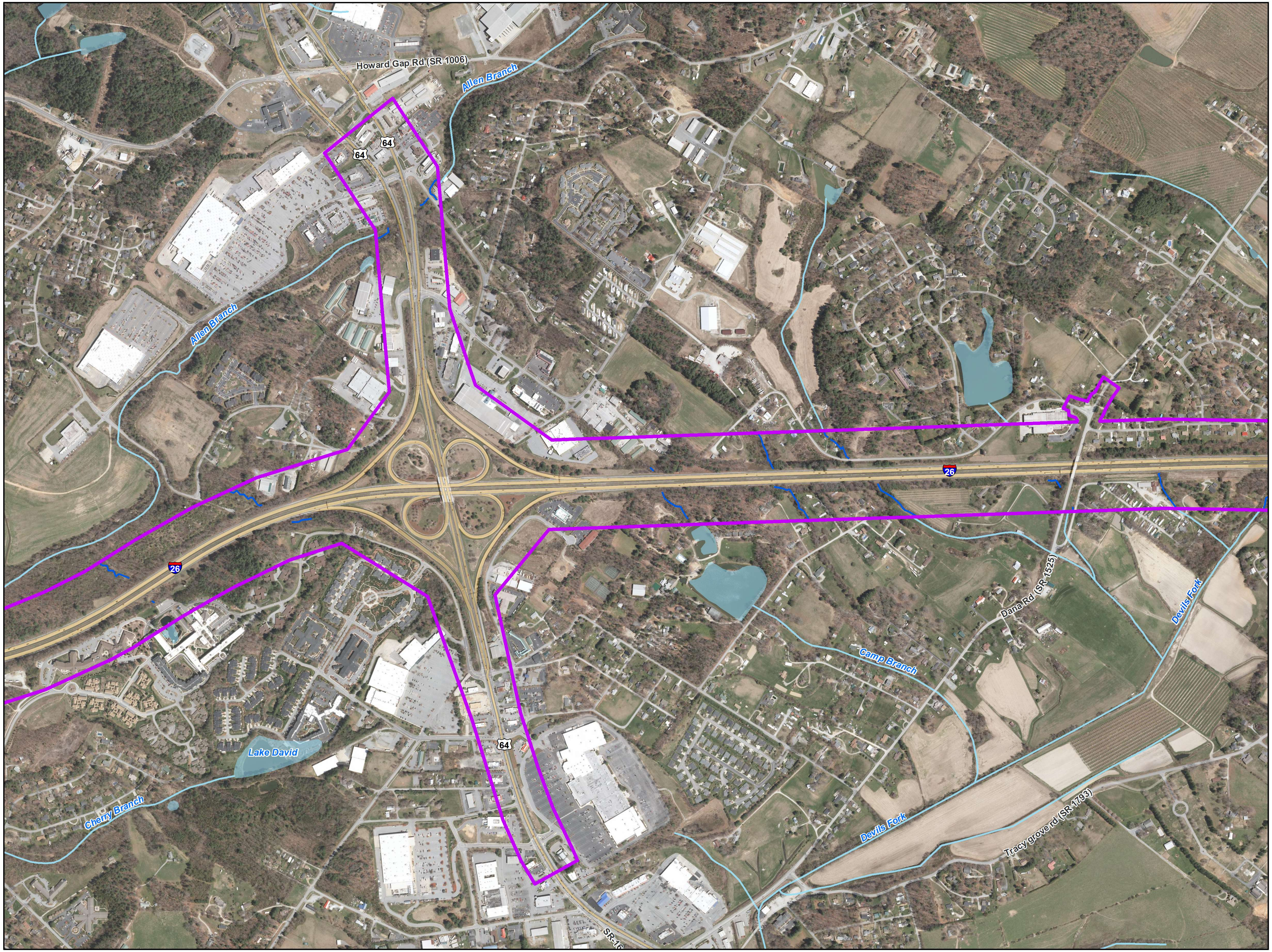
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure
4C

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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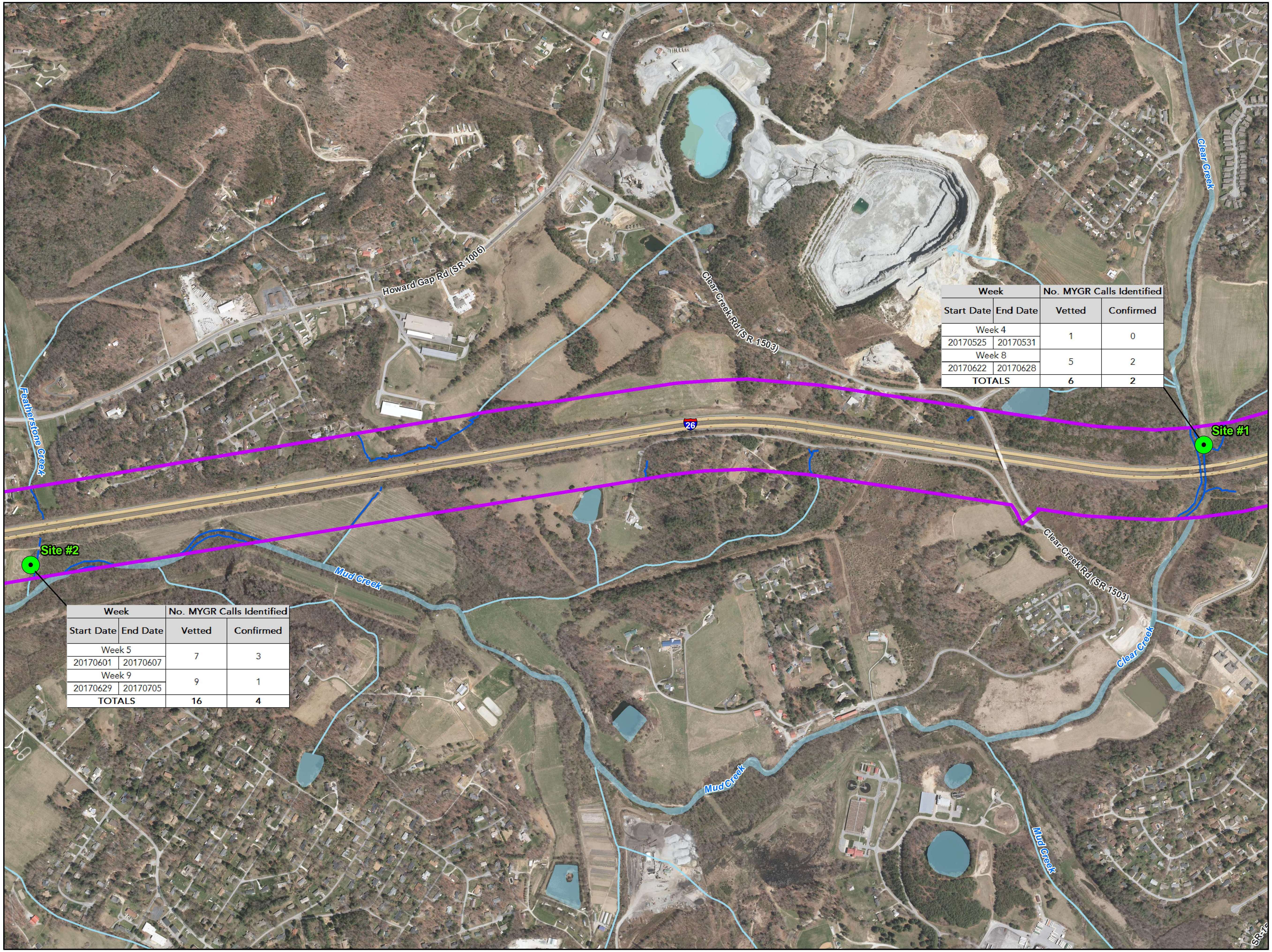
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Site #1

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 4		1	0
20170525	20170531		
Week 8		5	2
20170622	20170628		
TOTALS		6	2

Site #2

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 5		7	3
20170601	20170607		
Week 9		9	1
20170629	20170705		
TOTALS		16	4

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4D

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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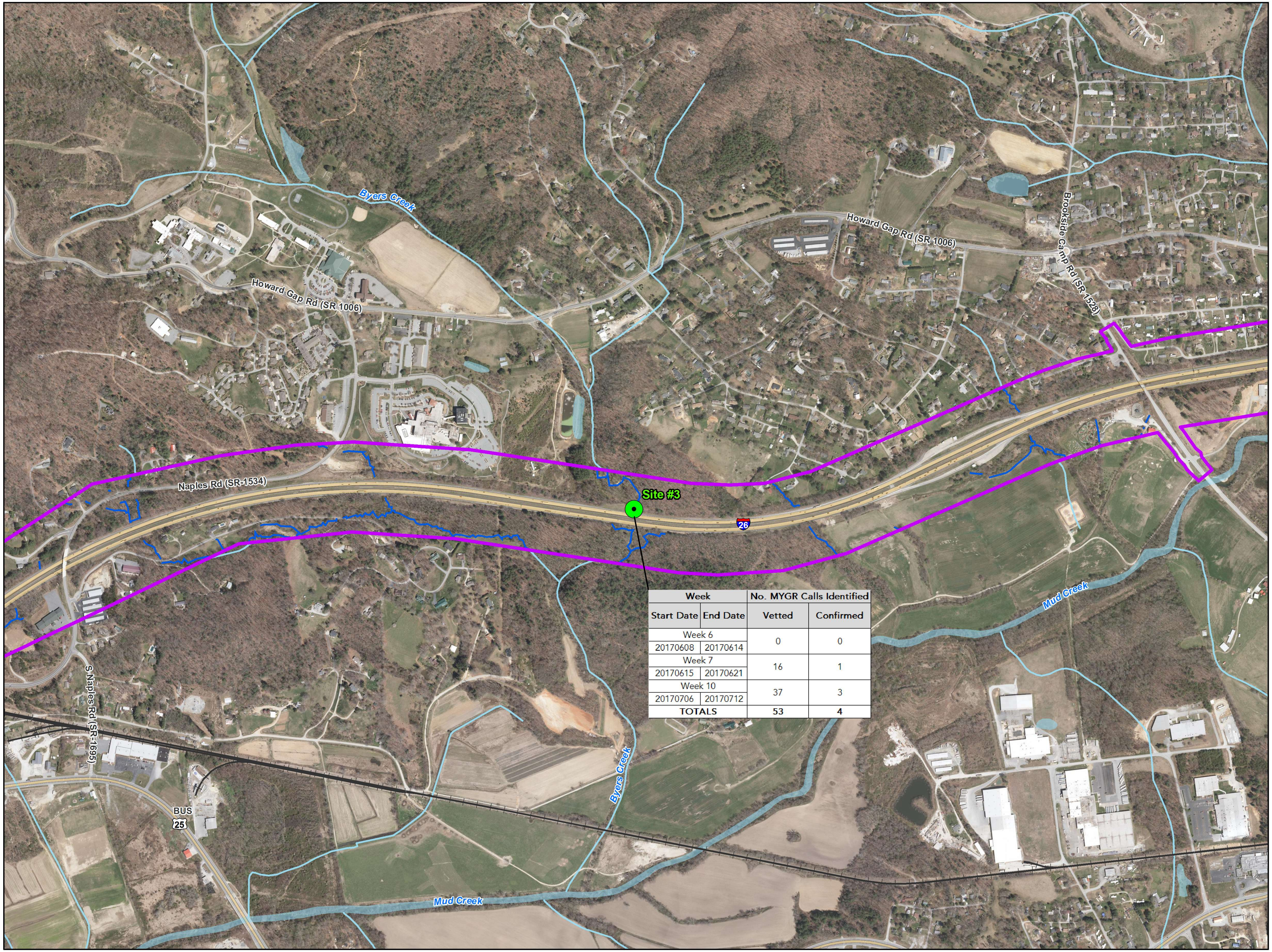
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 6		0	0
20170608	20170614		
Week 7		16	1
20170615	20170621		
Week 10		37	3
20170706	20170712		
TOTALS		53	4

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4E

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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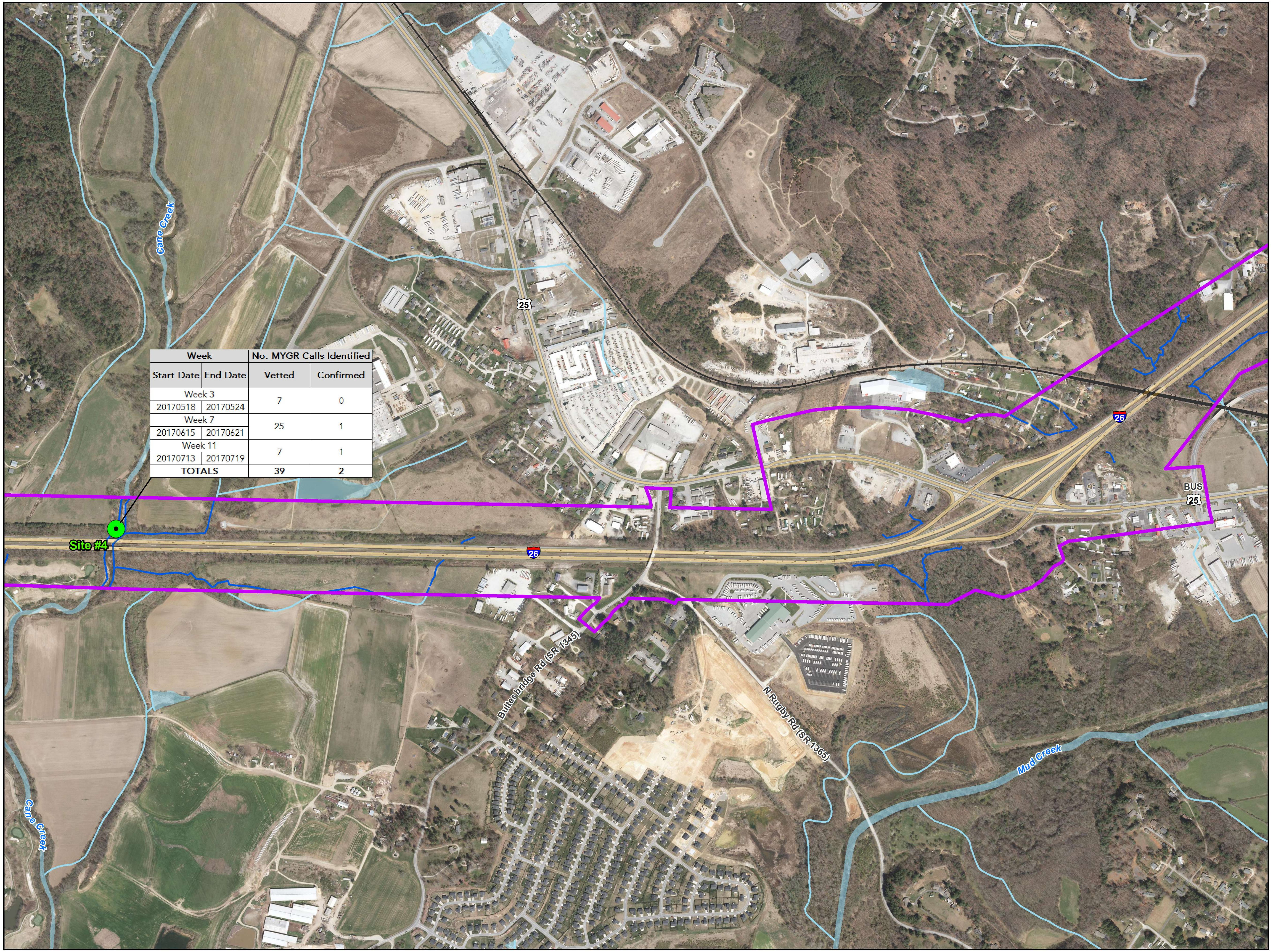
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 3		7	0
20170518	20170524		
Week 7		25	1
20170615	20170621		
Week 11		7	1
20170713	20170719		
TOTALS		39	2

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4F

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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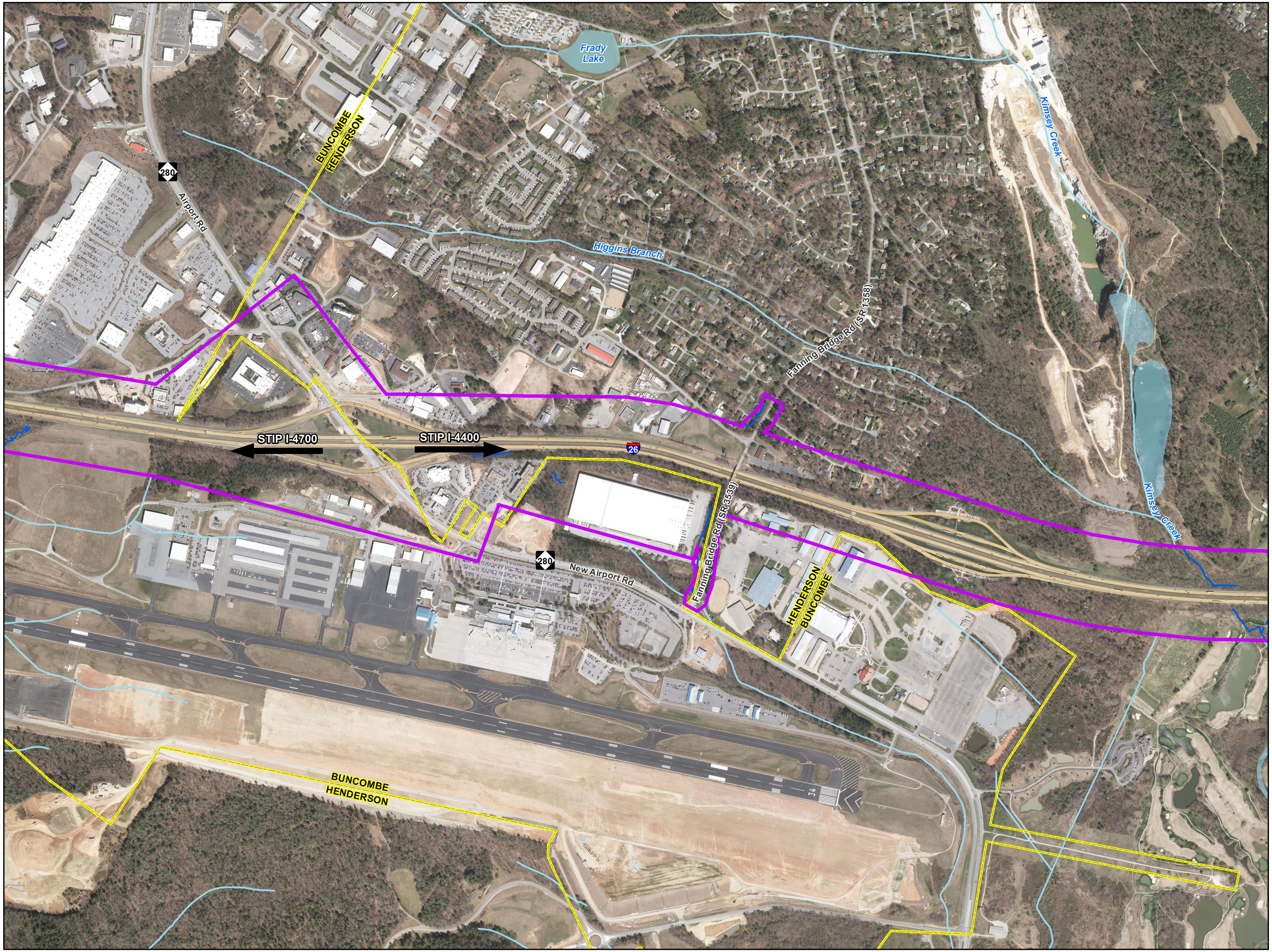
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4G

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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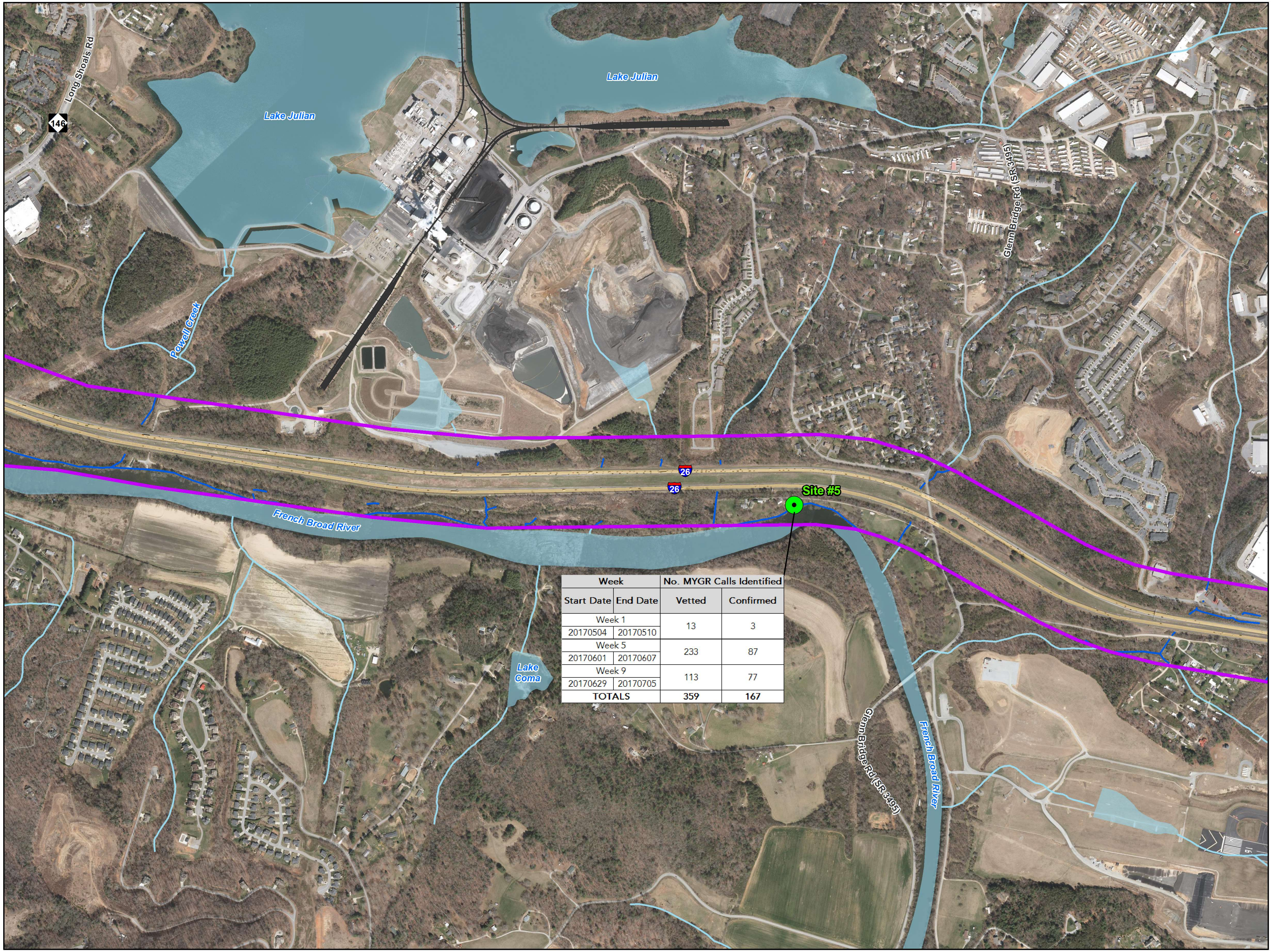
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 1		13	3
20170504	20170510		
Week 5		233	87
20170601	20170607		
Week 9		113	77
20170629	20170705		
TOTALS		359	167

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure
4H

Detector Locations
I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800
Feet
1 inch = 800 feet

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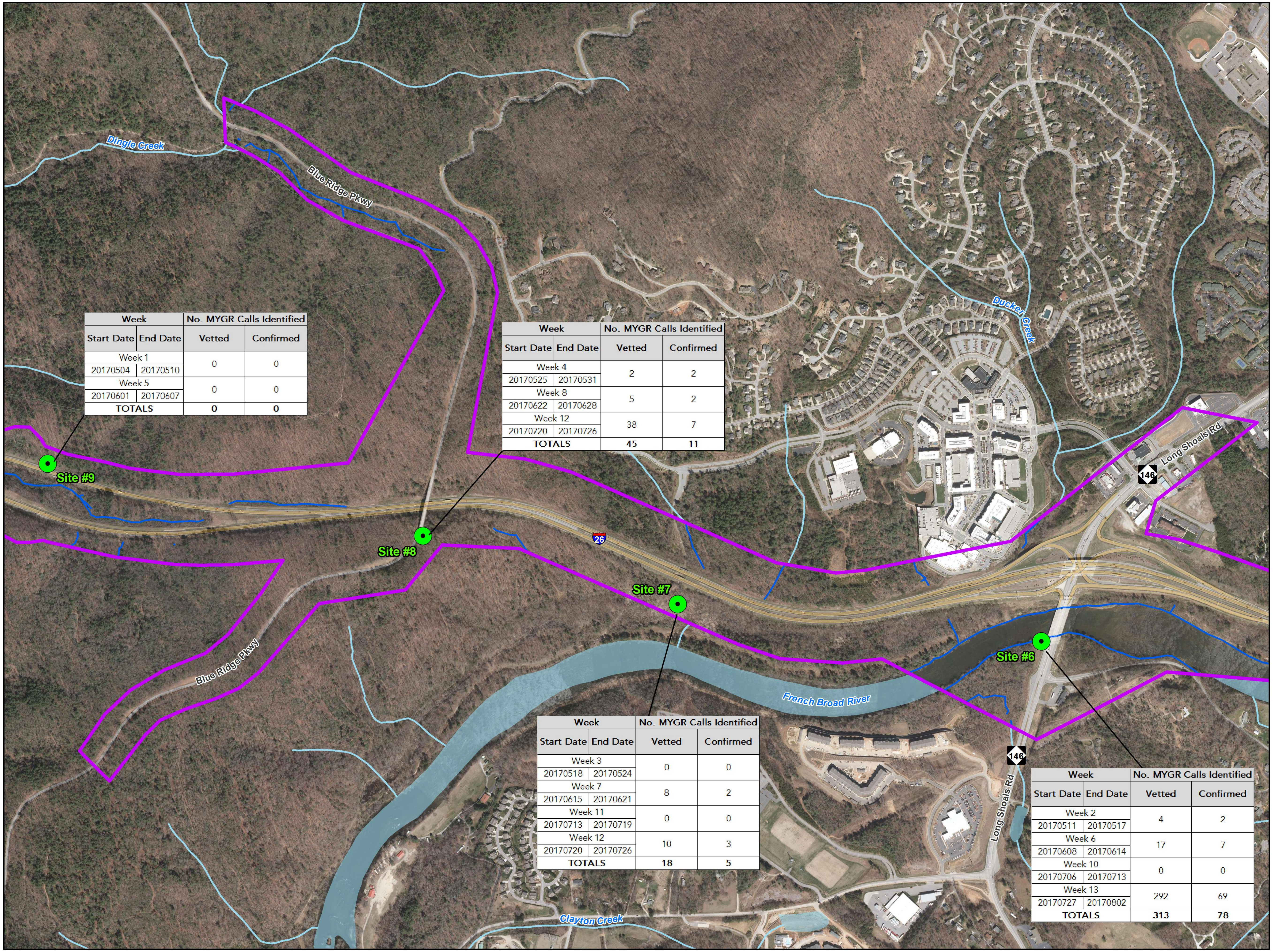
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Site #9

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 1		0	0
20170504	20170510		
Week 5		0	0
20170601	20170607		
TOTALS		0	0

Site #8

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 4		2	2
20170525	20170531		
Week 8		5	2
20170622	20170628		
Week 12		38	7
20170720	20170726		
TOTALS		45	11

Site #7

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 3		0	0
20170518	20170524		
Week 7		8	2
20170615	20170621		
Week 11		0	0
20170713	20170719		
Week 12		10	3
20170720	20170726		
TOTALS		18	5

Site #6

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 2		4	2
20170511	20170517		
Week 6		17	7
20170608	20170614		
Week 10		0	0
20170706	20170713		
Week 13		292	69
20170727	20170802		
TOTALS		313	78

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4I

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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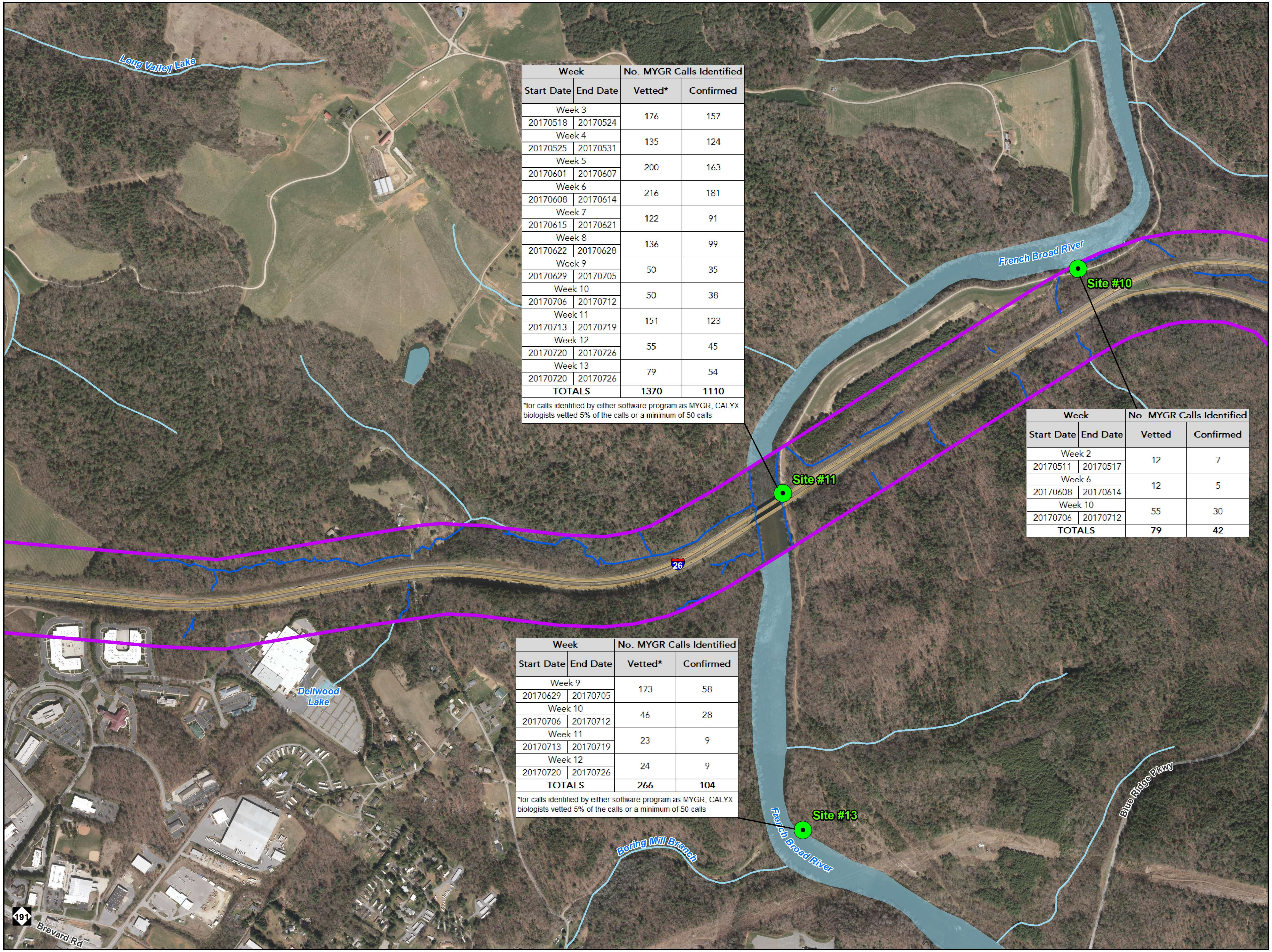
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted*	Confirmed
Week 3 20170518	20170524	176	157
Week 4 20170525	20170531	135	124
Week 5 20170601	20170607	200	163
Week 6 20170608	20170614	216	181
Week 7 20170615	20170621	122	91
Week 8 20170622	20170628	136	99
Week 9 20170629	20170705	50	35
Week 10 20170706	20170712	50	38
Week 11 20170713	20170719	151	123
Week 12 20170720	20170726	55	45
Week 13 20170720	20170726	79	54
TOTALS		1370	1110

*for calls identified by either software program as MYGR, CALYX biologists vetted 5% of the calls or a minimum of 50 calls

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 2 20170511	20170517	12	7
Week 6 20170608	20170614	12	5
Week 10 20170706	20170712	55	30
TOTALS		79	42

Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted*	Confirmed
Week 9 20170629	20170705	173	58
Week 10 20170706	20170712	46	28
Week 11 20170713	20170719	23	9
Week 12 20170720	20170726	24	9
TOTALS		266	104

*for calls identified by either software program as MYGR, CALYX biologists vetted 5% of the calls or a minimum of 50 calls

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure

4J

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/29/2017

800 400 0 800

Feet

1 inch = 800 feet

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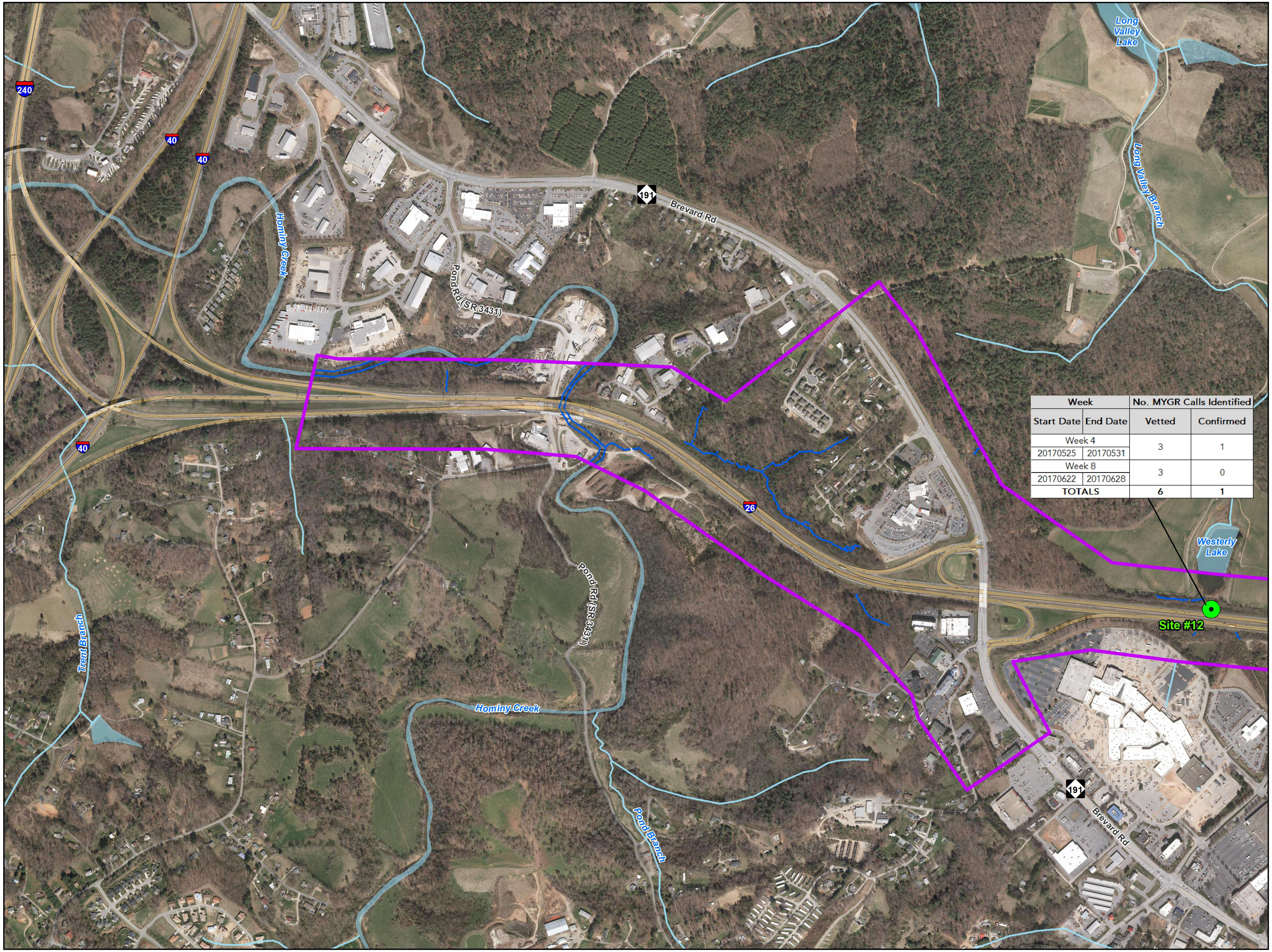
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Week		No. MYGR Calls Identified	
Start Date	End Date	Vetted	Confirmed
Week 4		3	1
20170525	20170531		
Week 8		3	0
20170622	20170628		
TOTALS		6	1

Legend

- Detector Site
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 4K

Detector Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 9/28/2017

800 400 0 800

Feet

1 inch = 800 feet

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Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT

Appendix B

Qualifications of Key Personnel

QUALIFICATIONS OF KEY PERSONNEL

Investigator:	Heather Wallace
Education:	B.S. Ecology, 1997
Experience:	Environmental Project Manager, CALYX, Inc., 2015-Present Environmental Program Consultant, NCDOT, 2013-2015 Environmental Senior Specialist, NCDOT, 2007-2013 Environmental Scientist, H.W. Lochner, 2003-2007 Biologist, Earth Tech, 2000-2003
Responsibilities:	Document preparation, data management, field investigation, detector deployment, acoustic call vetting
Other:	USFWS Endangered & Threatened Sp. Recovery Permit Number TE81430B-0 (northern long-eared bat, gray bat, Indiana bat, Virginia big-eared bat)

Investigator:	Ed Corey
Education:	B.S., Zoology, Wildlife Sciences, Botany, 2004
Experience:	Inventory Biologist, NC Division of Parks and Recreation, 2006-Present Senior Scientist, CALYX, Inc., 2017-Present
Responsibilities:	Acoustic call vetting

Investigator:	Mark Mickley
Education:	B.S., Biology, 2003
Experience:	Environmental Group Manager, CALYX, Inc., 2015-Present Project Manager, CALYX, Inc., 2014-2015 Environmental Scientist, CALYX, Inc., 2004-2014
Responsibilities:	Document preparation, detector deployment

Investigator:	Kathryn Cunningham
Education:	B.S., Fisheries and Wildlife, concentration in Wildlife, 2006
Experience:	Senior Biologist, CALYX, Inc., 2017-Present Wildlife Biologist, Jackson Group, 2013-2017 Research Assistant, West Virginia University, 2008-2009
Responsibilities:	Detector deployment
Other:	USFWS Endangered & Threatened Sp. Recovery Permit Number TE48049B-0 (northern long-eared bat, Indiana bat)

Investigator:	Blake Ellett
Education:	M.N.R. (Masters of Natural Resources), 2016 B.S., Natural Resource and Environmental Management, 2012
Experience:	Environmental Scientist, CALYX, Inc., 2012-present
Responsibilities:	Detector deployment, data management

Appendix C

Table 1. I-26 Widening; Summary of Acoustic Data Analysis for MYGR at All Sites, for all Weeks of Data Collection

Acoustic Survey Data Forms

Sensitive Information Intentionally Removed

Appendix C: Gray Bat Structure Survey Report

FEDERALLY PROTECTED BAT SPECIES
STRUCTURE SURVEY REPORT

I-26 Widening
Buncombe and Henderson Counties, North Carolina
Federal Aid Project No. NHF-26-1(622)23/IMNHF-026-1(86)9
WBS 34232.1.1/36030.1.1

TIP I-4400/I-4700

Prepared for

The North Carolina Department of Transportation
Environmental Analysis and Permitting Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

August 2017

FEDERALLY PROTECTED BAT SPECIES STRUCTURE SURVEY REPORT

I-26 Widening
Buncombe and Henderson Counties, North Carolina
Federal Aid Project No. NHF-26-1(622)23/IMNHF-026-1(86)9
WBS 34232.1.1/36030.1.1

TIP I-4400/I-4700

Prepared for

The North Carolina Department of Transportation
Environmental Analysis and Permitting Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

Prepared by

CALYX ENGINEERS + CONSULTANTS

CALYX Engineers + Consultants
6750 Tryon Road, Cary, NC 27518
919.836.4800

August 2017

Table of Contents

1.0 PROJECT DESCRIPTION

The North Carolina Department of Transportation (NCDOT) obtained the services of CALYX Engineers and Consultants, Inc. (CALYX) to perform protected bat surveys for the proposed widening of I-26 (STIP Project No. I-4400/I-4700). NCDOT, in cooperation with FHWA proposes to improve an approximate 20-mile segment of Interstate 26 (I-26), primarily by widening the roadway and realigning interchanges. The project is located in Henderson and Buncombe Counties, beginning just south of Hendersonville and terminating just south of Asheville (Appendix A, Figure 1). Although I-26 is an east to west interstate corridor, it primarily runs south to north through the study area and is described this way throughout the document. Figure 1 (Appendix A) shows the general project vicinity. The proposed project is included in the 2017 – 2027 STIP as project numbers I-4400 and I-4700. STIP Project I-4400 proposes to widen I-26 from US 25 (Exit 54) north to NC 280 (Exit 40). STIP Project I-4700 proposes to widen I-26 from NC 280 north to the I-40/I-240 interchange.

For purposes of this scope of work, the project footprint is defined as the study area to be depicted in the Final EIS, approximately 1,400' wide, centered on the existing roadway, with expansions around interchanges and the Blue Ridge Parkway crossing of I-26. Figure 2 (Appendix A) depicts the project footprint.

The study area lies in the Southern Blue Ridge Mountain physiographic region of North Carolina. Topography in the project vicinity ranges from very steep, rolling intermountain hills and narrow valleys to wide valleys and stream floodplains associated with the French Broad River. Elevations in the study area range from approximately 2,000 to 2,310 feet above mean sea level. Land use in the project vicinity is primarily urban and suburban, particularly in the northern half of the project, with mixed agricultural and natural areas elsewhere.

2.0 SPECIES INFORMATION

As of April 28, 1976 the U.S. Fish and Wildlife Service (USFWS) listed gray bat (*Myotis grisescens;* MYGR) as "Endangered" under the Endangered Species Act. As of June 8, 2017 (date accessed), MYGR was listed as "current" in Buncombe County and "probable/potential" in Henderson County (USFWS 2017). This species is known or presumed to occur in these counties only during summer months.

The nearest MYGR record (EO# 1) is from east Asheville. The historic record is dated 1968 and represents a capture from a residence in that area. This location is approximately 12 miles east of the study area. The individual was previously banded at a cave in Rhea County, TN. A more recent, more accurate MYGR record (EO# 9) represents a maternity colony that was documented in July 2017 on a bridge over the French Broad River in Buncombe County. This location is approximately one mile from the study area. It is important to note that, prior to the identification of this roost, there were no documented maternity roosts for this species in North Carolina. No hibernacula for this species have been documented in North Carolina (NCNHP 2017).

MYGR are typically a communally roosting, cave obligate species, meaning that groups of individuals are known to utilize caves for roosting in both summer and winter. This species has been documented using bridges and culverts as roosts during summer months. (Hayes and Bingham 1964, Keeley and Tuttle 1999).

3.0 METHODS

This section describes the methods used to perform surveys. All survey methods were developed in coordination with NCDOT, the Asheville USFWS Ecological Services Field Office and the North Carolina Wildlife Resources Commission (NCWRC).

3.1 Bridges and Culverts

Bridges (or bridge pairs) and large culverts (at least 5 feet high and 200 feet long) were assigned a unique identification number (CALYX ID) at the start of the study, as shown in Appendix A, Figures 3A through 3K, and Tables 1 and 2, in Section 4.1. These structures were visually inspected at least once during daylight hours by trained, experienced biologists or biological technicians. Three bridges (or pairs of bridges) were of particular concern to USFWS: I-26 over Hominy Creek (CALYX ID B23), I-26 over Cane Creek (B13), and I-26 over Clear Creek (B6). CALYX planned to check these bridges three times, staggered throughout the season, regardless of the results of the first or second check. The I-26 bridges over Hominy Creek were under construction at the start of the field season, so it was agreed that this pair of structures would be checked only pending safe access.

In addition, three bridges (or bridge pairs) that were particularly difficult to adequately check on foot were checked using a hydra lift truck; a machine typically used to conduct formal bridge safety inspections. These bridges were I-26 over the French Broad River (CALYX ID B21), Blue Ridge Parkway over I-26 (CALYX ID B20), and Long Shoals Road over the French Broad River (CALYX ID B18).

Coordinates were obtained for all bridges and culverts that were surveyed. In addition, the NCDOT Bat Habitat Assessment Form for Bridges and Culverts was completed as specified in the Standard Operating Procedures (SOP): NCDOT Preliminary Bat Habitat Assessments (Structures, Caves and Mines) for each bridge, culvert, and structure that was surveyed. Photos were taken of any bridges, culverts, and structures that exhibited evidence of bat use.

3.2 Abandoned Structures

Structures within the project study area that appeared to be abandoned, and appeared to have potentially suitable habitat for bats would be checked on an opportunistic basis only.

3.3 Caves and Mines

USGS mapping was reviewed prior to field investigations to determine if any caves or mine are documented within three miles of the project study area. If caves or mines were noted during field work, they are documented as part of this report.

3.4 Other Potential Roosting Sites

At the request of USFWS, the rock outcrop identified in the 2013 gray bat survey report as “13A” was also rechecked for evidence of bat use (Figure 3J).

4.0 FINDINGS

This section describes the results of the structure surveys. Figures 3-1 through 3-11 (Appendix A) depict the project footprint and other information discussed in this section.

4.1 Bridges and Culverts

Desktop analysis identified 23 bridges, or bridge pairs within the project footprint, and 20 concrete culverts meeting NCDOT survey criteria: at least five feet high and 200 feet or more in length. No abandoned structures were identified by desktop analysis within the project footprint.

After field evaluation, a total of 24 bridges and 18 culverts were checked in the field. The bridge over Hominy Creek and Pond Road (CALYX ID B23) could not be checked due to construction activities. Additionally, one culvert identified to meet criteria during desktop analysis was not checked in the field due to its small size (CALYX ID C13); only 4' high. Two bridges that were not identified as part of the desktop analysis were also checked (CALYX IDs B24, B25). CALYX biologists decided that it would be prudent to check these structures due to their close proximity to the project study area, and their location over large streams or rivers. Bridge and culvert surveys were performed between April 26, 2017 and July 27, 2017.

A comprehensive list of bridge and culvert survey information is provided in Table 1 and Table 2, below. Data forms for each structure check are provided in Appendix B and Appendix C.

In reference to Tables 1 and 2, the CALYX ID is a unique identification number assigned by CALYX as part of this study. NCDOT structure numbers were pulled directly from publicly available GIS data. "NRTR Map ID" relates to the feature ID assigned in the original Natural Resources Technical Report and all associated appendices. "2013 Structure Survey ID" relates to the feature ID assigned as part of the 2013 report that provides the results of the 2013 structure survey for bats completed by Alderman Environmental Services for NCDOT. "2015 Hydraulic Tech Memo ID" relates to the feature ID assigned as part of the hydraulic report associated with this project. All these reports are included as part of the appendices in the I-26 Draft Environmental Impact Statement (HNTB 2016).

Bridge Checks with Hydra Lift

<u>I-26 over French Broad River (CALYX ID B21)</u>

This pair of bridges was checked with a hydra lift and on foot on May 13 and 14, 2017. No evidence of bat roosting was observed. One eastern phoebe (*Sayornis phoebe*) nest was found. There is a sewer easement access road under the south side of these bridge spans that appears to have regular foot, vehicle and horse traffic.

<u>Long Shoals Road over French Broad River (CALYX ID B18)</u>

This bridge was checked with a hydra lift and on foot on May 14, 2017. In 2013, one eastern small-footed bat (*Myotis leibii*) was observed by Chris McGrath (Alderman Environmental Services) on the Long Shoals Road bridge over the French Broad River. This individual was roosting in an endwall crevice at the corner of the bridge with a small amount of guano below the individual. A small amount of guano was also noted on the endwall at the southwestern endwall of the bridge. No bats or guano were observed in these areas, during the check in 2017. There is evidence of squatters under both ends of this bridge, which may have an effect on bat roosting. However, a few small guano pellets were found on the vertical surface of the concrete support beams over the river. This evidence suggests that bats may be using this bridge infrequently for night roosting.

Table 1. Bridge Survey Results

CALY X ID	County	NCDOT Structure Number	Facility on Structure	Feature Under Structure	Date Surveyed	NRTR Map ID	2013 Structure Survey ID	2015 Hydraulic Tech Memo ID	Comment
B1	Henderson	440148	Crest Rd/SR 1803	I-26	5/14/2017	N/A	N/A	N/A	
B2	Henderson	440162	Upward Rd/SR 1783	I-26	5/14/2017	N/A	N/A	N/A	
B3	Henderson	440174	Tracey Grove Rd/SR 1793	I-26	5/15/2017	N/A	N/A	N/A	
B4	Henderson	440185	Dana Rd/SR 1525	I-26	5/30/2017	N/A	N/A	N/A	
B5	Henderson	440183	US 64	I-26	5/31/2017	N/A	N/A	N/A	
B6	Henderson	440211 (WBL), 440212 (EBL)	I-26	Clear Creek	5/31/2017, 6/28/2017, 7/27/2017	SBD	N/A	11	
B7	Henderson	440217	Clear Creek Rd/SR 1503	I-26	5/31/2017	N/A	N/A	N/A	
B8	Henderson	440221	Brookside Camp Rd/SR 1528	I-26	5/31/2017	N/A	N/A	N/A	
B9	Henderson	440223	Naples Rd/SR 1534	I-26	5/31/2017	N/A	N/A	N/A	
B10	Henderson	440228 (WBL), 440230 (EBL)	I-26	Southern Railroad	5/31/2017	N/A	N/A	N/A	
B11	Henderson	440181	US 25 BUS	I-26	5/15/2017	N/A	N/A	N/A	
B12	Henderson	440232	Butler Bridge Road/SR 1345	I-26	5/31/2017	N/A	N/A	N/A	
B13	Henderson	440233 (WBL), 440234 (EBL)	I-26	Cane Creek	5/31/2017, 6/28/2017, 7/27/2017	SCW	N/A	16	
B14	Buncombe	100008	Fanning Bridge Rd/SR 1358	I-26	5/30/2017	N/A	N/A	N/A	
B15	Buncombe	440240	New Airport Rd/NC 280	I-26	5/15/2017	N/A	24	N/A	
B16	Buncombe	100068 (WBL), 100069 (EBL)	I-26	Glenn Bridge Road	5/30/2017	N/A	23	N/A	
B17	Buncombe	100113	I-26	Long Shoals Rd/NC 146	5/16/2017	N/A	17	N/A	
B18*	Buncombe	100053	Long Shoals Rd	French Broad River	5/13/2017	French Broad River	18	N/A	MYLE found here in 2013. Approx 30 cliff swallow nests under bridge.
B19	Buncombe	100158 (WBL), 100156 (EBL)	I-26	Private road	5/18/2017	N/A	15	N/A	
B20*	Buncombe	100205	Blue Ridge Parkway	I-26	5/16/2017	N/A	14	N/A	Two raven nests under bridge on piers closest to travel lanes
B21*	Buncombe	100211 (WBL), 100214 (EBL)	I-26	French Broad River	5/13/2017	French Broad River	12	25	
B22	Buncombe	100171	Brevard Rd/NC 191	I-26	5/31/2017	N/A	8	N/A	Included in I-5504.
B23	Buncombe	100235 (WBL), 100238 (EBL)	I-26, Pond Rd/SR 3431	Hominy Creek	N/A	SEZ	3 (EBL), 4 (WBL)	28	Included in I-5504. Did not check. Brand new bridge pair in construction zone
B24	Buncombe	100046	Glenn Bridge Rd/SR 3495	French Broad River	5/30/2017	French Broad River	N/A	N/A	Not in study area, but checked due to proximity and size. Cliff swallows present
B25	Buncombe	100051	Pond Rd/SR 3431	Hominy Creek	5/31/2017	Hominy Creek	N/A	N/A	Not in study area, but checked due to proximity and size

* = Checked on foot and with hydra lift

Table 2. Culvert Survey Results

CALYX ID	County	NCDOT Structure Number	Facility on Structure	Feature Under Structure	Date Surveyed	NRTR Map ID	2013 Structure Survey ID	2015 Hydraulic Tech Memo ID	Comments
C1	Henderson	N/A	I-26	UT Dunn Creek	5/30/2017	SV	N/A	3	
C2	Henderson	440150	I-26	Dunn Creek	5/30/2017	ST	N/A	4	Part of I-5504
C3	Henderson	440369	Upward Rd/SR 1738	Dunn Creek	5/30/2017	ST	N/A	N/A	
C4	Henderson	440178	I-26	Devils Fork	5/31/2017	SAJ	N/A	7	
C5	Henderson	N/A	Dana Rd/SR 1525	UT Devils Fork	5/30/2017	SAV	N/A	8	
C6	Henderson	N/A	I-26	UT Devils Fork	5/31/2017	SAV	N/A	9	
C7	Henderson	N/A	I-26	UT Devils Fork	5/31/2017	SAR	N/A	10	
C8	Henderson	N/A	I-26	UT Mud Creek	5/31/2017	SBG	N/A	12	
C9	Henderson	N/A	I-26	UT Mud Creek	5/31/2017	SCK	N/A	15	
C10	Henderson	440236	I-26	Kimsey Creek	5/31/2017	SCY	N/A	17	
C11	Henderson	N/A	Fanning Bridge Rd/SR 3539	UT French Broad River	5/30/2017	SDI	N/A	18	
C12	Buncombe	N/A	I-26	UT French Broad River	5/30/2017	SDC	N/A	19	
C13	Buncombe	N/A	I-26	UT French Broad River	N/A	SDE	N/A	20	Tech memo said 66”, but only 4' tall. Did not check
C14	Buncombe	N/A	I-26	UT French Broad River	5/31/2017	SFX	N/A	21	
C15	Buncombe	N/A	I-26	UT French Broad River	5/31/2017	SDK	N/A	22	
C16	Buncombe	100101	I-26	Powell Creek	5/31/2017	SDN	20	23	
C17	Buncombe	N/A	I-26	Ducker Creek	5/30/2017	SDT	19	24	
C18	Buncombe	100223	I-26	UT Fench Broad River	5/16/2017	SFR	11	N/A	
C19	Buncombe	100226	I-26	Long Valley Branch	5/31/2017	SFN	10	26	Part of I-5504
C20	Buncombe	N/A	I-26	UT Hominy Creek	5/31/2017	SEJ	N/A	27	

There is an active colony of cliff swallows (*Petrochelidon pyrrhonota*) using this bridge. Approximately 30 nests were observed. No specific emergence surveys or acoustic surveys were performed because the bridge was thoroughly inspected with the hydra lift, and an acoustic detector is already deployed adjacent to bridge as part of the acoustic study.

Blue Ridge Parkway over I-26 (CALYX ID B20)
This bridge was checked with a hydra lift and on foot on May 15, 2017. No evidence of bat roosting was observed. Inactive common raven (*Corvus corax*) nests were found on the central pillars/caps of this bridge. Remnants of fur and bone were found adjacent to the nests. A raven was also observed several times flying in the vicinity of the bridge.

4.2 Abandoned Structures

No abandoned structures within the project study area that could provide potential roosting habitat for bats were noted during the site visits.

4.3 Caves and Mines

No caves or mines were observed during the field visits. According to USGS mapping, there are five underground mines located within a ½-mile radius of the study area (USGS 2017). Sixteen (16) mines are mapped between one half and three miles of the project study. All 21 mines are identified as surface mines, or are presumed to be surface mines based on their production type. No mines were investigated in the field as part of this field survey.

Table 3. Mines within Three Miles of I-4400/I4700

Mine Name	Distance from Study Area	Mine Type	County
Bluff Clay Mine	Within ½ mile	Surface	Buncombe
Case Pit	Between ½ and 3 miles	Surface	Henderson
Christ School Quarry	Between ½ and 3 miles	Unknown	Buncombe
Dana Pit	Between ½ and 3 miles	Surface	Henderson
Fletcher Mine	Between ½ and 3 miles	Surface	Henderson
Fletcher N-S Mine	Between ½ and 3 miles	Unknown	Henderson
Fletcher North Mine	Between ½ and 3 miles	Surface	Henderson
Fletcher Quarry	Within ½ mile	Unknown	Henderson
Fletcher Quarry	Within ½ mile	Surface	Henderson
Fletcher South Mine	Within ½ mile	Surface	Henderson
Greer Mine	Between ½ and 3 miles	Surface	Henderson
Hendersonville	Within ½ mile	Unknown	Henderson
Hendersonville Quarry	Between ½ and 3 miles	Unknown	Henderson
Hendersonville Quarry	Between ½ and 3 miles	Surface	Henderson
Moland-Drysdale Brick Corp. Clay Pit	Between ½ and 3 miles	Unknown	Buncombe
Pinner Creek Quarry	Between ½ and 3 miles	Unknown	Buncombe
Tri-State Fletcher Mill	Between ½ and 3 miles	Processing Plant	Henderson
Unnamed Clay Pit	Between ½ and 3 miles	Unknown	Henderson
Unnamed Crushed Stone Quarry	Between ½ and 3 miles	Unknown	Henderson
Unnamed Crushed Stone Quarry	Between ½ and 3 miles	Unknown	Henderson
Unnamed Crushed Stone Quarry	Between ½ and 3 miles	Unknown	Henderson

Based on the lack of underground mines in the project footprint and vicinity, potentially suitable summer/winter underground roosting habitat for MYGR will not be affected by the project. The Hendersonville Mine is the only mine that is questionable in terms of production type. Aerial mapping shows the location is a commercially developed area and no obvious mine location can be seen nearby.

In addition, Jody Kuhne, NCDOT Regional Geological Engineer for NCDOT, stated that no caves or cave like features, nor cliff forming units or rock outcrops (which might indicate the presence of caves) were noted during the geosocial studies performed in association with this project (personal communication, July 17, 2017).

4.4 Other Potential Roost Sites

At the request of USFWS, the rock feature identified in the 2013 MYGR survey report as "13A" was also checked again for evidence of bat use (Appendix A, Figure 3J). This feature is approximately 10' tall and 40' long. It is shaded and damp, and did not appear to provide suitable habitat for most bat species. More specifically, no caves or cave-like areas (which might potentially accommodate roosting MYGR) were noted anywhere along the feature.

4.5 Summary of Findings

After checking all potential MYGR bat roost sites located within (or in some cases, immediately adjacent to) the project study area, only one site was identified as a bat roost: the Long Shoals Road bridge over the French Broad River.

5.0 REFERENCES

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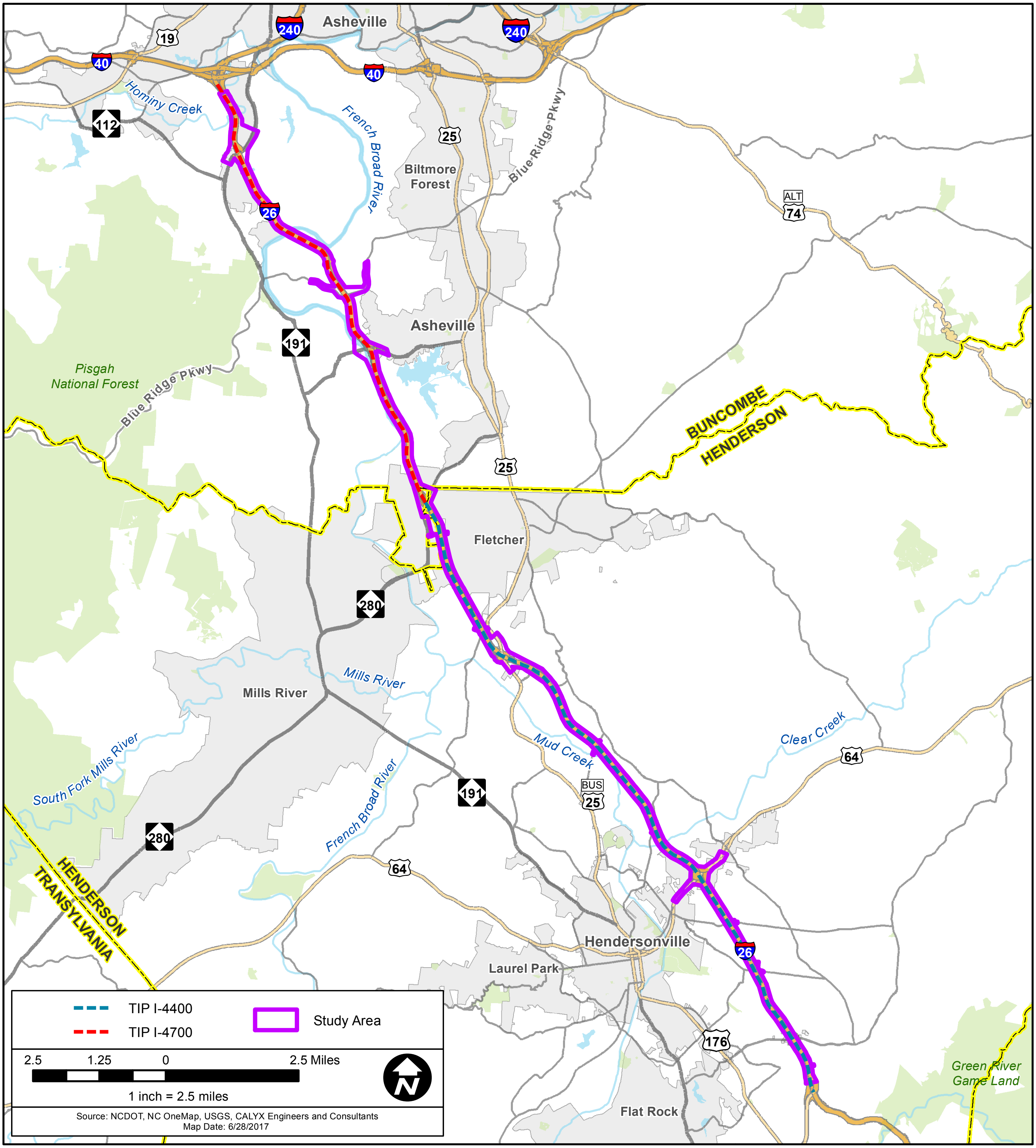
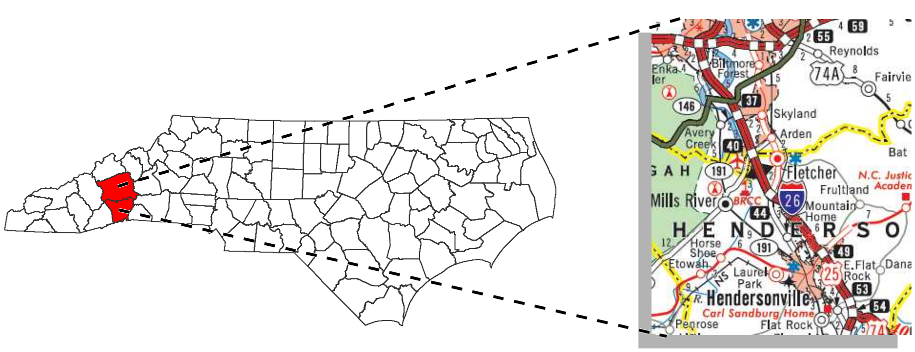
Appendix A: Figures





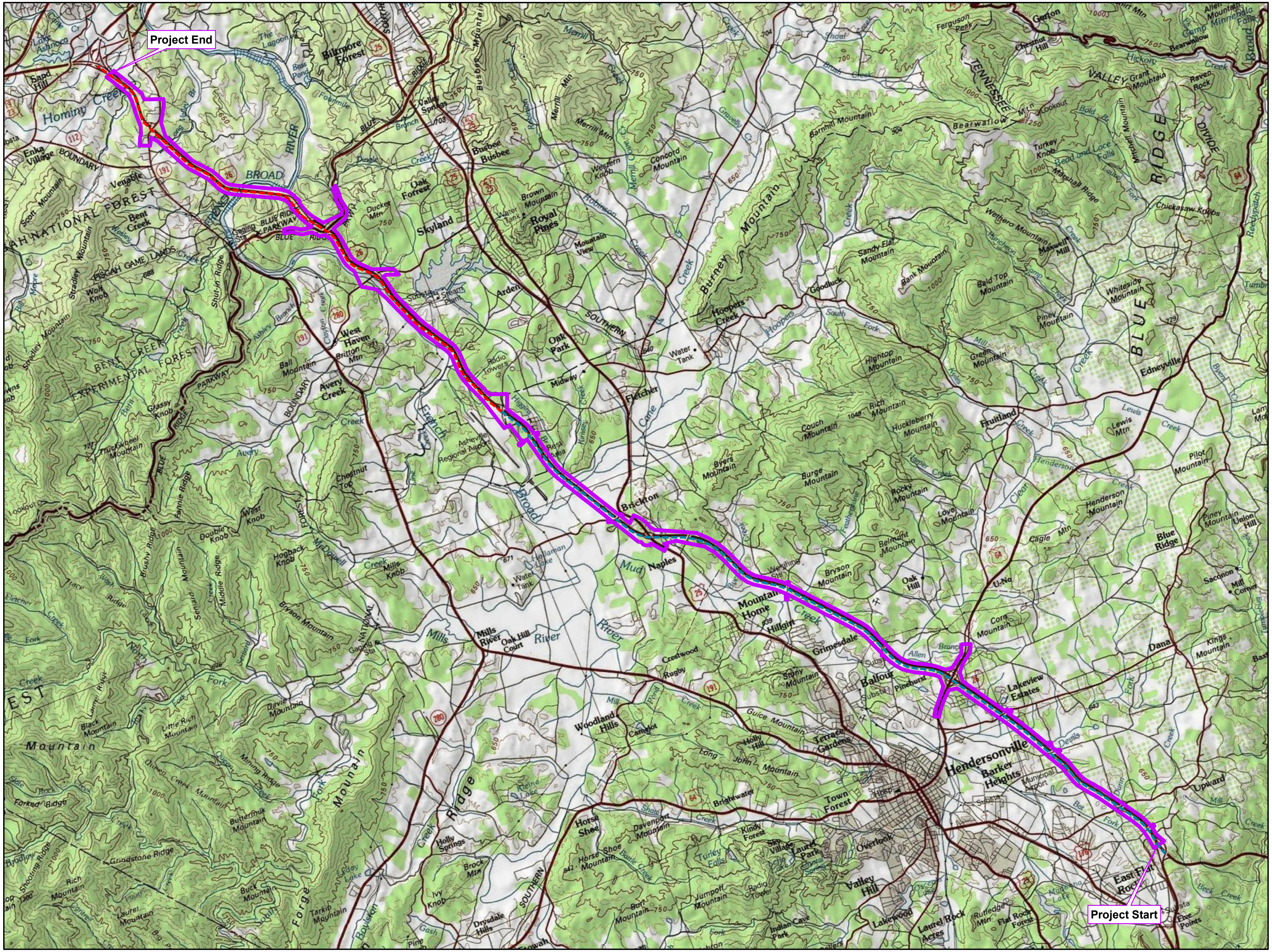
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Widening

TIP Project I-4400/I-4700

Buncombe &
Henderson Counties, NC

Project Vicinity



Legend

- TIP I-4400
- TIP I-4700
- StudyArea

Figure 2

Project Footprint

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

1.5 0.75 0 1.5

Miles

1 inch = 1.5 miles

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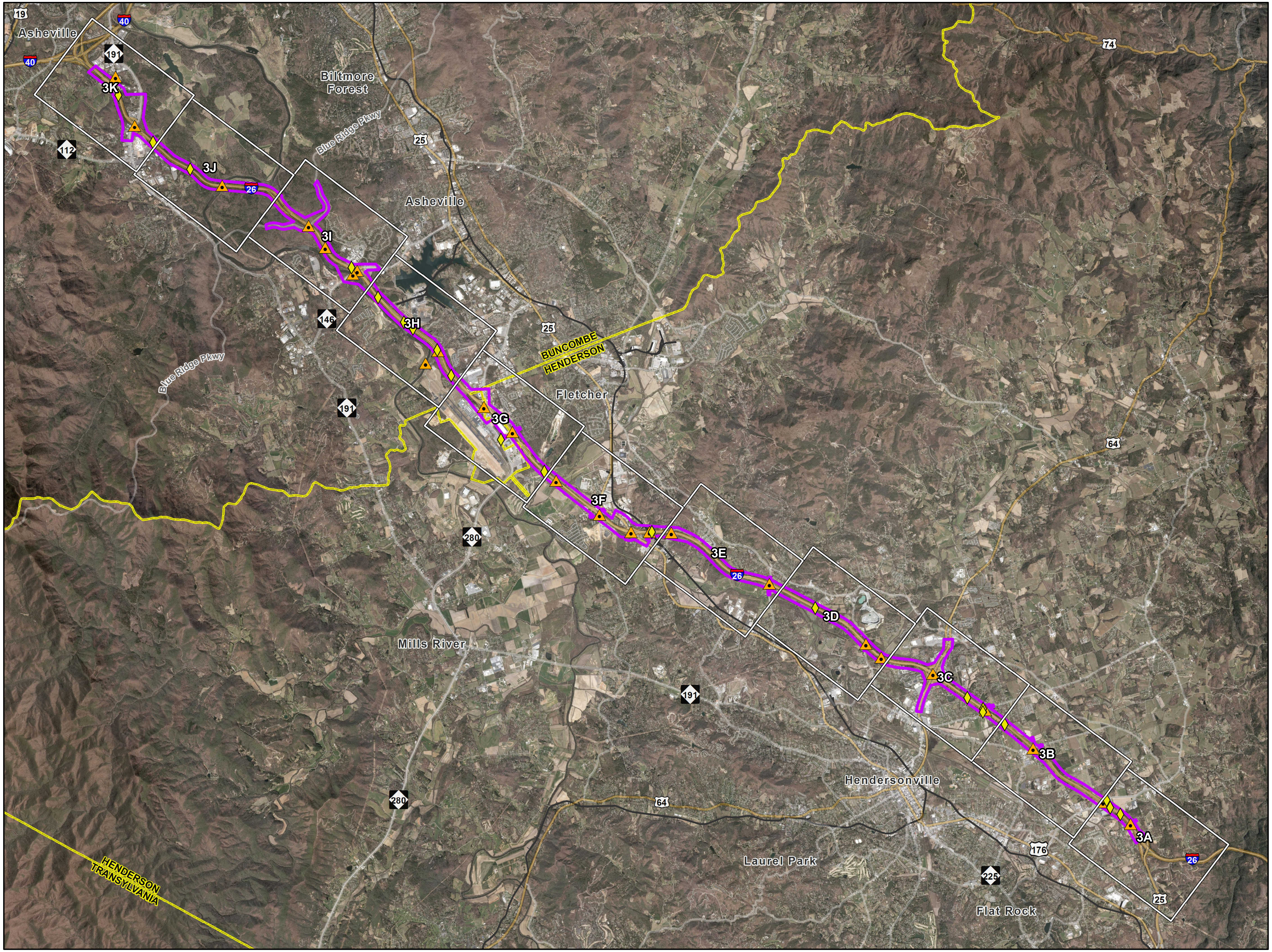
Sources: ESRI, Calyx Engineers and Consultants



Legend

- Bridge
- Culvert
- Railroad
- Map Tile
- StudyArea
- County Boundary

Figure 3

Structure Locations Overview

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

1.5 0.75 0 1.5

Miles

1 inch = 1.5 miles

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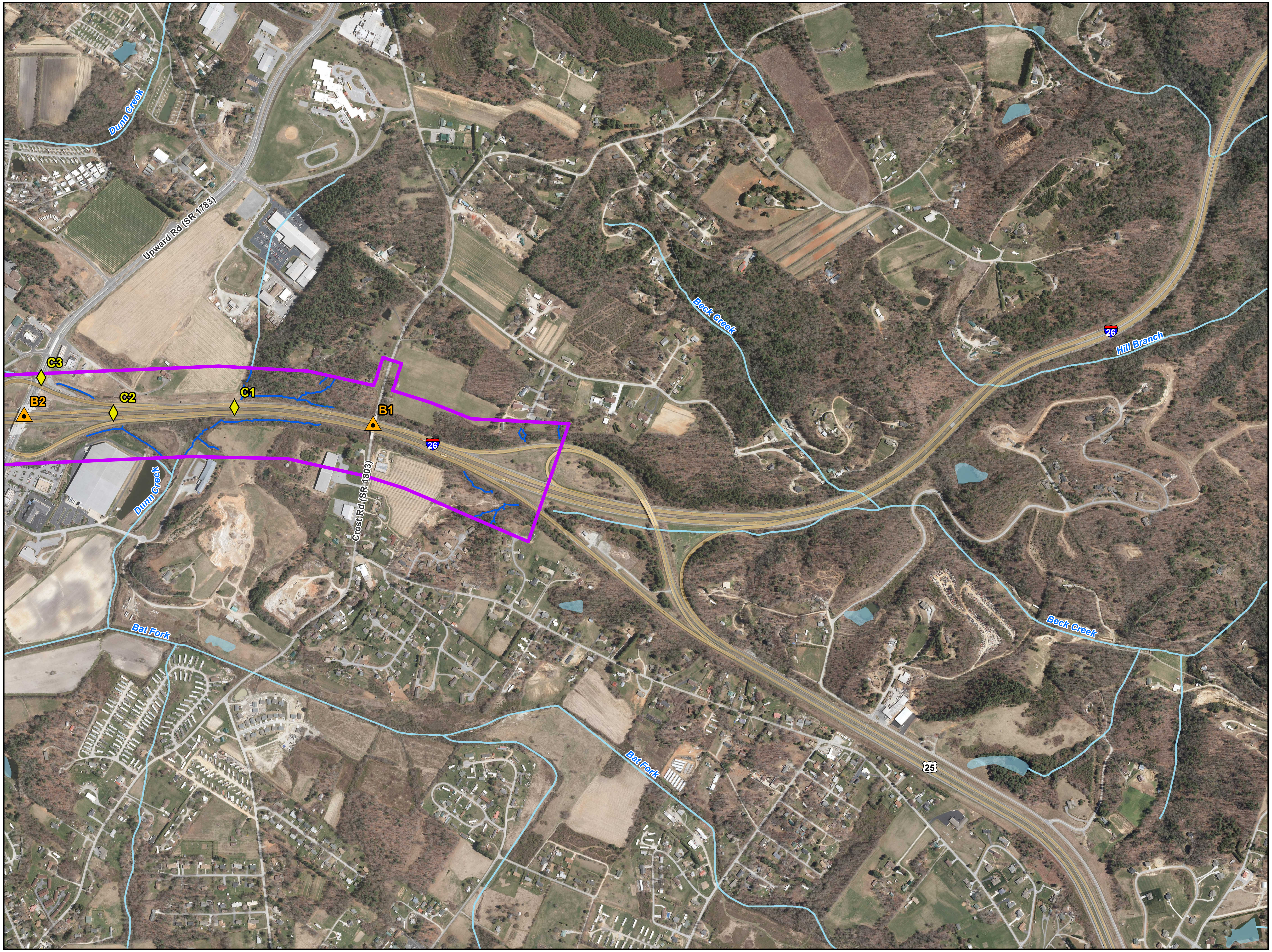
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3A

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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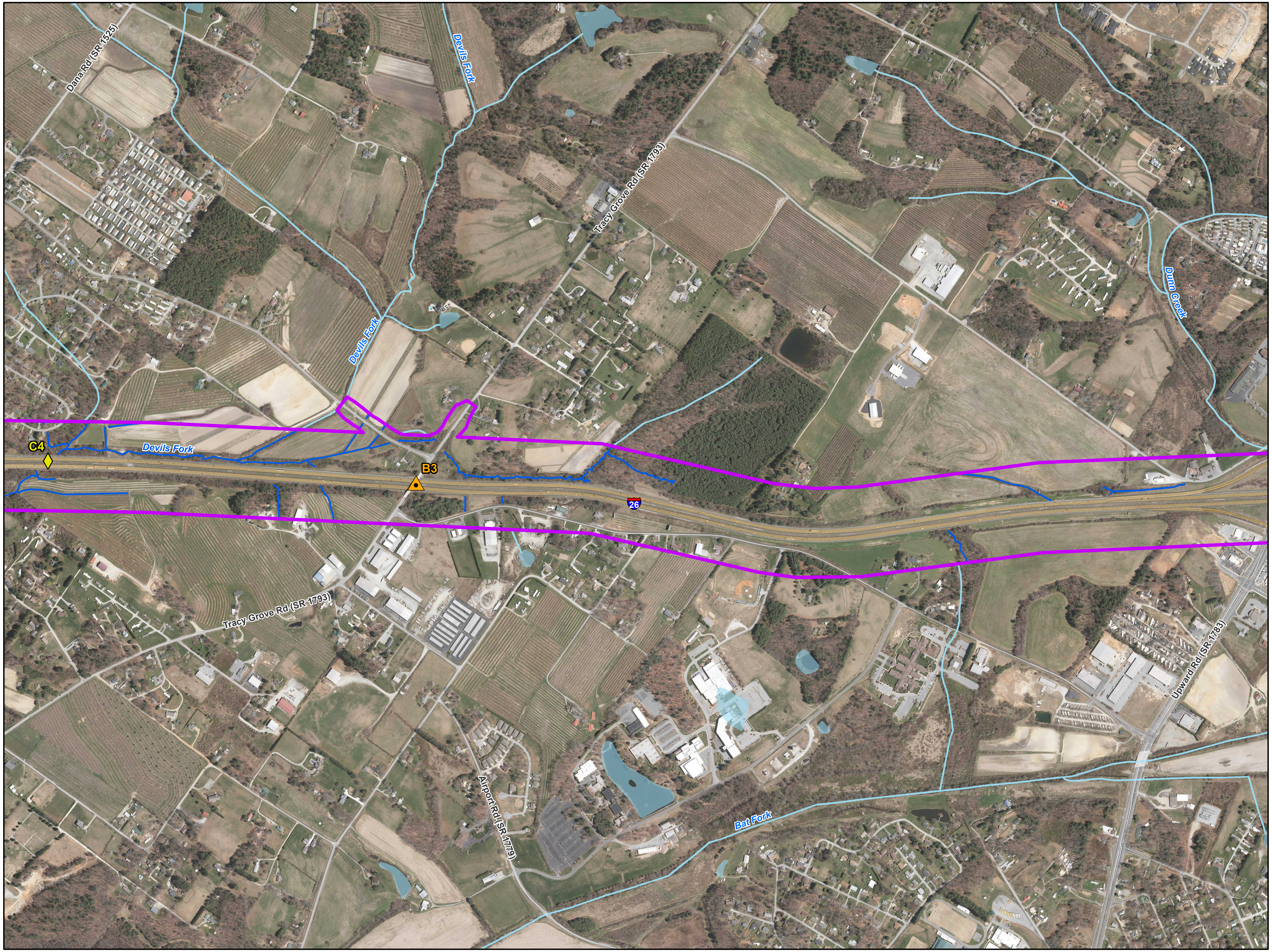
Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3B

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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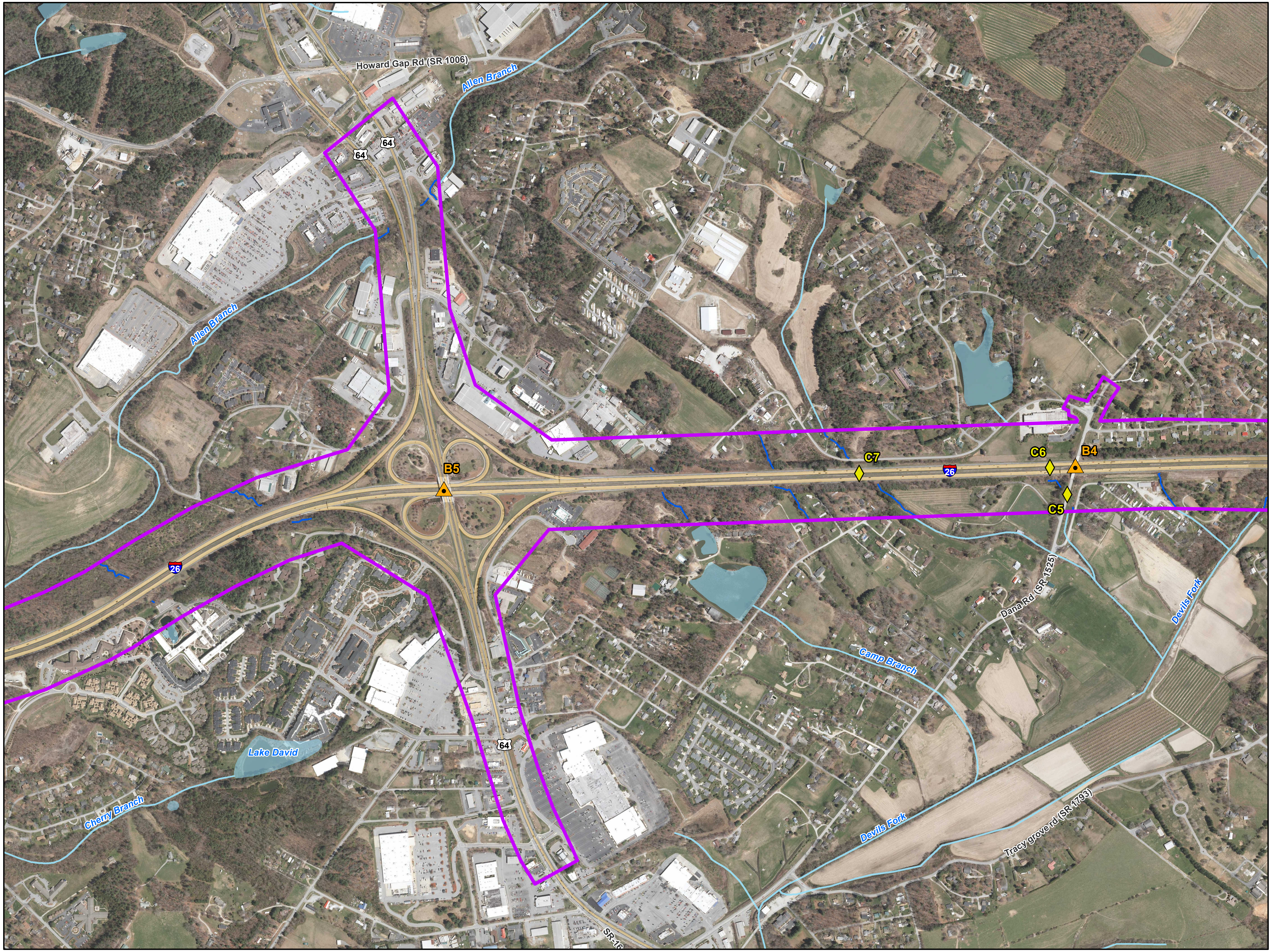
Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3C

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT

Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure
3D

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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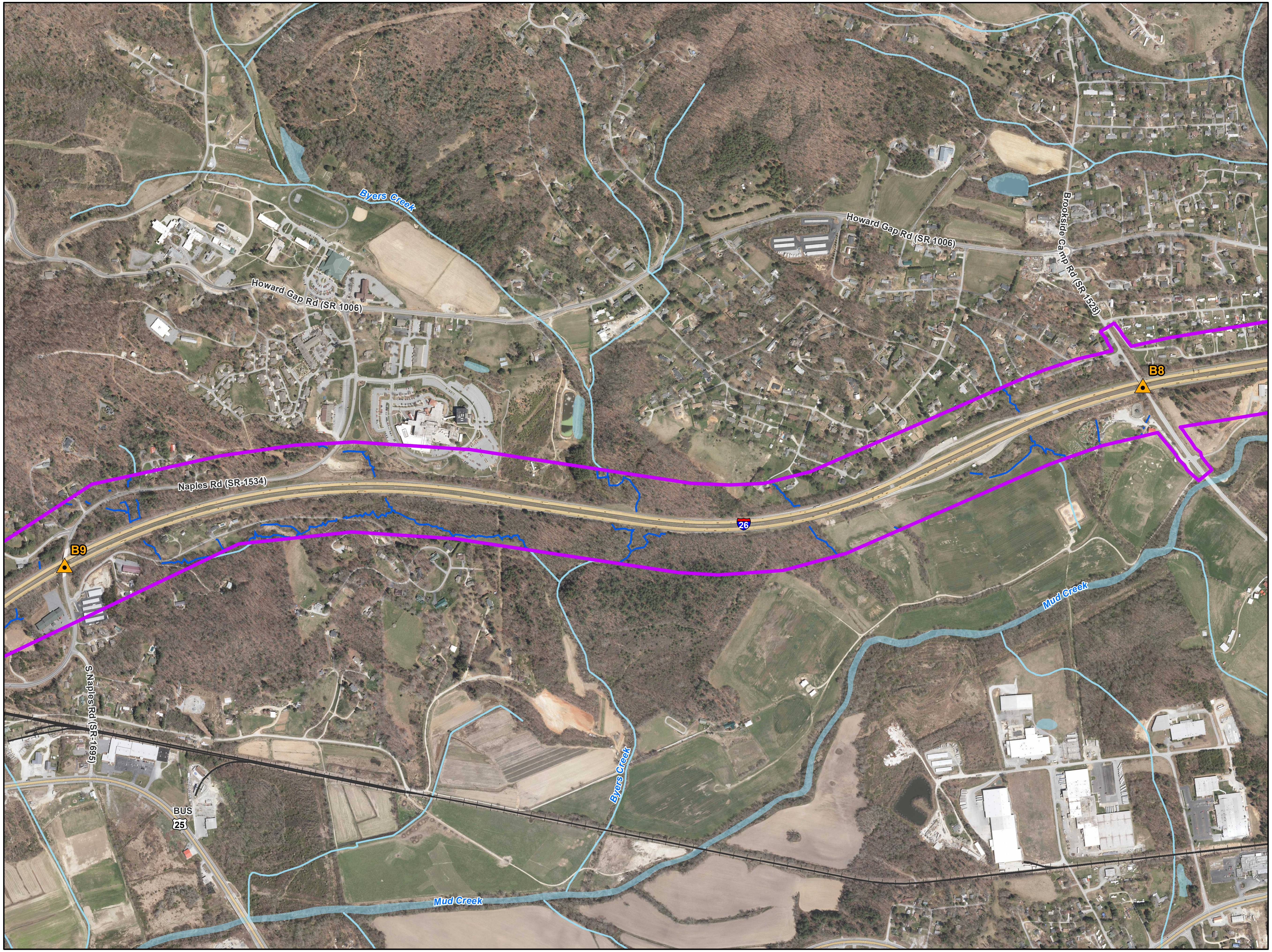
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3E

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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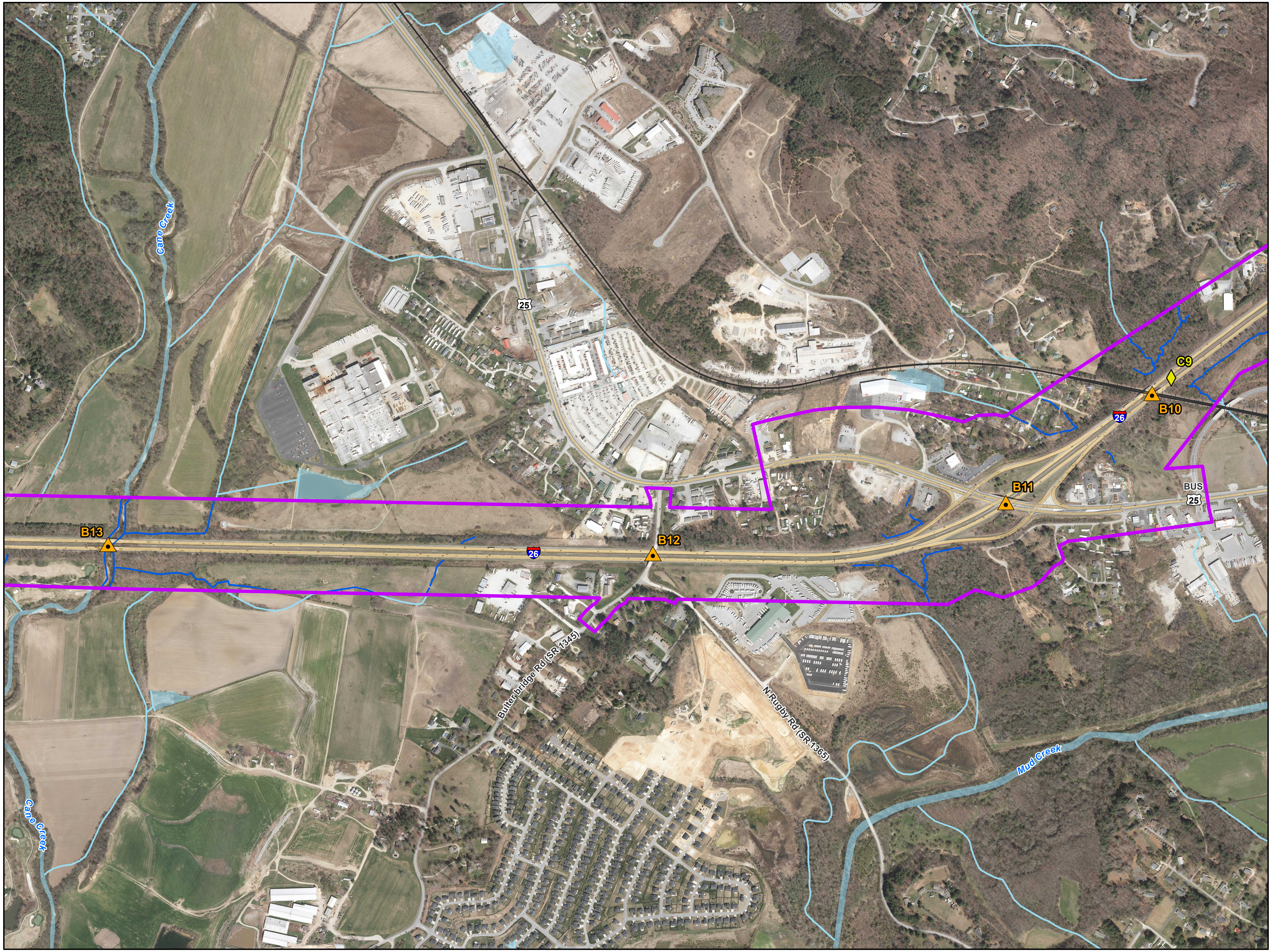
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure

3F

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe &
Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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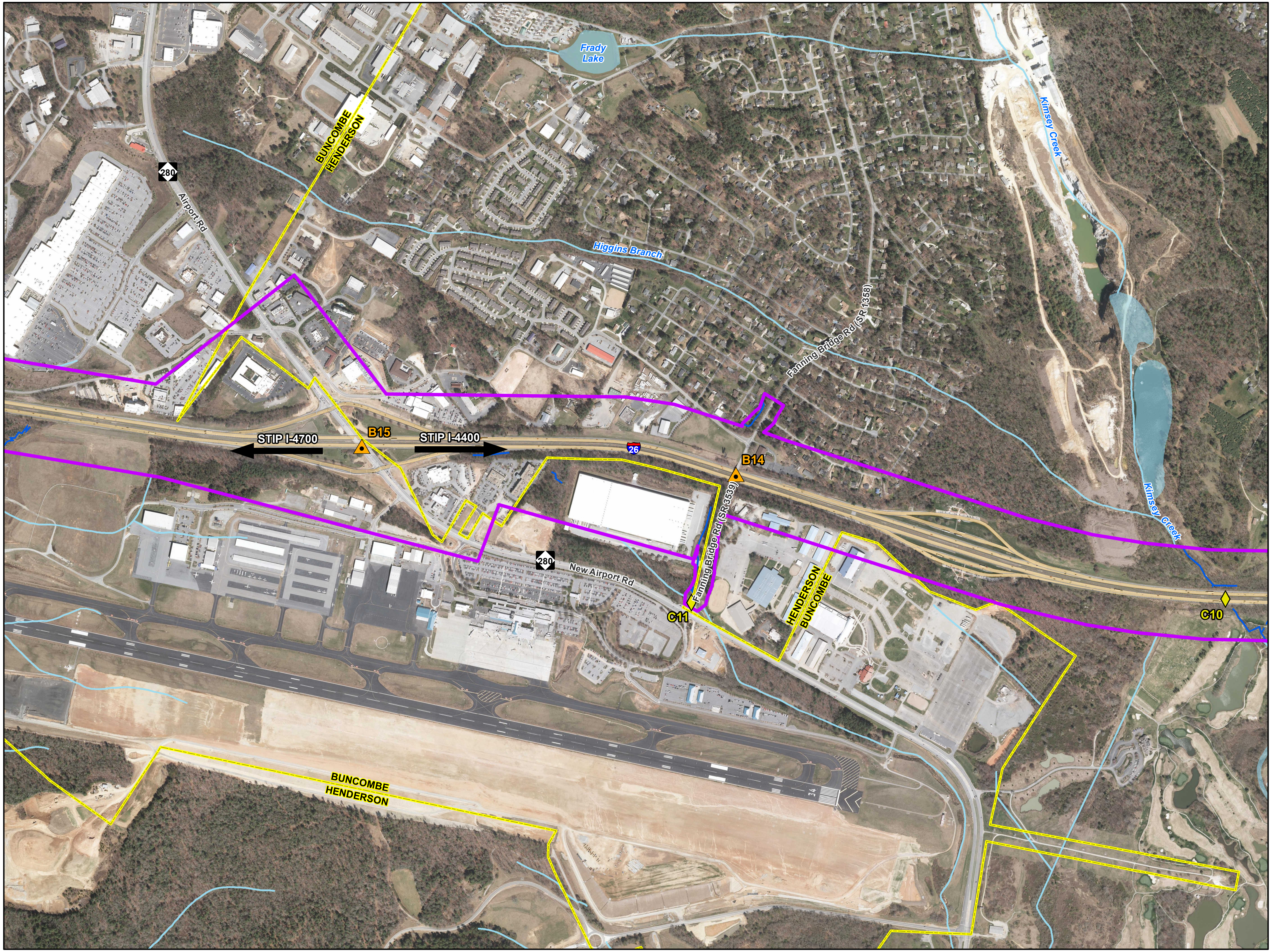
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3G

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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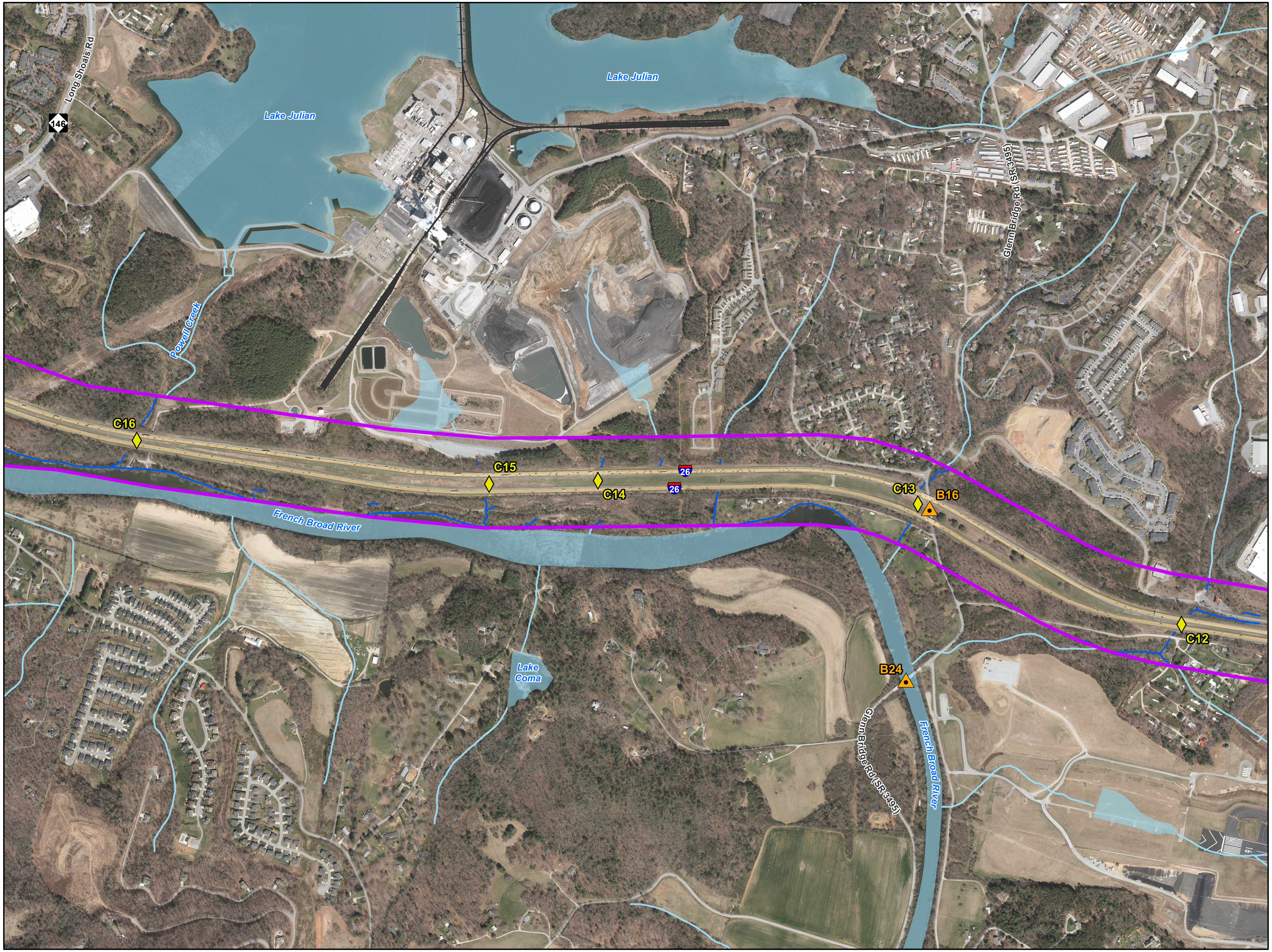
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3H

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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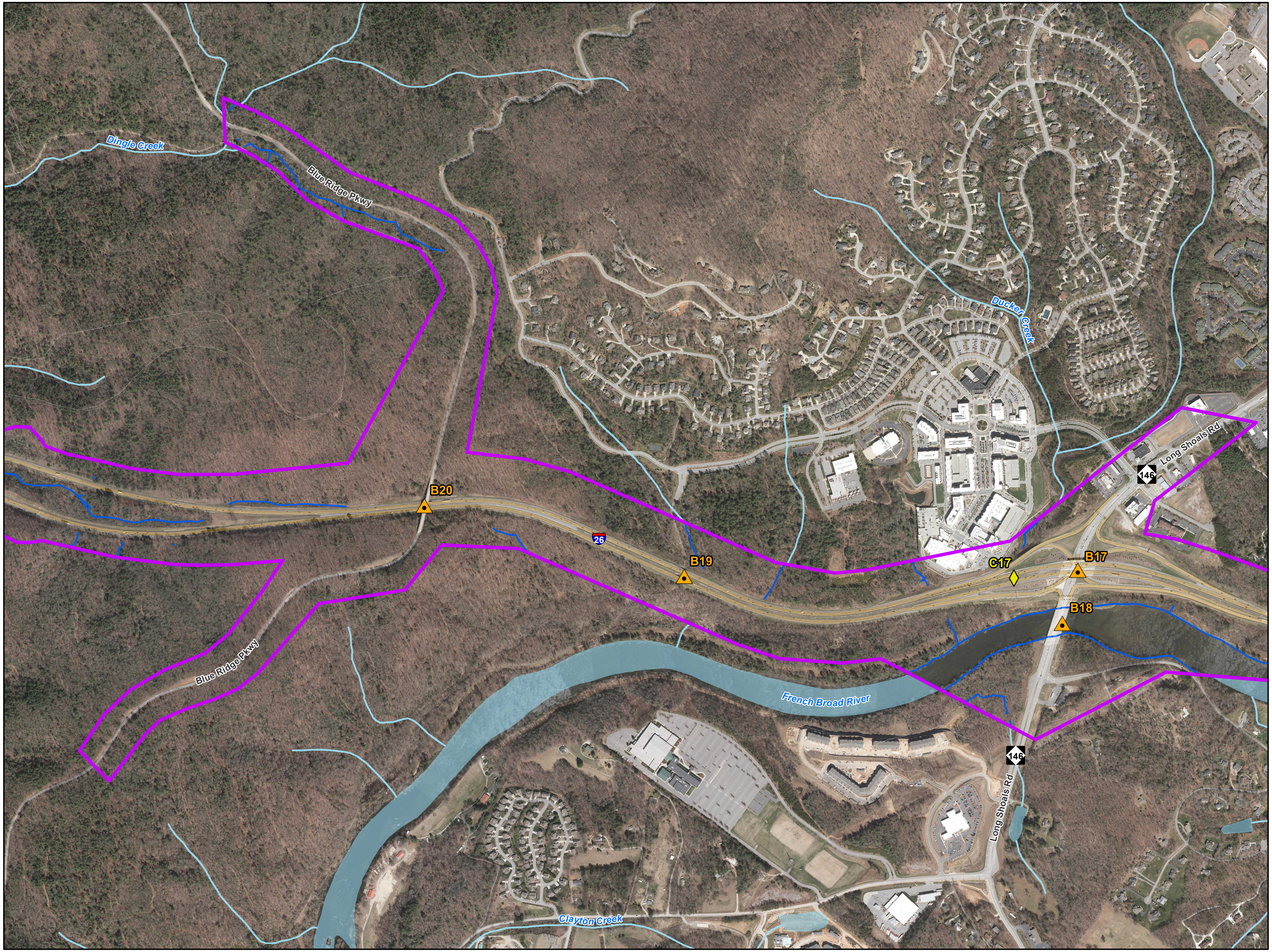
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure

3I

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/21/2017

800 400 0 800

Feet

1 inch = 800 feet

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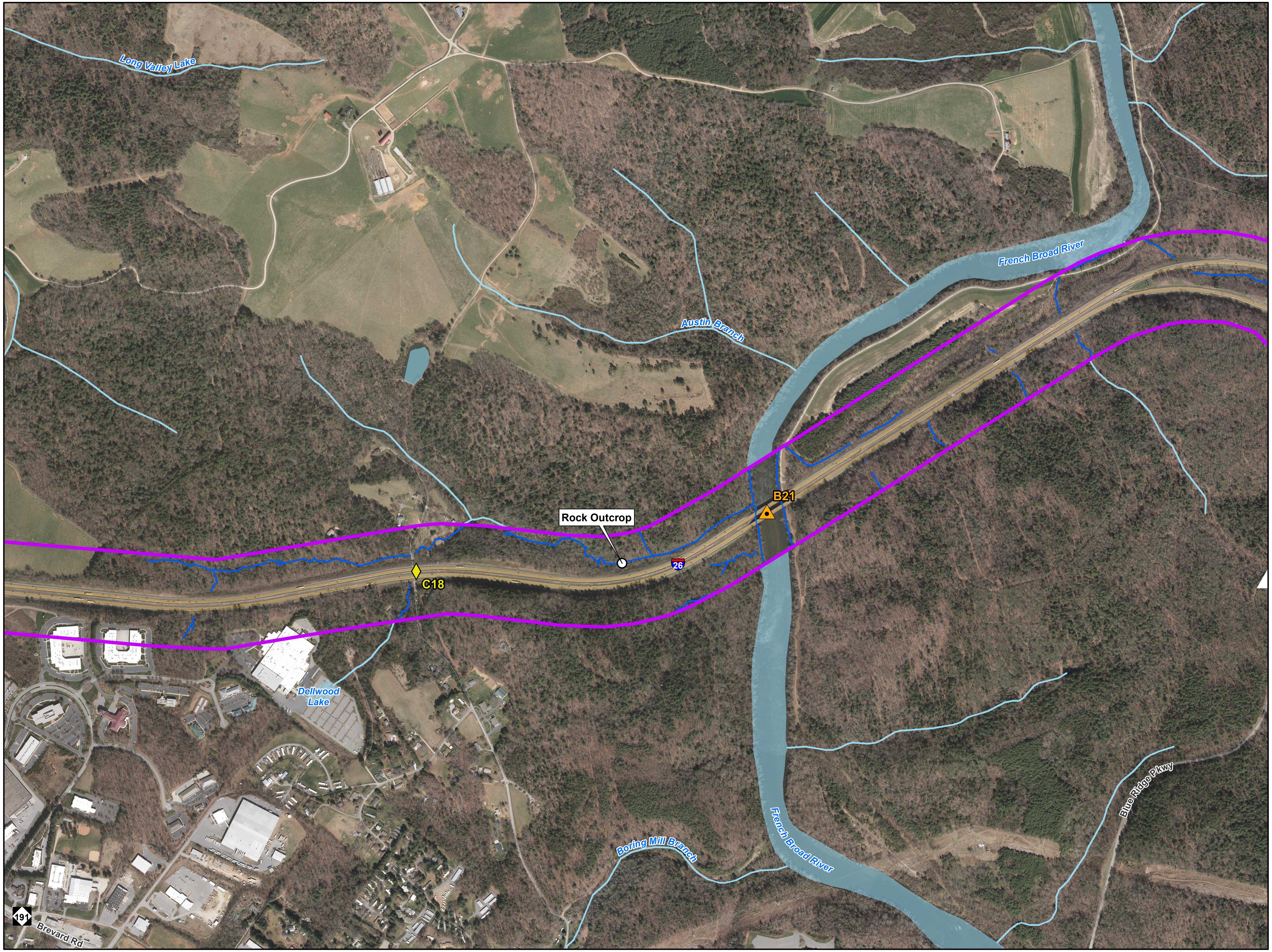
Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure

3J

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe &
Henderson Counties, NC

Map Date: 6/22/2017

800 400 0 800
Feet
1 inch = 800 feet

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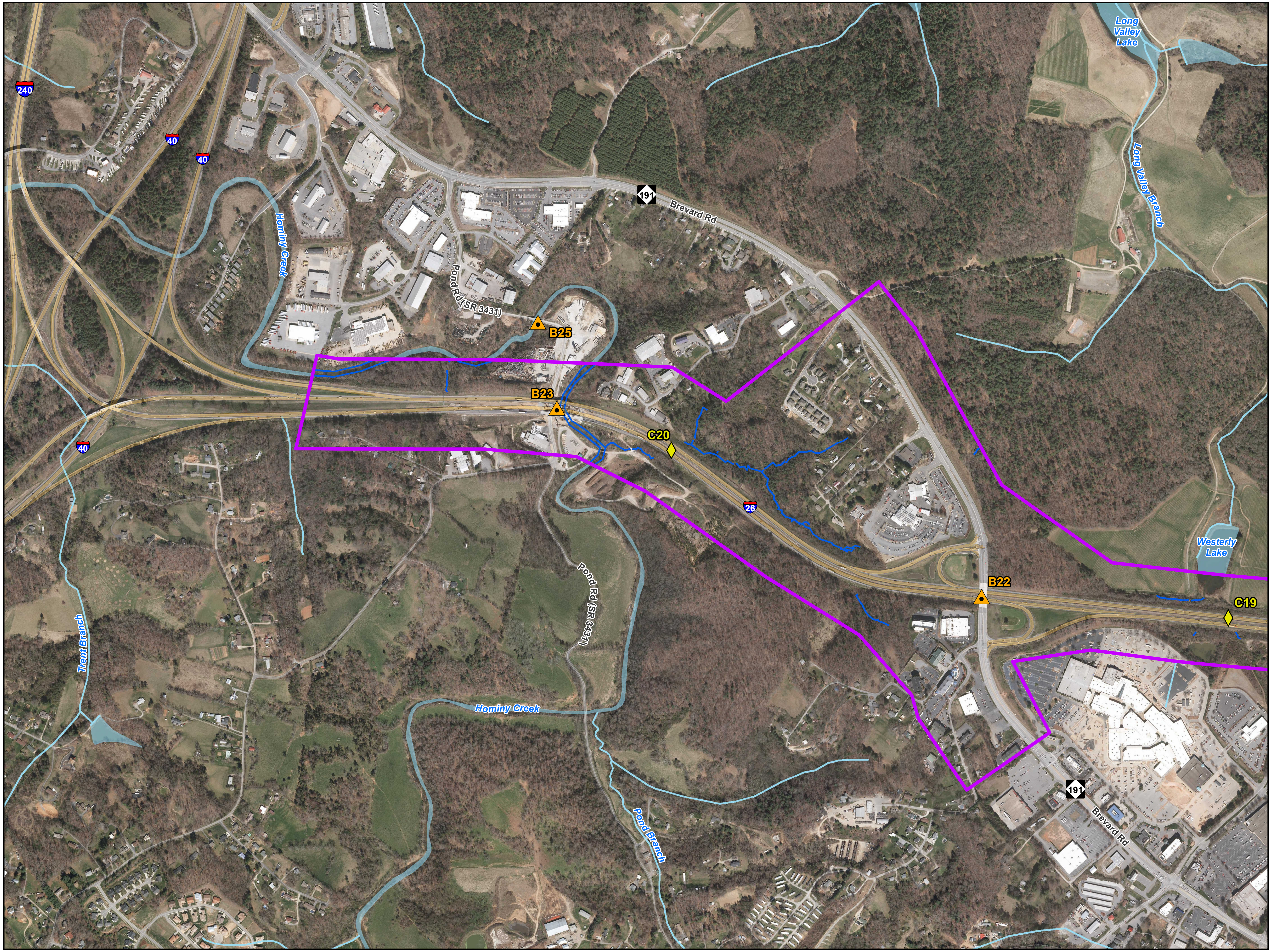
Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- Delineated Stream / Waterbody
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea
- County Boundary

Figure 3K

Structure Locations

I-26 Widening

TIP Project I-4400/I-4700

Buncombe & Henderson Counties, NC

Map Date: 6/22/2017

800 400 0 800

Feet

1 inch = 800 feet

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below. Streams and Wetlands: All features located in the field were recorded using a mapping grade Trimble GeoXT or GeoXH GPS receiver with supposed sub-meter accuracy.

Sources: NCDEQ, NCDOT, HNTB, Calyx Engineers and Consultants

Aerial Photography: NCDOT

Appendix B: Bridge Habitat Assessment Forms

Sensitive Information Intentionally Removed

Appendix D: I-26 Widening Mussel Survey Report

Freshwater Mussel Surveys:

I-26 Widening Final Report

TIP Nos. I-4700/I-4400

WBS 36030.1.2/34232.1.1

Buncombe and Henderson Counties, North Carolina

Appalachian Elktoe from mainstem French Broad River Site 170801.2ted

Prepared For:

NC Department of Transportation
Raleigh, North Carolina

Contact Person:

Jared Gray
Biological Surveys Group
North Carolina Department of Transportation
jgray@ncdot.gov
1598 Mail Service Center
Raleigh NC 27699-1598

January 3, 2018

Prepared by:

Three Oaks Engineering

324 Blackwell Street, Suite 1200
Durham, NC 27701

Contact Person:

Tom Dickinson
tom.dickinson@threeoaksengineering.com
919-732-1300

Table of Contents

Appendix A Figures:

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT) proposes to widen I-26 from I-40 to NC 225 (TIP Nos. I-4700/I-4400) in Henderson and Buncombe Counties, North Carolina (Figure 1). The project will cross waterbodies in the French Broad River Basin. The Federally Endangered Appalachian Elktoe (*Alasmidonta raveneliana*) is listed by the U.S. Fish and Wildlife Service (USFWS) for Buncombe and Henderson Counties and is currently known to occur in portions of the French Broad River Basin in Henderson County. The Federally Endangered Tan Riffleshell (*Epioblasma florentina walkeri*) is listed by the USFWS for Buncombe County as "Historic and Obscure" based on museum shell records from the early 20th century collected from the Asheville area, however, the species has not been collected since. Additionally, The NC Scientific Council of Mollusks 2010 reevaluation of the listing status of NC mollusks recommended the species status be changed from Endangered to Extirpated, a recommendation which was accepted in February 2011. As such, the project will have "No Effect" on the Tan Riffleshell.

According to the NC Natural Heritage Program database (NCNHP 2017), three element occurrences (EOs) for Appalachian Elktoe are located near the Project Study Area (Figure 2); from downstream to upstream they are as follows. The most downstream EO (EO ID: 21150) is a historic record located in the French Broad River approximately 5.6 river miles (RM) downstream of the 1-26 crossing of the French Broad River. This occurrence includes part of the Swannanoa River, is about 5.3 RM in length, and captures the original description of the species collected in the early 19th century. Continuing upstream, there is a current EO in the Mills River (EO ID: 7990). It is approximately 13.3 RM upstream of the 1-26 crossing of the French Broad River, was first observed July 2003 and last observed in October 2014, and is approximately 2.8 RM in length. The most upstream EO (EO ID: 19162) is located in the French Broad River and Little River approximately 17 RM upstream of the Mills River EO and 28.9 RM upstream of the 1-26 crossing of the French Broad River. It was first observed in 1953 and last observed in September 2015, and is approximately 10 RM in length.

As part of the federal permitting process that requires an evaluation of potential project-related impacts to federally protected species, Three Oaks Engineering (Three Oaks) was contracted by NCDOT to conduct surveys targeting Appalachian Elktoe.

2.0 WATERS IMPACTED

The project is located in the Upper French Broad River subbasin (HUC# 06010105).

2.1 303(d) Classification

French Broad River, Cane Creek, and Clear Creek are all listed on the NCDWR 2014 303(d) list of impaired streams. French Broad River is listed for fecal coliform, Cane Creek is listed for Poor Benthos, and Clear Creek is listed for both Poor Benthos and Fair Fish Community (Figure 3).

2.2 NDPES dischargers

There are multiple minor permitted NPDES dischargers in the French Broad survey area. Two major permitted dischargers in the immediate vicinity of the study area are the Asheville Steam Electric Power Plant (NC0000396) and the Hendersonville WWTP (NC0025534) (Figure 3) (USEPA 2017).

3.0 TARGET FEDERALLY PROTECTED SPECIES DESCRIPTIONS

3.1 Appalachian Elktoe (Alasmidonta raveneliana)

3.1.1 Characteristics

Isaac Lea (1834) described Appalachian Elktoe from the French Broad River system in North Carolina. Its shell is thin, but not fragile, oblong and somewhat kidney-shaped, with a sharply rounded anterior margin and a broadly rounded posterior margin. Parmalee and Bogan (1998) site a maximum length of 3.1 inches (80 mm). However, recently observed individuals from the Little River (French Broad River Basin) in Transylvania County and West Fork Pigeon River (French Broad River Basin) in Haywood County measured in excess of 3.9 inches (100 mm) in length (USFWS 2009). The periostracum (outer shell) of the adult Appalachian Elktoe varies in color from dark brown to yellowish-brown. Rays may be prominent in some individuals, usually on the posterior slope, and nearly obscure in other specimens. The nacre (inside shell surface) is a shiny bluish white, changing to salmon color in the beak cavity portion of the shell. A detailed description of the shell characteristics is contained in Clarke (1981). Ortmann (1921) provides descriptions of the soft anatomy.

The reproductive cycle of Appalachian Elktoe is similar to that of other native freshwater mussels. Males release sperm into the water column, and the sperm are then taken in by the female through their siphons during feeding and respiration. The females retain the fertilized eggs in their gills until the larvae (glochidia) fully develop. The mussel glochidia are released into the water, and within a few days they must attach to the appropriate species of fish, which they parasitize for a short time while they develop into juvenile mussels. They then detach from their fish host and sink to the stream bottom where they continue to develop, provided they land in a suitable substrate with the correct water conditions (USFWS 2002).

Many mussel species have specific fish hosts that must be present to complete their life cycle. Based upon laboratory infestation experiments (Watters 1994), Banded Sculpin (*Cottus carolinae*) was identified as a potential fish host for Appalachian Elktoe; however, the ranges of these two species rarely overlap. Keller documented transformation of Appalachian Elktoe glochidia on Mottled Sculpin (*Cottus bairdi*) in 1999 (USFWS 2002), and ongoing research at Tennessee Technical University (TTU) identified 10 fish species with encysted Appalachian Elktoe glochidia from the Little Tennessee River in North Carolina (Jim Layzer and Kendall Mole, TTU personal communication; Table 1).

Table 1. Fish species collected from the Little Tennessee River (NC) that contained encysted *Alasmidonta raveneliana* glochidia.

Common Name	Scientific Name
Banded Darter	*Etheostoma zonale*
Wounded Darter	*Etheostoma vulneratum*
Greenfin Darter	*Etheostoma chlorobranchium*
Tangerine Darter	*Percina aurantiaca*
Mottled Sculpin	*Cottus bairdi*
Black Redhorse	*Moxostoma duquesnei*
River Redhorse	*Moxostoma carinatum*
Sicklefin Redhorse	*Moxostoma sp.*
Northern Hog Sucker	*Hypentelium nigricans*
Warpaint Shiner	*Luxilus coccogenis*

Additionally, nine of the species shown in Table 2 were shown to successfully transform Appalachian Elktoe glochidia in laboratory induced infestations (Jim Layzer and Kendall Mole, TTU, personal communication). Based on over two years of ongoing monitoring of Appalachian Elktoe population in the Little Tennessee River by the NC Wildlife Resource Commission (NCWRC), it is apparent that Appalachian Elktoe is a bradytictic (long-term) breeder, with the females retaining glochidia in their gills from late August to mid-June (USFWS 2009). Glochidia are released in mid-June attaching to either the gills or fins of a suitable fish host species, and encysting within 2-36 hours. Transformation time (time until encystment) for Appalachian Elktoe occurs within 18-22 days at a mean temperature of 18° C (Jim Layzer, TTU, personal communication). Encystment time for freshwater mussels is reduced at higher temperatures (Zale and Neves 1982). McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

Table 2. Fish species collected from the Tuckasegee River (NC) on April 21, 2004, and used for laboratory induced infestations.

Common Name	Scientific Name	Number
Gilt Darter	*Percina evides*	6
Banded Darter	*Etheostoma zonale*	8
Wounded Darter *	*Etheostoma vulneratum*	17
Greenfin Darter *	*Etheostoma chlorobranchium*	32
Greenside Darter *	*Etheostoma blennioides*	3
Olive Darter	*Percina squamata*	1
Mottled Sculpin *	*Cottus bairdi*	19
Rock Bass	*Ambloplites rupestris*	1
River Chub *	*Nocomis micropogon*	20
Northern Hogsucker *	*Hypentelium nigricans*	3
Central Stoneroller *	*Campostoma anomalum*	6
Longnose Dace *	*Rhinichthys cataractae*	9
Rosyside Dace *	*Clinostomus funduloides*	1
Mirror Shiner	*Notropis spectrunculus*	3

Common Name	Scientific Name	Number
Tennessee Shiner	*Notropis leuciodus*	2
Total	**15**	**131**

* Species that successfully transformed *Alasmidonta raveneliana* glochidia.

3.1.2 Distribution and Habitat Requirements

Appalachian Elktoe is known only from the mountain streams of western North Carolina and eastern Tennessee. Historically, the species has also been recorded from Tulula Creek (Tennessee River drainage), the main stem of the French Broad River, and the Swannanoa River (French Broad River system) (Clarke 1981), but it was reported to have been eliminated from these streams (USFWS 1994; USFWS 1996). Currently, it is known to occur in low numbers in a reach of the mainstem French Broad River in Transylvania County (see discussion below). It is unclear whether this represents a re-colonization, or an erroneous conclusion of extirpation. There is also a historical record of Appalachian Elktoe from the North Fork Holston River in Tennessee (S.S. Haldeman collection); however, this record is believed to represent a mislabeled locality (Gordon 1991). If the historical record for the species in the North Fork Holston River was a valid record, the species has apparently been eliminated from this river as well.

Although the complete historic range of Appalachian Elktoe is unknown, available information suggests that the species once lived in the majority of the rivers and larger creeks of the upper Tennessee River system in North Carolina, with the possible exception of the Hiwassee and Watauga River systems (the species has not been recorded from either of these river systems). At the time of listing, two known populations of the Appalachian Elktoe existed, the Nolichucky River including its tributaries, the Cane River and the North Toe River, and the Little Tennessee River and its tributaries. The record in the Cane River was represented by one specimen found just above the confluence with the North Toe River (USFWS 1996). Since listing, the Appalachian Elktoe has been found in additional areas. These occurrences include extensions of the known ranges in the Nolichucky River (North Toe River, South Toe River, and Cane River) and Little Tennessee River (Tuckasegee River and Cheoah River), as well as a rediscovery in the French Broad River Basin (Pigeon River, Little River, Mills River and main stem French Broad River). Many of these newly discovered populations are relatively small in size and range.

Of the known surviving Appalachian Elktoe populations, two – the Nolichucky River system population and the Tuckasegee River population – currently appear to meet the definition of a viable population given in the Recovery Plan (though the number of individuals needed to comprise a viable population is presently unknown and is one of the tasks identified in the Recovery Plan to be completed).

The other populations of Appalachian Elktoe currently appear to be comprised of scattered individuals restricted to very short stream reaches and their viability is questionable (USFWS 2009). The Cheoah River, Pigeon River, Little River, Mills River, and French Broad River populations are restricted to scattered areas of suitable habitat in stream reaches of approximately 5.8 km (3.60 RM), 22.6 km (14.04 RM), 17.8 km (11.1 RM), 3.2 km (2.0 RM), and 28 km (17.4 RM), respectively, making them vulnerable to extirpation from a single catastrophic event such as a major chemical spill (USFWS 2009).

3.1.3 Threats to Species

The decline of Appalachian Elktoe throughout its historic range has been attributed to a variety of factors, including sedimentation, point and non-point source pollution, and habitat modification (impoundments, channelization etc.).

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. 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 or railroads.

Siltation resulting from improper erosion control of various types of land usage, including agricultural, forestry, and development, has been recognized as a major contributing factor to degradation of mussel populations (USFWS 1996). 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 1 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 endangered Dwarf Wedgemussel (*Alasmidonta heterodon*) because of accelerated sedimentation and erosion (Smith 1981). The abrasive action of sediment on mussel shells has been shown to cause erosion of the outer shell, which allows acids to reach and corrode underlying layers (Harman 1974).

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes with aquatic community composition. These changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for glochidia (Fuller 1974). In addition, the construction of dams often results in fragmentation of mussel populations by effectively blocking upstream expansion and recruitment of mussel and fish species. Along with modification of habitat, dams can indirectly impact freshwater mussel species by posing as a barrier to fish migration. The construction of the Petitcodiac River Causeway in Canada in 1968, resulted in the extirpation of the Dwarf Wedgemussel because the causeway restricted the migration of the diadromous Inner Bay of Fundy stock of Atlantic salmon (*Salmo salar*), which served as the fish host for the Dwarf Wedgemussel in this region (Locke et al. 2003).

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 might not occur for up to 2 mi (3.2 km) below points of chlorinated sewage effluent. Most of the water bodies where Appalachian Elktoe still exist have relatively few point source discharges within the watershed and are rated as having 'good' to 'excellent' water quality (NCDWQ 2012a, USFWS 1996).

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). Concern has been raised over competitive interactions for space, food, and oxygen between this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987; Alderman 1997). When Appalachian Elktoe was listed, it was speculated that due to its restricted distribution, it "may not be able to withstand vigorous competition" (USFWS 1996).

The Zebra Mussel, native to the Black, Caspian and Aral Seas, is an exotic freshwater mussel that was introduced into the Great Lakes in the 1980s. Since its introduction, this species 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 1996). The Zebra Mussel is not currently known from any river supporting Appalachian Elktoe populations.

Another exotic species that has the potential to adversely impact aquatic species, including Appalachian Elktoe, is Japanese Knotweed (*Fallopia japonica*). The plant is considered to be an invasive species that can reproduce from its seed or from its long, stout rhizomes. It can tolerate a variety of conditions such as full shade, high temperatures, high salinity, and drought. It can be spread by wind, water, and soil movement to an area where it quickly forms dense thickets that excludes native vegetation and greatly alters the natural ecosystem. This species has become established in riparian habitats throughout western North Carolina. The species has a very shallow root system; because of this shallow root system and its preclusion of other vegetation, areas where this species has been established may be susceptible to erosion during flood events.

3.2 Tan Riffleshell (Epioblasma florentina walkeri)

3.2.1 Characteristics

Two subspecies of *Epioblasma florentina* are currently recognized based on differences in shell morphology; the Tan Riffleshell (*Epioblasma florentina walkeri*), described by Wilson and H. W. Clark (1914) from the East Fork of the Stones River, Rutherford County, Tennessee and the Yellow Blossom (*E. florentina florentina)* described from the Tennessee River in Florence, Alabama by Issac Lea (1857). These two purported subspecies represent two extremes of a cline, with the Yellow Blossom being the "big river form" and the Tan Riffleshell the "headwater form". The Yellow Blossom form occurring in big rivers is presumed extinct and the Tan Riffleshell form occurring in head water streams is very restricted. In 1976, the USFWS listed the Yellow Blossom (*E. florentina*) as endangered. While Turgeon et al. (1988, 1998) did not recognize the separate subspecies, the USFWS listed the Tan Riffleshell as a subspecies and endangered in 1977.

The Tan Riffleshell is a relatively small mussel, seldom exceeding 60 mm in length. Its periostracum is a dull brownish green or yellowish green in color with numerous faint green rays evenly distributed over the entire valve surface; the nacre is a bluish white. Its shell outline is irregularly elliptical or obovate with inequilateral valves, subinflated, and rather solid. Both valves contain two small triangular pseudocardinal teeth. Lateral teeth are double in the left

valve, single or sometimes double in the right; they are short and curved. Anterior muscle scars are well impressed, while posterior muscle scars are shallow; the pallial line is distinct only anteriorly.

The Tan Riffleshell shows sexual dimorphism in many features. Males have a slightly protruding posterior end while females have a pronounced posterior marsupial swelling defined by anterior and posterior sulchi and are often serrated along the ventral margin. The posterior ridge of the male shell appears faintly doubled, ending in a slight biangulation posteriorly while it is scarcely visible in females. In male shells the umbo is quite full and elevated and located slightly anterior of middle, while in female you find it in the anterior third of the shell. Additionally, the posterior end of female shell is especially thin and iridescent.

Like many other freshwater mussels, life history information is limited for this species. It is assumed that their reproductive cycle is like that of other native freshwater mussels (See Section *3.1.1*). Rogers et al. (2001), working with the Indian Creek population in southwest Virginia, reported collecting gravid females of the Tan Riffleshell from February through August with glochidia being released principally in May and June. A fecundity estimate of almost 20,000 glochidia from one female was made. Maximum age of individuals from this population was estimated at 11 years based on shell thin sections (Rogers et al. 2001).

Laboratory tests of the Tan Riffleshell glochidia resulted in identification of five species of fish as suitable hosts (Table 3) (Watson and Neves 1996; Rogers et al. 2001). Of the 16 species tested, it was the benthic, riffle dwelling species that were successful fish hosts (Rogers et al. 2001).

Table 3. Laboratory identified fish hosts for Tan Riffleshell

Common Name	Scientific Name
Banded Sculpin	*Cottus bairdi*
Mottled Sculpin	*Cottus carolinae*
Greenside Darter	*Etheostoma blennioides*
Fantail Darter	*Etheostoma flabellare*
Redline Darter	*Etheostoma ruflineatum*

3.2.2 Distribution and Habitat Requirements

Historically the Tan Riffleshell was wide spread in the headwaters of the Tennessee and Cumberland River drainages. Recent populations of the Tan Riffleshell have been reported from the Duck River (Tennessee), Hiwassee River (Tennessee), Middle Fork Holston River (Virginia), Clinch River (Virginia), Indian Creek (Virginia), and the Big South Fork Cumberland River (Tennessee) (Parmalee and Hughes 1994; Rogers et al. 2001; Jones et al. 2004; Jones et al. 2006). The Tan Riffleshell is known in North Carolina from two museum lots from the French Broad River, Asheville, Buncombe County [identifications by D. H. Stansbery and confirmed by J. W. Jones].

Extant populations of the Tan Riffleshell in the Clinch (Virginia) and Hiwassee (Tennessee) River drainages are found in less than three feet of flowing water in a substrate of coarse sand, gravel, and some silt (Parmalee and Hughes 1994).

3.2.3 Threats to Species

Threats to the Tan Riffleshell are similar to those described for the Appalachian Elktoe and have contributed to the decline of this species throughout its range. All the remaining Tan Riffleshell 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.

4.0 MUSSEL SURVEY EFFORTS

Surveys reported in this report were led by Three Oaks Engineering with the personnel listed on the following dates (Table 4):

Table 4. Survey Dates and Personnel

Date	Surveyors
6-13-17	Tom Dickinson (TD, Permit 17-ES00343), Jonathan Hartsell (JH)
7-12-17	TD, Chris Sheats (CS)
8-1-17	TD, JH, Tim Savidge (TS, Permit 17-ES0034), Mike Sanderson (NCDOT, MS)
8-2-17	TD, JH, TS, MS, John Roberts (JR), Evan Morgan (EM)
8-3-17	TD, JH, TS, JR, EM
8-24-17	TS, John Fridell (JF), Mary Frazer (MF)
9-28-17	TS, TD, JF, CS
9-29-17	TS, TD, JF, CS. Jason Mays (USFWS, JM)
10-5-17	TD, Lizzy Stokes-Cawley (LSC), CS, JM, Janet Mizzi (USFWS, JMi, site 171005.1)
10-6-17	TS, EM, Nathan Howell (NH), LE, MH

4.1 Survey Methodology

Mussel surveys were conducted at 23 distinct sites: 21 sites in the French Broad River, one site in Clear Creek, and one in Cane Creek (Figure 4). The reach length and methodologies were determined individually for each site in the field based on habitat and survey conditions and survey crew size. Areas of appropriate habitat were searched, concentrating on the stable habitats preferred by the target species. The survey team spread out into survey lanes. Visual surveys were conducted using either mask/snorkel, SCUBA, or glass bottom view buckets (bathyscopes), or a combination there of depending on survey conditions. Tactile methods were employed, particularly in streambanks under submerged rootmats. Further description of the methodologies used for each site are provided by site. 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.

5.0 MUSSEL SURVEY RESULTS

The following details survey results for the project by site.

5.1 Clear Creek 170613.1ted

This reach flowed through mixed forested, agricultural, road, and residential land uses. Within the surveyed reach, the creek channel ranged from 30 to 60 feet wide with areas of both stabilized and partially eroded banks from six to 15 feet high. In stream habitat consisted of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, gravel, silt, and cobble. The stream was running clear during the site visit. A total of 2.9 person hours of survey time, primarily with bathyscopes, was spent during which no mussels were located. The only mollusk species found were the Asian Clam, which was uncommon, and the aquatic snail Sprite Elimia, which was common to abundant with a patchy distribution.

5.2 Cane Creek 170712.1ted

This reach flowed through primarily agricultural land use (left descending side), and a golf course (right descending side). A narrow buffer was present. Within the surveyed reach, the creek channel ranged from 23-30 feet wide with areas of both stabilized and eroded banks from 10 to 15 feet high. In stream habitat consisted of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, gravel, and cobble. The stream was running clear during the site visit. A total of 3.5 person hours of survey time, primarily with bathyscopes, was spent during which no mussels were located. The only mollusk species found was the Asian Clam (uncommon to common).

5.3 French Broad River Site 170801.1ted

The survey reach occurs in the Horseshoe Bend section of the river downstream of US 64. Surveys were conducted using SCUBA focusing mainly on areas considered to provide the best habitat attributes for the targeted species based on professional opinion.

The river is approximately 80 feet wide in this location with relatively stable banks up to 10 feet high. Water depth ranged from six inches along the bank and dropped quickly to maximum depth of ten feet, with the majority of surveyed habitat in the four to eight feet deep range. The weather was warm and mostly sunny and water clarity was slightly turbid.

The majority of the evaluated habitat occurred primarily along the right descending side of the river in a deep thalweg area with steep sloping bank areas. The substrate consisted of cobble, gravel, and sand with scattered bedrock and boulder.

A total of 2.25 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.4 French Broad River Site 170801.2ted

The survey reach occurs in a narrow section of the river adjacent to large agricultural fields. Surveys were conducted using SCUBA focusing on the best available habitats.

The river was approximately 85 feet wide in this location with eroded banks ten to 15 feet high. Water depth ranged from six inches along the bank and dropped quickly to maximum depth of eight feet, with the majority of surveyed habitat in the four to six feet deep range. Water clarity was slightly turbid.

The majority of the evaluated habitat occurred primarily along the right descending side of the river in a deep thalweg area with gradually sloping bank areas. In this area, the substrate consisted of cobble, gravel, and sand with scattered bedrock and boulder in this area; the majority of the channel consisted of shifting sand.

A total of 1.75 person hours of survey time was spent in the reach during which one Appalachian Elktoe was found along the margin of the thalweg and bank slope (Table 5).

Table 5. CPUE for Freshwater Mussels at Site 170801.2ted

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Alasmidonta raveneliana	Appalachian Elktoe	1	0.57/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C/PA

5.5 French Broad River Site 170801.3ted

The survey reach occurs in long, straight section of the river bordered by large agricultural fields. Surveys were completed by a four-person crew with three divers using SCUBA and the other person using a bathyscope in shallow areas.

The river was approximately 110-130 feet wide in this location with banks up to ten feet high that exhibited erosion and undercutting. Water depth ranged from six inches along the bank to maximum depth of eight feet. The weather was warm and mostly sunny, and the water was slightly turbid.

General habitat conditions consisted of a swift run up to three feet deep, with a deeper thalweg along the right descending bank. The substrate consisted of cobble, gravel, and sand with scattered bedrock and boulder.

A total of 2.33 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.6 French Broad River Site 170802.1ted

The survey reach occurs in long straight section of the river approximately one mile downstream of the Banner Road crossing and is bordered by large agricultural fields. Surveys were completed by a six-person crew with four divers using SCUBA and the other two people using bathyscopes in shallow areas.

The river was approximately 100 feet wide in this location with banks up to ten feet high. Water depth ranged from six inches along the bank to maximum depth of eight feet. The weather was warm and mostly sunny, and the water was slightly turbid.

General habitat conditions consisted of a swift run up to three feet deep, with a deeper thalweg along the right descending bank. The substrate consisted of cobble, gravel, and sand with scattered bedrock and boulder.

A total of 6.0 person hours of survey time were spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.7 French Broad River Site 170802.2ted

The survey reach occurs in sharp bend of the river approximately a half mile downstream of the NC 191 crossing. Surveys were completed by a six-person crew with four divers using SCUBA and the other two people using bathyscopes in shallow areas.

The river was approximately 100-120 feet wide in this location with relatively stable banks up to 6 feet high. Water depth ranged from six inches along the bank to maximum depth of eight feet, with the majority of surveyed habitat in the four to six feet deep range. The weather was warm and mostly sunny, and the water was slightly turbid.

General habitat conditions consisted of a swift run up to three feet deep, with a deeper thalweg along the right descending bank, that transitioned to the left descending side of the river in the downstream extent of the site. A large log jam along the left descending side of the river created a slackwater, back eddy habitat in the middle portion of the reach. The substrate consisted of cobble, gravel, and sand with scattered bedrock and boulder.

A total of 3.2 person hours of survey time was spent in the reach during which one Appalachian Elktoe was found in the thalweg along the edge of a bedrock area in sand and gravel substrate (Table 6).

Table 6. CPUE for Freshwater Mussels at Site 170802.2ted

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Alasmidonta raveneliana	Appalachian Elktoe	1	0.31/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C/PA

5.8 French Broad River Site 170802.3ted

The survey reach occurs just upstream of the Mills River confluence in a wide straight section with moderate gradient. Surveys were completed by a six-person crew with four divers using SCUBA and the other two people using bathyscopes in shallow areas.

The river was approximately 100 to110 feet wide in this location with banks up to 6 feet high that were relatively stable. Water depth ranged from six inches along the bank to maximum depth of five feet, with the majority of surveyed habitat in the two to four feet deep range. The weather was warm and mostly sunny, and the water was slightly turbid.

General habitat conditions consisted of a pool/riffle/run sequence with the pool occurring in the upper third of the reach. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulder. Large boulder accumulations within the general run habitat created pool/riffle/run sequences on a smaller scale.

A total of 3.5 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.9 French Broad River Site 170802.4ted

The survey reach occurs between two broad bends in the river adjacent to large agricultural fields. Surveys were completed by a six-person crew with two divers using SCUBA and the other four people using bathyscopes in shallow areas.

The river was approximately 125-140 feet wide in this location with relatively stable banks up to ten feet high. Water depth ranged from six inches along the bank to maximum depth of five feet, with the majority of surveyed habitat in the one to three feet deep range. The weather was warm and mostly sunny and the water was slightly turbid.

General habitat conditions consisted of a shallow riffle/run shoal area that transitioned to a pool in the lower portion of the reach. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulder. Many substrates were covered with aquatic vegetation. SCUBA was used in the deeper thalweg habitat along the left descending bank.

A total of 2.8 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.10 French Broad River Site 170802.5ted

The survey reach occurs in the vicinity of the Cane Creek confluence. Surveys were completed by a five-person crew using mask/snorkel and/or bathyscopes.

The river was approximately 110-165 feet wide in this location with banks up to eight feet high that were relatively stable with the exception of a moderately scoured section in the vicinity of the Cane Creek confluence. Water depth ranged from six inches along the bank to three feet in the deepest pools; however, over 70% was between 1.5 and 2.5 feet. The weather was warm and mostly sunny and the water was slightly turbid.

General habitat conditions consisted of a pool/riffle/run sequence with the pool occurring in the upper third of the reach. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulder. Large boulder accumulations within the general run habitat create pool/riffle/run sequences on a smaller scale. A slackwater area approximately 200 feet long by 20 feet wide occurred along the right descending bank in a back eddy created by the sandbar delta at the mouth of Cane Creek. The substrate in this area was covered with large amounts of silt and sand.

A total of 2.5 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.11 French Broad River Site 170803.1ted

The survey reach occurs in a wide shoal dominated section of the river a half mile upstream of the Blue Ridge Parkway crossing. Surveys were completed by a four-person crew using mask/snorkel and bathyscopes focusing on the best available mussel habitats.

The river was approximately 280-440 feet wide in this location with banks up to eight feet high that were relatively stable with the exception of a few small scour areas associated with logjams. Water depth ranged from six inches to three feet. The weather was warm and mostly sunny and the water clarity was relatively clear.

General habitat conditions consisted of a shallow riffle/run shoal. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulder. Large boulder accumulations within the general run habitat created pool/riffle/run sequences on a smaller scale. A slackwater area approximately 30 feet long by 20 feet wide occurred along the left descending bank in a back eddy created by a large log jam. The substrate in this area was covered with large amounts of silt and sand.

A total of 10.67 person hours of survey time was spent in the reach during which two mussel species, the Eastern Elliptio (*Elliptio complanata*) and the Creeper (*Strophitus undulatus*) were located (Table 12). All of the Eastern Elliptio individuals were found in small (50 feet by 30

feet) pocket of bedrock and cobble habitat along the left descending side of the river, and the one Creeper was found in a shallow riffle/run area along the right descending bank. The Asian Clam and the Sprite Elimia (*Elimia proxima*), an aquatic snail, were also found (Table 7).

Table 7. CPUE for Freshwater Mussels at Site 170803.1ted

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	20	1.87/hr
Strophitus undulatus	Creeper	1	0.09/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P-U

5.12 French Broad River Site 170824.1tws

The survey reach began approximately 340 feet downstream of the Avery Creek confluence and covered approximately two thirds of the total river width; total survey length was approximately 580 feet. Surveys were completed by a three-person crew using mask/snorkel focusing mainly on areas considered to provide the best habitat attributes for the targeted species based on professional opinion. However, all in-stream habitat types (pool, riffle, slackwater, etc.) were surveyed to some degree. Each surveyor stayed in a loosely defined survey lane of variable width, but were basically segmented into left, middle and right thirds of the river. Surveys proceeded in an upstream direction in a zigzag manner and generally followed the upstream transitions between microhabitats. The rate at which the surveyor moved through the lane was dependent on microhabitat conditions within the respective lanes to maximize coverage of the “best” habitats. For example, an area of solid bedrock, with no crevices, or a slackwater areas with large accumulations of silt, which are generally considered “poor” habitat for mussels were traversed more quickly than a bedrock area with crevices, or a cobble/gravel dominated area.

The river was approximately 175-260 feet wide in this location with banks up to ten feet high that were relatively stable with the exception of a moderately scoured section in the vicinity of the Avery Creek confluence. Water depth ranged from six inches along the bank to 3.5 feet in the deepest pools; however, over 70% was between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was slightly turbid.

General habitat conditions consisted of a pool/riffle/run sequence with the pool occurring in the upper third of the reach. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulder. Large boulder accumulations within the general run habitat create pool/riffle/run sequences on a smaller scale. A slackwater area approximately 200 feet long by 20 feet wide occurred along the left descending bank in a back eddy created by the sandbar delta at the mouth of Avery Creek. Another slackwater area about half that size occurred in the general pool area along the left descending bank above Avery Creek and was formed by an accumulation of large woody debris. The substrate in these areas was covered with large amounts of silt and sand.

A total of 4.25 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam (common) and the Sprite Elimia (patchy uncommon).

5.13 French Broad River Site 170824.2tws

The survey reach began approximately 50 feet upstream of the Long Shoals Road crossing and covered approximately half of the total river width; total survey length was approximately 450 feet. Surveys were completed by a three-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 260-475 feet wide in this location and the banks were 12 feet high and relatively stable with the exception of a small (50 feet long 30 feet wide) section adjacent to a large logjam along the left descending bank in the middle portion of the reach, which caused bank sloughing and created a slackwater area. Water depth ranged from six inches along the bank to three feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was slightly turbid.

General conditions were characterized predominantly as run habitat with short pools followed by higher gradient riffles created by bedrock ledges. The substrate consisted of cobble, gravel, and sand of varying depth over bedrock. Much of the riffle habitat was entirely bedrock and the slackwater habitat consisted of large amounts of silt and sand and accumulations of trash (plastic bottles, bags, etc.) trapped by the logjam.

A total of 4.25 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam(common) and the Sprite Elimia and the Pointed Campeloma (*Campeloma decisum*) (patchy uncommon and present, respectively).

5.14 French Broad River Site 170824.3tws

The survey reach occurs near the Bent Creek River Park below the Blue Ridge Parkway crossing. Surveys were completed by a three-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 190-260 feet wide in this location and the banks were 10-12 feet high and moderately eroded along the left descending side of the river. Water depth ranged from six inches along the bank to three feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was slightly turbid.

The survey reach occurred within a long run habitat, with small microhabitat pools and riffles created by boulders throughout. The substrate consisted of cobble, gravel, and sand of varying depth over bedrock.

A total of 3.60 person hours of survey time was spent in the reach. The Eastern Elliptio was the only mussel species observed, and a number of those were found in bedrock crevices (Table 8).

Table 8. CPUE for Freshwater Mussels at Site 170824.3tws

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	14	3.89/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P-U

5.15 French Broad River Site 170928.1tws

The survey reach occurs in the French Broad River along the Biltmore property downstream of the I-26 crossing. Surveys were completed by a two-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river is approximately 196-230 feet wide in this location and the banks are approximately nine feet high with some erosion and undercutting. Water depth ranged from six inches along the bank to three feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurs within riffle and run habitat, with small microhabitat pools and riffles created by boulders throughout. The substrate was dominated by of cobble and gravel.

A total of 1.17 person hours of survey time was spent in the reach. The only mollusk species found were the Asian Clam (common) and the Sprite Elimia (patchy uncommon).

5.16 French Broad River Site 170928.2tws

The survey reach occurs in the French Broad River above and below the I-26 crossing near the Biltmore property. Surveys were completed by a four-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 130-164 feet wide in this location and the banks approximately nine feet high with some erosion and undercutting. Water depth ranged from six inches along the bank to three feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurred within a riffle/run/pool sequence. The substrate consisted of cobble, gravel, and sand of varying depth over bedrock.

A total of 6.8 person hours of survey time was spent in the reach. The Eastern Elliptio was the only mussel species observed. The Asian Clam, Sprite Elimia, and Pointed Campeloma were also found (Table 9).

Table 9. CPUE for Freshwater Mussels at Site 170928.2tws

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	2	0.147/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P-U
Campeloma decisum	Pointed Campeloma	~	P-U

5.17 French Broad River Site 170928.3tws

The survey reach occurs in the French Broad River downstream of the I-26 crossing near the Biltmore property below the confluence with Dingle Creek. Surveys were completed by a four-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 164-180 feet wide in this location and the banks approximately nine feet high with some erosion and undercutting. Water depth ranged from six inches along the banks to three feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurred within riffle and run sequence, with small microhabitat pools and riffles created by boulders throughout. The substrate was dominated by cobble and bedrock.

A total of 4.0 person hours of survey time was spent in the reach. The only mollusk species found were the Asian Clam (common), the Sprite Elimia (patchy common), and the Pointed Campeloma (present).

5.18 French Broad River Site 170928.4tws

The survey reach occurs in the French Broad River downstream of the I-26 crossing along the Biltmore property above a ramp along Old River Road. Surveys were completed by a four-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 164-200 feet wide in this location and the banks approximately eight feet high with some erosion and undercutting. Water depth ranged from six inches along the banks to four feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurred within a riffle/run/pool sequence, with small microhabitat pools and riffles created by boulders throughout. The substrate consisted of cobble, gravel, and sand of varying depth over bedrock.

A total of 4.0 person hours of survey time was spent in the reach. Two Appalachian Elktoe were observed. The Asian Clam, Sprite Elimia, and Pointed Campeloma were also found (Table 10).

Table 10. CPUE for Freshwater Mussels at Site 170928.4tws

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Alasmidonta raveneliana	Appalchian Elktoe	2	0.5/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P-C
Campeloma decisum	Pointed Campeloma	~	Present

5.19 French Broad River Site 170929.1tws

The survey reach occurs in the French Broad River downstream of the I-26 crossing adjacent to the Biltmore property adjacent to a lagoon along Winery Approach Road. Surveys were completed by a five-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 150-180 feet wide in this location and the banks approximately nine feet high with some erosion and undercutting. Water depth ranged from six inches along the bank to three feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurred within a riffle/run/pool sequence. The substrate consisted of cobble and bedrock, with varying depths of gravel and sand of over bedrock.

A total of 7.17 person hours of survey time was spent in the reach. The only mollusk species found were the Asian Clam(common), the Sprite Elimia (patchy common), and the Pointed Campeloma (present).

5.20 French Broad River Site 170929.2tws

The survey reach occurs in the French Broad River downstream and to the I-26 crossing adjacent to the Biltmore property. Surveys were completed by a five-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 150-180 feet wide in this location and the banks approximately nine feet high with some erosion and undercutting. Water depth ranged from six inches along the bank to four feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurred within a riffle, run sequence, with small microhabitat pools and riffles created by boulders throughout. The substrate was dominated by of cobble, gravel, and sand of varying depth over bedrock.

A total of 11.5 person hours of survey time was spent in the reach, with eight Eastern Elliptio being observed. The Asian Clam, Sprite Elimia, and Pointed Campeloma were also found (Table 11).

Table 11. CPUE for Freshwater Mussels at Site 170929.2tws

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	8	0.7/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P-U
Campeloma decisum	Pointed Campeloma	~	Present

5.21 French Broad River Site 170929.3tws

The survey reach occurs in the French Broad River downstream of the I-26 crossing near the Biltmore property adjacent to Winery Approach Road. Surveys were completed by a three-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 125-144 feet wide in this location and the banks approximately six feet high with some erosion and undercutting. Water depth ranged from six inches along the bank to four feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurred within a riffle, run, pool sequence. The substrate consisted of cobble, gravel, and sand of varying depth over bedrock.

A total of 3.6 person hours of survey time was spent in the reach. One Appalachian Elktoe was observed. The Asian Clam, Sprite Elimia, and Pointed Campeloma were also found (Table 12).

Table 12. CPUE for Freshwater Mussels at Site 170929.3tws

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Alasmidonta raveneliana	Appalchian Elktoe	1	0.278/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	A
Elimia proxima	Sprite Elimia	~	P-C

5.22 French Broad River Site 171005.1ted

This survey reach occurs near the Biltmore Equestrian Center. Surveys were completed by a five-person crew using view scopes and mask/snorkels.

The river was approximately 160-200 feet wide in this location with moderately eroded banks 10-12 feet high. Water depths searched ranged from one to three feet. The weather was warm and sunny, and the water was clear.

The survey reach occurred primarily in run habitat, with small riffles created by boulders and bedrock outcroppings. Substrates consisted primarily of sand and gravel, silt along river margins, and cobble and boulder interspersed throughout.

A total of 4.25 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam (common to abundant).

5.23 French Broad River Site 171006.3tws

The survey reach occurs in the French Broad River downstream of the I-26 crossing adjacent to the Biltmore property. Surveys were completed by a five-person crew using mask/snorkel in a similar manner as site 170824.1tws.

The river was approximately 160 feet wide in this location with very stable banks approximately nine feet high. Water depth ranged from six inches along the bank to four feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was warm and mostly sunny and the water was clear.

The survey reach occurred within a riffle, run sequence, with small microhabitat pools and riffles created by boulders throughout. The substrate consisted of cobble, gravel, and sand of varying depth over bedrock.

A total of 5.47 person hours of survey time was spent in the reach. The Eastern Elliptio was observed along with the Asian Clam, Sprite Elimia, and Pointed Campeloma (Table 13).

Table 13. CPUE for Freshwater Mussels at Site 171006.3tws

Scientific Name	**Common Name**	**# live**	**Abundance/ CPUE**
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	3	0.548/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P-C
Campeloma decisum	Pointed Campeloma	~	Present

6.0 DISCUSSION/CONCLUSIONS

The Appalachian Elktoe was found at four sites within the French Broad River, which is a significant expansion (approximately 32 river miles downstream) of the previously known extant range of this species in the river. Based on habitat conditions and the difficulty detecting species that are present in low numbers, it is possible that the Appalachian Elktoe occurs at other sites surveyed on the French Broad River, but was not detected. The Tan Riffleshell was not found during the surveys. Records of this species in this portion of the French Broad River Basin are historic.

Based on these survey results, impacts could occur in the project area. Biological conclusions on potential impacts from the project to these two species are provided below.

Biological Conclusion Appalachian Elktoe: Unresolved

Biological Conclusion Tan Riffleshell: No Effect

The USFWS is the regulating authority for Section 7 Biological Conclusions and as such, it is recommended that they be consulted regarding their concurrence with the finding of this document.

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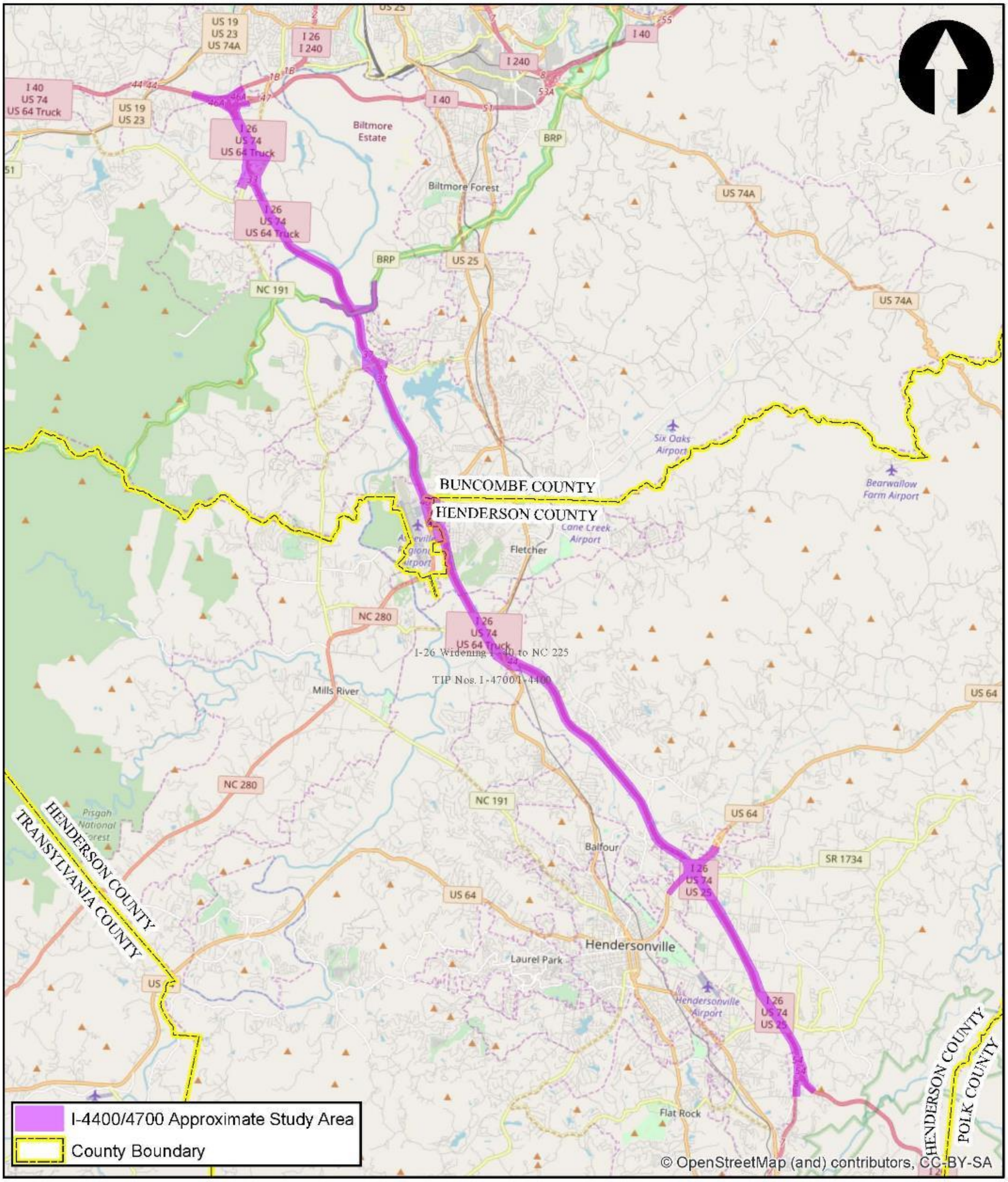
Appendix A: Figures



Prepared For:

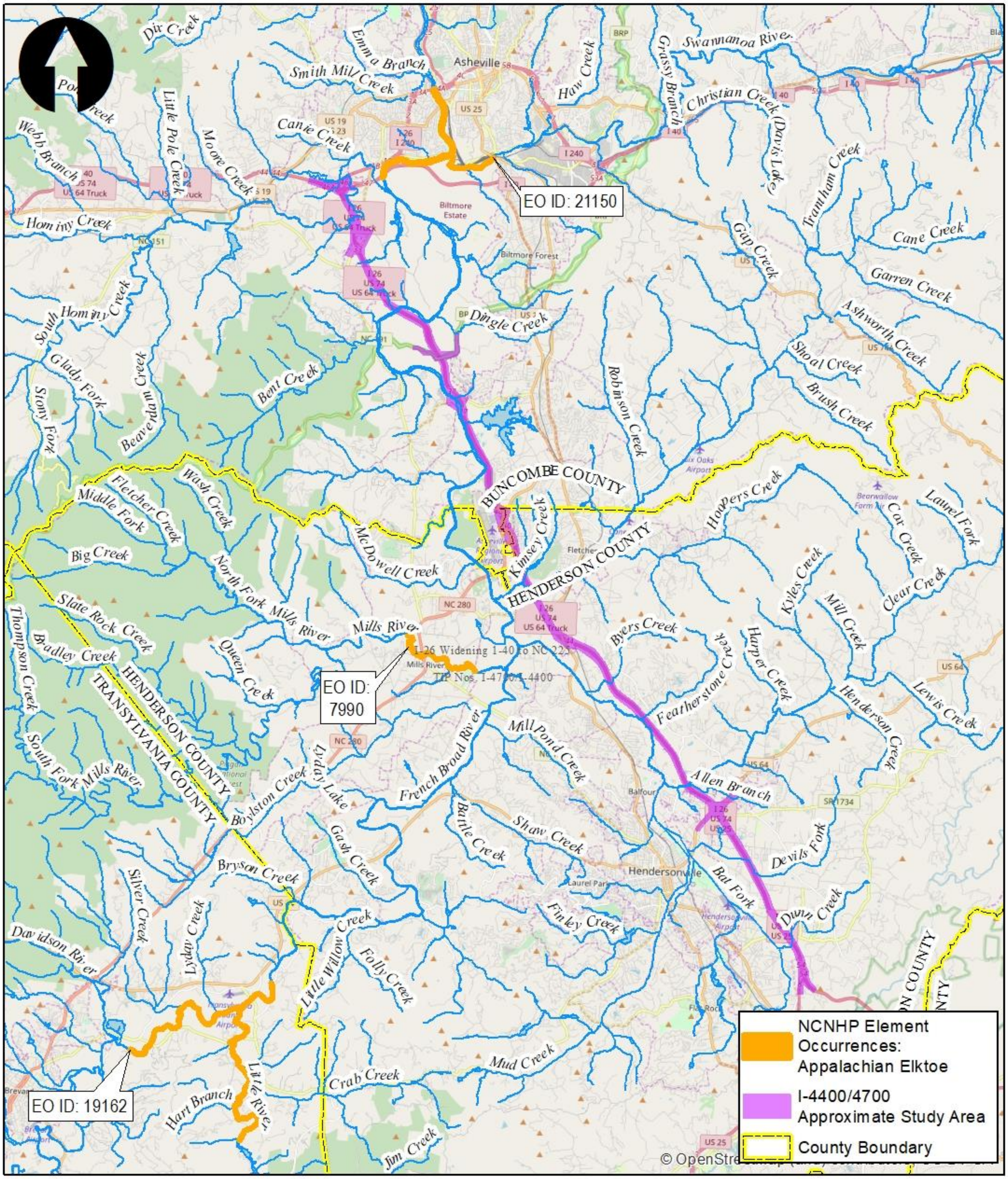
Freshwater Mussel Surveys

I-26 Widening
(TIP Nos. I-4700/I-4400)
Vicinity Map

Buncombe & Henderson Counties,
North Carolina

Date:	November 2017
Scale:	0 1 2 Miles
Job No.:	17-310
Drawn By: KEMS	Checked By: TED

Figure 1

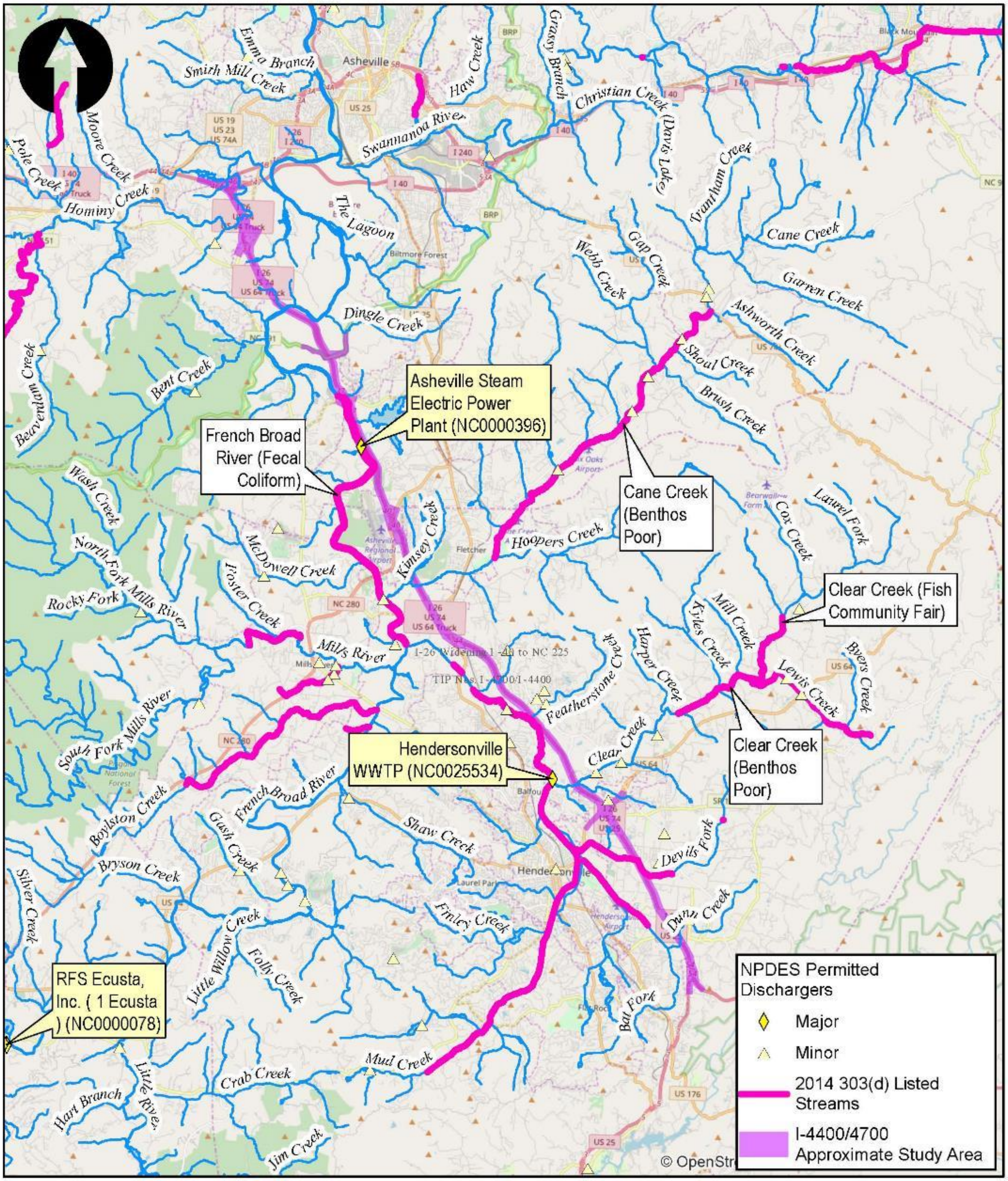


Prepared For:

Freshwater Mussel Surveys
I-26 Widening
(TIP Nos. I-4700/I-4400)
NCNHP Element Occurrences:
Appalachian Elktoe
Buncombe & Henderson Counties, North Carolina

Date:	November 2017
Scale:	0 1 2 Miles
Job No.:	17-310
Drawn By: KEMS	Checked By: TED

Figure 2



Prepared For:

Freshwater Mussel Surveys
I-26 Widening
(TIP Nos. I-4700/I-4400)
NPDES Discharges &
303(d) Listed Streams
Buncombe & Henderson Counties,
North Carolina

Date: November 2017

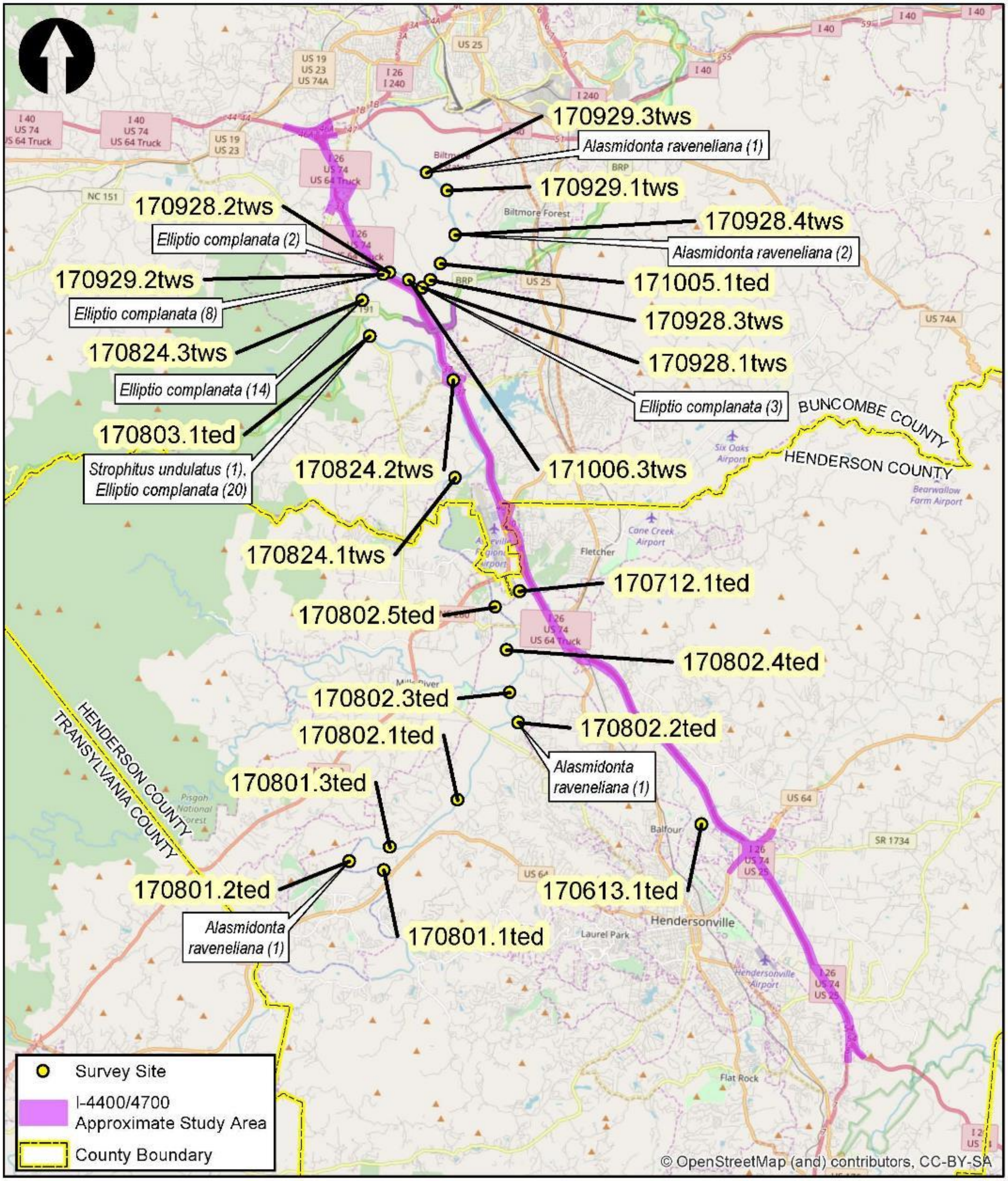
Scale: 0 1 2 Miles

Job No.: 17-310

Drawn By: KEMS

Checked By: TED

Figure 3



Prepared For:

Freshwater Mussel Surveys

I-26 Widening
(TIP Nos. I-4700/I-4400)
Survey Locations

Buncombe & Henderson Counties, North Carolina

Date:	November 2017
Scale:	0 1 2 Miles
Job No.:	17-310
Drawn By: KEMS	Checked By: TED

Figure 4

Appendix E: Bridge Replacement Description and Hydraulic Modeling Summary

I-26 Bridge Over the French Broad River Proposed Construction and Demolition

I-26 Widening
STIP I-4400/I-4700
Henderson and Buncombe Counties

July 2018

HNTB

INTERSTATE 26

Summary

As part of the widening of I-26, STIP Project Nos. I-4400 and I-4700, the existing pair of two-lane bridges that carry I-26 over the French Broad River will be replaced with one new structure that will provide a total of eight travel lanes. These bridges lie within an area occupied by two federally protected species: gray bat (*Myotis grisescens*) and Appalachian elktoe (*Alasmidonta raveneliana*). Consequently, NC Department of Transportation (NCDOT) evaluated the various constraints associated with the bridges replacement, conducted preliminary coordination with the US Army Corps of Engineers (USACE), US Fish and Wildlife Service (USFWS), Federal Highway Administration (FHWA), NC Department of Water Resources (NCDWR), and the NC Wildlife Resources Commission (NCWRC) and accelerated the design process to better determine potential impacts on protected species within the Action Area as defined in the Biological Assessment.

NCDOT's preferred replacement structure is a three-span bridge, which will take approximately three to four years to build. Although the three-span bridge is NCDOT's preferred option, the preliminary design that was used to determine potential impacts is considered a worst-case scenario and will be refined as design progresses.

To build the bridge, access roads and causeways will be used. Access roads are required to transport materials and construction equipment to the worksite. The access roads will be built parallel to I-26, one in each quadrant of I-26 and the river. The access roads will require approximately 3.75 acres beyond the current slope stake limits for the project. This area will be cleared of trees and other vegetation; however, these areas would need to be cleared as part of the typical construction process for this project.

The access road design will use Design Standards in Sensitive Watersheds (DSSW) to mitigate the amount of sediment and erosion that enters the French Broad River. NCDOT has identified the French Broad River and streams that drain directly into the French Broad River as Environmentally Sensitive Areas (ESAs) due to the presence of the Appalachian elktoe. ESAs require that special procedures must be used for construction activities within a 50-foot zone on both sides of the stream measured from top of bank. The proposed access road in the southeast and northeast quadrants are within approximately 30 feet and 10 feet, respectively, of jurisdictional streams SEE and SFG. To reduce potential sediment and erosion caused by the access road, NCDOT shall temporarily pipe streams SEE and SFG during bridge construction and demolition. USFWS and USACE will have the opportunity to review the design of the SEC measures for Stream SEE. A revegetation and stream monitoring plan shall be developed for Streams SEE and SFG, to observe vegetation success and stream stability. The revegetation and stream monitoring plan shall be approved by the USACE and will commence once the bridge construction and demolition are complete and the pipe is removed.

Due to insufficient area between the toe of slope and the top of bank to allow construction vehicle passage under the bridge and the location of the interior bents within the river, a causeway is required to provide construction access. The causeways are illustrated in the Causeway Sketches, Appendix A. The size, width and length into the river, of the causeways varies from stage to stage depending on the work being performed.

Between 51 and 67 percent of the river will remain free-flowing depending upon the causeway stage. The bridge is anticipated to be built in four stages. Demolition of the existing bridge, including the superstructure and interior bents and the top of the center bent will occur in conjunction with construction of the new bridge. The first stage of construction comprises building the bridge to the west of the existing bridge. In the second stage, the existing eastbound I-26 bridge will be demolished and construction will then continue, adding four lanes to the new bridge structure. The third stage will

demolish the westbound bridge and then build the remainder of the structure. In the fourth stage the two center bents will be removed. This approach minimizes the restriction of the river created by the causeway.

The French Broad River was modeled using the US Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS). The modeling was conducted for two scenarios, the first with the causeway that is anticipated to be in place for the entire construction time, shown as Stage 1A, 2A, 3A in the Causeway Sketches. The second scenario used the 'L' causeway extension (shown as Stage 4 in the Causeway Sketches) that will be in place for approximately four weeks at the end of construction. The modeling shows a rise in the water surface elevation (WSE) during a mean rain event and during a 100-year storm event for both scenarios. The rise in WSE under the mean event for the Stage 1A, 2A, 3A causeway is approximately 8.5 inches at approximately 0.02 mile (116 feet) upstream of the causeway, and returns to 0 inches, or no difference, 0.6 mile upstream. During a 100-year storm event a WSE rise of approximately 1.5 feet to 2.5 inches may occur between the causeway and approximately 2.1 miles upstream of the bridge before returning to a normal WSE for a 100-year flood event. Similar results were found for the Stage 4, 'L' causeway.

Using the Flood Risk Information System (FRIS) database, nine residential structures are within the 100-year floodplain from the I-26 bridge over the French Broad River to the Long Shoals Road bridge over the FBR, approximately 3.2 miles upstream. Aerial photography suggests an additional eight structures may also be in the 100-year floodplain. During a 100-year flood event all of the structures would be flooded under existing conditions (see Structures in Floodplain, Appendix A). Due to the temporary causeway (Stage 1A, 2A, 3A) an additional increase of 10 inches in flood water would occur to the structure located approximately 0.6 mile upstream. The temporary 'L' causeway (Stage 4) would increase the 100-year flood water elevation by an additional 3 inches for the structure located approximately 0.6 mile upstream. No additional structures are anticipated to be affected by a 100-year storm event while the causeways are in place.

NCDOT has committed to a channel morphology study of the French Broad River to determine the preconstruction channel condition, as well as any effects of the causeways during and after construction.

As part of its evaluation, NCDOT also took into consideration the time of day when construction and demolition may take place. It was determined that some work would likely need to be completed at night. These activities may include setting girders, drilling shafts, concrete pours, deck concrete pours, beam setting, construction material(s) stockpiling, and traffic shifts. The amount and type of lighting for all construction and demolition activities will be minimized to the extent possible. Red safety lighting will be used to alert river users to the location of the causeways.

Additional measures to protect the French Broad River during construction will be taken and are summarized in the Avoidance and Minimization Measures.

Because the French Broad River is regularly used for recreation, it cannot be closed for the life of construction (three to four years). There are no options for portage due to the location of the bridge. The nearest public river access is at Bent Creek River Park, 1 mile upstream of the bridge, and the next public river access is at Hominy Creek River Park. The distance by road between these two locations is 5.9 miles on NC 191 (Brevard Road). This is not a feasible portage option. It would be possible for NCDOT to coordinate with private land owners to provide output pull-out and put-in at the bridge; however, this would require users to walk through an active construction zone. This was deemed to be less safe than leaving the river open to water traffic throughout construction.

NCDOT shall commit to providing a safe passage lane for river users. To do so, NCDOT shall employ safety measures, including a catchment device on the overhead structure to prevent material from falling on river users, equestrians or bicyclists on Old River Road, or in the water. In addition, a floating navigational aid to guide river users to the safe passage lane and away from the causeways/construction zone. Red, steady-state, solar powered lights will be located on the causeways to alert river users to the presence of the causeways. Certain activities, such as setting girders, will require temporary river closure to ensure the safety of river users. Most of these activities are anticipated to occur at night. NCDOT has developed a Communication Plan specific to the construction/demolition of the I-26 bridge and will work with river users, businesses, and recreational river and civic groups to insure public notification of the temporary closures.

Avoidance and Minimization Measures

The avoidance and minimization measures are summarized here and are discussed throughout the document.

Topic	Measure
Bridge Design: Three-span bridge type	**Avoidance** • Choosing the three-span bridge avoids the existing substructure foundations, including the center bent. • Choosing the three-span bridge reduces the number of spans and, therefore, one additional bent in the center of the river. • No direct discharge of bridge deck drainage, design will direct discharge to stormwater structures. **Minimization** • Requires fewer bents. • Maximizes the hydraulic opening with smaller causeways. • Reduced time to construct. • With the exception of streams SEE and SFG, Design Standards in Sensitive Watersheds [15A NCAC 04B .0124 (b) – (e)] will be used for streams that drain directly to the French Broad River.
Access roads	**Minimization** • Temporary retaining walls will be used on the outer edges of the access roads to reduce impacts to adjacent forested land and jurisdictional features. • Footprint for access roads will not extend beyond permanent project footprint. • To reduce potential sediment and erosion caused by southeast and northeast access roads NCDOT shall temporarily pipe streams SEE and SFG, respectively, during bridge construction and demolition. USFWS and USACE will have the opportunity to review the design of the SEC measures for Streams SEE and SFG. A revegetation and stream monitoring plan shall be developed for Streams SEE and SFG. The revegetation and stream monitoring plan shall be approved by the USACE and will commence once the bridge construction and demolition are complete and the pipe is removed. Monitoring to

Topic	Measure
	observe vegetation success and stream stability will take place for a minimum of three years after construction.
Causeways	**Avoidance** • Causeways will be used instead of multiple work bridges that would require drilled piles, be time intensive, and add an additional obstacle in the air. **Minimization** • The design of the causeways has been refined to allow for a maximum free flow area of the French Broad River. The first causeway concept allowed for only a 28 percent free flow area of the river at its largest size. The design was refined and at its largest size the causeways will allow a 51 percent free flow area. • Causeway material will be added/removed as needed for each stage to minimize footprint over the length of the project. • To minimize disturbance to the riverbed, all readily detectable causeway material will be removed to the extent practicable, while removing as little of the original riverbed as possible. • Causeway extension (Stage 4) will be sloped to allow water to flow over top; reducing overall impact to channel flow • NCDOT shall require the contractor to use clean stone for the construction of the causeways. This will minimize unnecessary sediment input into the river. • All of the stone will be removed and disposed of off-site, or the stone can be used in areas that require permanent stone protection after project completion. NCDOT shall also require that concrete barriers (barrier rail) be placed along the downstream edge of each causeway to limit the downstream movement of causeway material during high flow events. • Construction fabric will not be used under the causeway material, because it tends to tear into pieces and float downstream during removal. • With the exceptions noted for the drill rig and crane, all construction equipment will be refueled outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater) and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater), not in a Water of the U.S., and preferably at an upland site. Areas used for borrow or construction by-products will not be located in wetlands or in the

Topic	Measure
	100-year floodplain. • Equipment that is placed on the causeways will be removed any time throughout a work day when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, it must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded. • NCDOT shall require the contractor to use brand new or steam cleaned equipment to access causeways that are underwater if these causeways are utilized for removal of existing bents in underwater conditions. • NCDOT shall commit to channel morphology monitoring.
Demolition	**Avoidance** • After removal of existing bents, natural substrate will not be used as backfill. **Minimization** • Removal of the existing bridge shall be performed so as not to allow debris to fall into the water. If debris is dropped in the river, it will be immediately removed. • All resource agencies will be invited to review the demolition plan and will be notified prior to start of demolition so they may have a representative on site. • NCDOT shall provide USFWS with the French Broad River bridge demolition plan and allow 15 days for review.
Construction	**Minimization** • NCDOT shall include language outlining the staged construction/ demolition in the construction contract. • NCDOT shall provide USFWS with the Sediment and Erosion Control plan and allow 15 days for review. • The Sediment and Erosion Control plan shall be in place prior to any ground disturbance. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented. • NCDOT has developed erosion control measures for the project, specifically to protect the Appalachian elktoe and its habitat. NCDOT shall commit to retain one dedicated inspector for each project section (I-4400, I-4700) to perform SEC inspections. Inspections of erosion control devices adjacent to the bridge will be completed on a daily basis by the Construction Project Inspector. • When constructing drilled bents, a containment system will be

Topic	Measure
	developed so that substrate material does not enter the river. Any material by-product will be pumped out of the shaft to an upland disposal area and treated through a proper stilling basin or silt bag. • Construction of new bridges will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river. • NCDOT shall commit to requiring its contractor to have clean, non-leaking equipment; diapers on-site for each causeway; and spill kits located at each causeway. • Activities in the floodplain shall be limited to those needed to construct the proposed bridge and remove the existing bridges. • All construction equipment will be refueled outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater) and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater), not in a Water of the U.S., and preferably at an upland site. Areas used for borrow or construction by-products will not be located in wetlands or in the 100-year floodplain. • The Contractor shall be required to prosecute the work in a continuous and uninterrupted manner from the time they begin the work until completion of each phase of structure construction, demolition and completion. The Contractor will not be permitted to suspend his operations except for reasons beyond his control or except where the Engineer has authorized a suspension of the Contractor's operations in writing. • In the event that the Contractor's operations are suspended in violation of the above provisions or it is determined the Contractor is not deemed to be pursuing the work in a continuous manner in accordance with his submitted and approved schedule, the sum of $1,000 per day will be charged the Contractor for each and every calendar day that such suspension takes place. The said amount is hereby agreed upon as liquidated damaged due to extra engineering and maintenance costs and due to increased public hazard resulting from a suspension of the work. Liquidated damages chargeable due to suspension of the work will be additional to any liquidated damages that may become chargeable due to failure to complete the work on time. • NCDOT shall install a rainfall data logger at the French Broad River and other sensitive locations to continuously monitor and record rainfall events.

Topic	Measure
	• NCDOT shall commit to self-reporting SEC device failures to USFWS that result from excessive rainfall events (intensity that exceeds 25-year storm event). • NCDOT shall commit to collect background data on river turbidity.
Construction: Night Work	**Minimization** • Between June 1 and August 1, NCDOT shall commit to restrict the construction contractor to no more than 28 total nights of work, and no more than four consecutive nights within a two-week period. • Lighting used for construction will be limited to whatever is necessary to maintain safety standards, and will only be directed toward active work areas. • NCDOT shall place steady-state, solar-powered red lights on the causeway to alert river users to its location. Generators will not be used to provide power.
River Users	**Minimization** • Development of a Communication Plan to inform stakeholders of bridge construction/ demolition. • Use of a catchment system to avoid having construction/demolition debris fall on river users and equestrians and bicyclists using Old River Road. NCDOT shall specify that the contractor use a rigid, non-drooping system placed approximately 1 to 2 feet below the structure wherever construction/demolition is occurring. • NCDOT shall use a floating navigational aid to direct river users to the “safe zone” of the river, away from construction. • NCDOT shall place steady-state, solar-powered red lights on the causeway to alert river users to its location. Generators will not be used to provide power. • NCDOT shall place signs at upstream and downstream of the construction areas and at river inputs to alert river users of the I-26 bridge construction.

Contents

Appendix A

1 Introduction

As part of the widening of I-26, the pair of existing two-lane bridges crossing the French Broad River will be replaced with one new structure to provide a total of eight travel lanes. This bridge lies within an area occupied by two federally protected species, gray bat (*Myotis grisescens*) and Appalachian elktoe (*Alasmidonta raveneliana*). Consequently, NCDOT evaluated the various constraints associated with the bridge replacement, conducted preliminary coordination with USACE, USFWS, FHWA, and NCWRC and accelerated the design process to better determine potential impacts on protected species within the Action Area.

This document describes the preferred structure type, the construction and demolition staging, and additional challenges associated with construction and demolition. Avoidance and minimization measures are included where appropriate throughout the document.

2 Structure

2.1 Existing

The existing pair of I-26 bridges over the French Broad River are approximately 450 feet in length and 33.4 feet in width. There is a clear distance between the two structures of approximately 34.6 feet. Each structure consists of six spans of approximately 75 feet in length supported by four lines of steel girders. Interior bents are supported on spread footings and all but one of the ten interior bents are in the water. The river is approximately 253 feet wide at the crossing.

2.2 Proposed

This project is in the preliminary design phase, so detailed drawings are not currently available. Figures of the proposed access roads, proposed causeway sketches, and hydraulic cross sections are located in Appendix A.

Designs for the I-26 bridge over the French Broad River propose a single bridge with a deck approximately 464 feet in length and 153.3 feet in width. Two bridge designs were proposed: a four-span structure and three-span structure. Both designs would maintain the same approximately 15.4-foot vertical clearances over Old River Road and the water surface of the river as the current structure. Due to the surrounding topography, the existing and proposed bridges are higher on the western side. To accommodate the bridge construction and maintenance of traffic, the new I-26 centerline will be shifted approximately 12.5 feet to the south of the existing centerline.

NCDOT has chosen to move forward with the three-span design. The three spans for this design are anticipated to have lengths of approximately 151 feet, 170 feet, and 143 feet from east to west, and will require two bents in the river. Each bent will require ten drilled shafts. Assuming ten, 5-foot diameter shafts for each bent, the drilled shaft area is approximately 200 square feet, per bent, for a total of 400 square feet for both bents. The unequal span arrangement avoids all existing foundations, including the center bent. This design reduces impacts to the river by using fewer bents than the four-span arrangement; maximizes the hydraulic opening with smaller causeways; and speeds construction. The center span length exceeds the standard concrete girder length typically utilized by NCDOT, so it is likely that final design specifications will call for steel girders. It is expected that this bridge will require approximately three to four years to complete.

The current barrier on the bridge is a one bar metal rail on concrete parapet with retrofitted guardrail. It will be replaced with concrete barrier rail, a 42-inch solid, concrete “Jersey barrier” style guard wall.

Bridge Deck Drainage

NCDOT makes every attempt to eliminate direct deck drainage into water bodies whenever federally protected aquatic species or sensitive habitats are present. Currently, drainage from the deck of the existing structure flows directly into the river. The proposed design for the bridge over the French Broad River will include shoulders sufficient to convey runoff into adjacent stormwater control devices and eliminate direct discharge into the river.

3 Construction and Demolition of the I-26 Bridge

The location of the I-26 bridge over the French Broad River presents certain challenges to its construction and demolition. These include the proximity of wetlands and streams adjacent to the existing roadway, mountainous topography, and right of way restrictions. The substrate of the French Broad River is largely bedrock in this area. Consequently, NCDOT shall construct access roads and causeways from which to construct the new structure and demolish the existing one.

3.1 Access Roads

Access road locations are illustrated on the Proposed Access Roads and Construction Access Plan figure (Appendix A). The access roads will be placed in all four quadrants of I-26 and the French Broad River. These temporary access roads will be located parallel and adjacent to the proposed shoulders of I-26. The size of access roads and construction staging areas will be minimized wherever practicable. The access roads and construction staging areas will be established from the start of the project and designed with sediment and erosion-control measures. Temporary retaining walls will be used on the outer edges of the access roads to reduce impacts to adjacent land and jurisdictional features. The approximate area required for the access roads beyond current slope stake limits is shown in Table 1.

Table 1. Tree Clearing Area for Access Roads

Access Road Location	Approximate Area of Clearing (ac)
I-26 WB, southeast quadrant	0.25
I-26 WB, northeast quadrant	0.5
I-26 EB, southwest quadrant	0.5
I-26 EB, northwest quadrant	2.5
Total:	3.75

It is anticipated that this area will be cleared of trees and other vegetation. However, these areas would need to be cleared as part of the typical construction process for this project.

The proposed bridge will be constructed in stages beginning on the upstream side of the existing bridge that carries east-bound traffic. The access roadways will tie to rock causeways located on the corresponding side of the river. The causeways at each bridge end will traverse from one edge of the proposed superstructure to the other, under the existing bridges. These causeways will be used as work pads for the construction cranes and other equipment needed during demolition and construction activities.

3.2 Causeways

Due to insufficient area between the toe of slope and the top of bank to allow construction vehicle passage under the bridge and the location of the interior bents within the river, NCDOT reviewed using either a work bridge or causeway to provide construction access. Work bridges were ruled out for several reasons. The bedrock that makes up the riverbed of the French Broad River in this location prohibits the use of driven piles that would be required to set the foundations of temporary work bridges. The piles would need to be drilled, which would increase the length of time it would take to construct the work bridge by approximately three months. In addition, work bridges would require a larger pile size drilled into rock and backfilled with concrete. The piles would be drilled every 30 feet. Consequently, driven piles that would typically be utilized for work bridges cannot be used and drilled piles are costly, time intensive, and difficult to remove. Therefore, causeways are the preferred option to access the river so that construction equipment can operate safely.

Causeways will be constructed along each side of the river in stages mirroring the construction of the bridge. The design of the causeways has been refined to maximize the free flow area of the river at all times. This refinement increased the free flow area of the French Broad River by 23 percent for the largest causeway, when compared to the original causeway design.

Causeway size will be reduced to the extent practicable during each stage of the construction, and the contractor will be required to use clean stone for the causeway material, to minimize additional sediment input to the river. Pipes will not be used in causeway construction due to safety concerns for river users. The top causeway elevation (assumed to be 2,000 feet) will provide 2 feet or more clearance above the mean flow (discussed in more detail in the Hydraulics section).

In the first stage of construction, the causeway along the east bank of the river near End Bent 1 will be constructed in full (Causeway Sketch, Sheet 1 of 6, Appendix A) in Stage 1A. This causeway will be approximately 318.4 feet in length along the eastern river bank allowing for the required tie-ins to the access road, in addition to allowing cranes and other construction vehicles to traverse under the existing bridges. The east bank causeway will extend approximately 52.5 feet into the river. During Stage 1B this causeway will extend out an additional approximately 10 feet into the water for approximately 74.8 feet of causeway length to drill the new shafts. Once the shafts have been drilled, this Stage 1B causeway will be removed. Stage 1B is expected to be in place for approximately six weeks. On the west bank of the river, at End Bent 2, Stage 1A will construct a causeway for approximately 151 feet along the river bank, extending approximately 62.5 feet into the water. During Stage 1C this causeway will extend out an approximately 10 feet into the water for 77.4 feet of causeway length to drill the new shafts. Once the shafts have been drilled, this Stage 1C causeway will be removed. Stage 1C is expected to be in place for approximately six weeks. Without the causeways in place, the cross-sectional area of free flow is approximately 803 square feet. Under “normal” conditions (Stage 1A), with no additional extensions of the causeway, approximately 462 square feet, or 58 percent, of free flow cross-sectional area is expected between the two causeways. During Stage 1B or Stage 1C, free flow cross-sectional area will be 435 square feet, or 54 percent.

During Stage 2A construction (Causeway Sketch, Sheet 2 of 6, Appendix A) an additional approximately 72.8 feet of causeway will be added to the downstream portion of the Stage 1A causeway on the west bank of the river to facilitate removal of the existing eastbound bridge and construction of the Stage 2 new bridge construction. This Stage 2A causeway will also extend approximately 62.5 feet into the river. Stages 1A and 2A total approximately 224 feet in length adjacent to the west river bank. As Stage 2A is added to Stage 1A on the west bank, a portion of Stage 1A will be removed from the east bank. This will decrease the length of the east bank Stage 1A causeway to approximately 244.5 feet. A temporary layer

of rock will be left behind to protect the riverbank from scour. No rock will be permanently left on the riverbed.

The west and east bank causeways are temporarily extended into the river to permit demolition of the existing bridge (Causeway Sketch, Sheet 2 of 6, Appendix A). Stages 2B and 2C are temporary and expected to be constructed, used for demolition, and removed over an approximately three-week period. These causeways will extend approximately 21 feet into the river and extend approximately 59 feet along each river bank. This will leave approximately 406 square feet, or 51 percent, of free flow cross-sectional area.

Stages 2D and 2E (shown on Causeway Sketch Sheet 3 of 6, Appendix A) are similar in that they extend out from each side of the bank for approximately 10 feet in the water. These temporary stages are necessary to drill the shafts for the proposed bents. These stages will not occur simultaneously and are expected to be in place approximately five weeks each before removal. Stage 2E is located on the east river bank and is 65.4 feet in causeway length. Stage 2D is located on the west river bank and is approximately 65.3 feet in causeway length. Once the existing eastbound bridge is removed and the Stage 2 construction is complete, Stage 3 will begin.

During Stage 3A (Causeway Sketch, Sheet 4 of 6, Appendix A) an additional approximately 96 feet of causeway will be constructed along the western bank of the river, downstream of the section constructed during Stages 1A and 2A, and will again extend 62.5 feet into the river. As Stage 3A is added to Stages 1A and 2A on the west bank, another portion of Stage 1A will be removed from the east bank. This will decrease the length of the east bank Stage 1A causeway to approximately 207 feet. A layer of rock will be left behind to protect the riverbank from scour.

Stages 3B and 3C are necessary to demolish the existing westbound bridge. Stages 3B and 3C are temporary and expected to be constructed, used for demolition, and removed over an approximately three-week period. Stage 3B and Stage 3C will not occur at the same time. Stages 3B and 3C causeways will also extend approximately 21 feet into the river and extends approximately 59 feet along the east river bank. This will leave approximately 406 square feet, or 51 percent, of free flow cross-sectional area, while Stages 3B and 3C are in place.

Stages 3D and 3E are temporary stages necessary to drill the shafts for the proposed bents. These stages are expected to be in place approximately nine weeks each before removal. Stage 3D will be constructed on the west bank causeway and Stage 3E will be constructed on the east bank causeway (shown on Causeway Sketch, Sheet 5 of 6, Appendix A). Both Stage 3D and 3E will extend approximately 10 feet into the water for approximately 126 feet of causeway length. While Stages 3D and 3E are in place free flow cross-sectional area will be 435 square feet, or 54 percent.

Following the staging sequence provided later in this document, the Stage 1A causeway on the east bank will be removed in its entirety (Causeway Sketch, Sheet 6 of 6, Appendix A). On the west bank, near End Bent 2, Stages 2A and 3A will be removed. Stage 1A will be partially removed leaving 91.5 feet of causeway along the river bank. From this causeway an extension will slope down into the water approximately 38.8 feet and an approximate 36-foot width. This will lead to a causeway in the water that is approximately 225.3 feet parallel to the riverbank and approximately 26 feet wide. This 'L'-shaped extension is necessary to remove the bents of the existing bridge from the center of the river. While this final Stage 4 is in place the free flow cross-sectional area will be approximately 382 square feet, or 64 percent.

The area of the causeway along the east bank, near End Bent 1, is approximately 11,800 square feet (Stage 1A) at its largest size, without the temporary extensions. The east bank causeway will be

temporarily extended to between approximately 440 square feet to 1,100 square feet to construct the new interior bent 1 and to remove the existing bents.

The area of the causeway along the west bank, near End Bent 2, when constructed in its entirety, though not including any temporary extensions, is approximately 14,800 square feet (Stages 1A, 2A, and 3A). The west bank causeway will be temporarily extended to between approximately 440 square feet and 1,100 square feet to construct the new interior bent 2 and to remove the existing bents.

During Stage 4, when the east bank causeway is completely removed, the west bank causeway will be reduced along the bank and extend out into the river. This causeway will be approximately 10,020 square feet.

NCDOT shall make the following commitments where causeways are concerned:

- NCDOT shall require the contractor to use clean stone for the construction of the causeways. This will minimize unnecessary sediment input into the river.
- All of the stone will be removed and disposed of off-site, or the stone can be used in areas that require permanent stone protection after project completion. NCDOT shall also require that concrete barriers (barrier rail) be placed along the downstream edge of each causeway to limit the downstream movement of causeway material during high flow events.
- To minimize disturbance to the streambed, care will be taken to remove all readily detectable causeway material to the extent practicable, while removing as little of the original streambed as possible.
- Construction fabric will not be used under the causeway material, as it has a tendency to tear into pieces and float downstream during removal.
- Equipment that is placed on the causeways will be removed any time throughout a work day when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, it must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded.
- NCDOT shall commit to requiring its contractor to have clean, non-leaking equipment; diapers on-site for each causeway; and spill kits located at each causeway.
- With the exceptions noted below for the drill rig and crane, all construction equipment will be refueled outside the 100-year floodplain or at least 200 ft. from all water bodies (whichever distance is greater) and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 ft. from all water bodies (whichever distance is greater), not in a Water of the U.S., and preferably at an upland site. Areas used for borrow or construction by-products will not be located within wetlands or the 100-year floodplain.

The proposed causeway construction and phasing will allow free-flow of 138 feet, or a cross-sectional free flow area of 462 square feet or 58 percent under “normal” conditions (Stage 1A, 2A, 3A) for the

duration of the project. Table 2 summarizes the duration of each phase, the width of free-flowing river, the cross-sectional free flow area, and the percentage of the area.

Table 2. Summary of Causeway Construction Phases, Duration and Free Flow

Stage	Duration (weeks)	Water Surface Elevation[1]	Free Flow	Free Flow (Cross Section)	
			Distance (ft)[2]	Area (sq ft)	Percent
Existing	n/a		253	803	100
1A, 2A, 3A	130[3]	1994.01	138	462	58
1B[4]	6	1994.03	128	435	54
1C	6	1994.03	128	435	54
2B	3	1994.06	117	406	51
2C	3	1994.03	128	435	54
2D	5	1994.03	128	435	54
2E	5	1994.03	128	435	54
3B	3	1994.06	117	406	51
3C	3	1994.03	128	435	54
3D	9	1994.03	128	435	54
3E	9	1994.03	128	435	54
4	4	1994.11	129	534	67

[1]Water Surface Elevation measured at the causeways.
[2]Distance between the two causeways, where the causeways are widest.
[3]Total time for construction is approximately 3 – 4 years. This duration only includes the time when Stages 1A, 2A, and 3A are in place (no extensions).
[4]The 10-foot extensions (Stages 1B, 1C, 2D, 2E, 3D, and 3E) may occur at the same time at the contractor's discretion.

3.3 Hydraulics

The replacement structure for the I-26 bridge over the French Broad River will result in a positive hydraulic effect on the river and the river users. The three-span bridge will only have two bents in the river and they will be located away from the middle of the river. The current structure includes a total of 5 bents for each bridge, with one bent located in the center of the river. Fewer bents in the river will reduce the potential for debris to become lodged at the bents and provide less obstructions for river users.

FEMA Compliance

A review of flood map data upstream of the I-26 bridge reveals that there are several residential structures that are currently located within the 100-year floodplain. During the construction of the proposed bridge the causeways will create a constriction in the flow of the river and the water surface elevation (WSE) upstream of the causeways will increase. The maximum increase in WSE occurs immediately upstream of the causeways and decreases to the natural WSE further upstream.

The increase in the 100-year flood elevation for residential structures varies from 0 to 10 inches depending on the location upstream from the causeway. No additional structures have been identified that would be in the 100-year floodplain due to the causeways. NCDOT understands the risk for additional inundation of properties that could occur if a 100-year storm event happens while the causeways are in place. WSE gages will be added to North Carolina Emergency Management's (NCEM)

Flood Inundation Mapping and Alert Network (FIMAN) web application to provide real-time alerts about flooding risk and to be better identify concerns during construction and into the future.

River Analysis

Impacts of placing causeways in the river were modeled using the US Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS). Per the USACE website, HEC-RAS "allows the user to perform one-dimensional steady flow, one and two-dimensional unsteady flow calculations, sediment transport/mobile bed computations, and water temperature/water quality modeling." For this project, HEC-RAS models were constructed to represent conditions during mean hydraulic events and during 100-year flood events at stations along the French Broad River, predominantly upstream of the I-26 bridge. The cross-section locations for each river station (RS) used in HEC-RAS are shown in the River Station and Structure figure in Appendix A. The HEC-RAS models were used to determine the approximate WSE and the velocity of the river without the causeways (existing), with the causeways in place (Stages 1A, 2A, and 3A), and with the temporary 'L' causeway (Stage 4).

Using the Flood Risk Information System (FRIS) database provided by NCEM, nine residential structures are within the 100-year floodplain from the I-26 bridge over the French Broad River to the Long Shoals Road bridge over the FBR, approximately 3.2 miles upstream. Aerial photography suggests an additional eight structures may also be in the 100-year floodplain. During a 100-year flood event all structures would be flooded under existing conditions. Due to the temporary causeway (Stage 1A, 2A, 3A) an additional increase of approximately 10 inches in flood water would occur to the structure located approximately 0.6 mile upstream. The temporary 'L' causeway (Stage 4) would increase flood water by approximately 3 inches for the structures located approximately 0.6 mile upstream.

The results of the HEC-RAS models are shown in Tables 3 and 4. The structure placed in the HEC-RAS models at RS 8279.2 is intended to represent the causeways (Stages 1A, 2A, 3A) and temporary 'L' causeway (Stage 4), while the adjacent upstream (RS 8279.6) and downstream (RS 8277.9) locations are intended to represent the outer reaches of the bridge itself. Depictions of the cross sections at RS 8279.2 with Stage 1A, 2A, 3A and Stage 4 in place are found in Appendix A. Table 2 reports the WSE, from the HEC-RAS model, under existing conditions and the change in WSE with the Stage 1A, 2A, 3A causeway in place and the Stage 4 "L" causeway in place at various RSs. Similarly, Table 3 reports the velocities at various RSs under existing conditions and the change with the Stage 1A, 2A, 3A causeway in place and the Stage 4 "L" causeway in place.

The HEC-RAS outputs for WSE and velocity can be best understood in terms of the "continuity for fluids" concept (Q=VA), where flow (Q) is measured in cubic feet per second, velocity (V) is measured in feet per second, and area (A) is measured in square feet. The flow of the river is considered a constant because it is a function of the drainage area leading into the river and the flow return period/flood event, not the geometry of the river itself. The flow return period is the probability that a flood event will occur. For example, the return period of a flood might be 100 years, or have a 1 percent chance of occurring in any given year.

Table 3. Change in Water Surface Elevation[1] for Proposed Construction of the I-26 Bridge over the French Broad River

River Station	Approximate Distance from Bridge (miles)	Flow Return Period					
		Mean			100-YR Flood Event		
		Existing WSE	Stages 1A, 2A, & 3A	Stage 4	Existing WSE	Stages 1A, 2A, & 3A	Stage 4
		Change in Water Surface Elevation (feet)					
8277.9 (DS RS)[2]	Bridge	1993.88	-0.01	0.02	2011.00	-0.19	-0.12
8279.2 BR D (DS Face)[3]	Causeway	1993.99	0.02	0.12	2011.08	-0.14	-0.05
8279.2 BR U (US Face)[4]	Causeway	1994.17	0.58	0.53	2011.48	1.06	0.30
8279.6 (US RS)[5]	Bridge	1994.22	0.67	0.56	2011.73	1.19	0.20
8280	0.02	1994.29	0.72	0.60	2012.20	1.52	0.47
8311	0.57	1997.46	-0.18	-0.35	2015.63	0.83	0.24
8329	0.91	1999.62	0	0	2018.06	0.55	0.15
8338	1.1	2000.44	-0.01	-0.01	2018.49	0.49	0.14
8369	1.7	2004.72	0	0	2021.20	0.30	0.08
8390	2.1	2007.47	0	0	2022.60	0.20	0.05
8448	3.2	2014.27	0	0	2031.42	0	0.00

[1] Approximate water surface elevation as determine by the HEC-RAS model.
[2] Refers to downstream side of the bridge
[3] Refers to downstream side of the causeway
[4] Refers to upstream side of the causeway
[5] Refers to upstream side of the bridge

Table 4. Change in Velocity[1] for Proposed Construction of the I-26 Bridge over the French Broad River

River Station	Approximate Distance from Bridge (miles)	Flow Return Period					
		Mean			100-YR		
		Existing	Stages 1A, 2A, & 3A	Stage 4	Existing	Stages 1A, 2A, & 3A	Stage 4
		Change in Velocity (ft/s)					
8277.9 (DS RS)[2]	Bridge	2.45	1.08	1.13	8.67	1.69	1.09
8279.2 BR D (DS Face)[3]	Causeway	2.64	1.80	1.20	8.91	2.17	1.02
8279.2 BR U (US Face)[4]	Causeway	2.50	1.17	0.68	8.70	1.16	0.75
8279.6 (US RS)[5]	Bridge	2.23	0.54	0.49	8.36	0.75	0.81
8280	0.02	1.89	-0.30	-0.26	7.00	-0.51	-0.16
8311	0.57	2.81	0.15	0.14	9.18	-0.46	-0.14
8329	0.91	2.08	0	0	5.94	-0.19	-0.05
8338	1.1	2.35	0	0	7.71	-0.21	-0.06
8369	1.7	2.42	0	0	5.29	-0.11	-0.03
8390	2.1	2.73	0	0	10.61	-0.16	-0.05
8448	3.2	2.66	0	0	7.29	0	0

[1] Approximate velocity as determine by the HEC-RAS model.
[2] Refers to downstream side of the bridge
[3] Refers to downstream side of the causeway
[4] Refers to upstream side of the causeway
[5] Refers to upstream side of the bridge

As the area under the bridge is reduced by the causeway and temporary causeway extensions, the velocity of the water passing through the bridge opening is expected to increase. This is observed in Table 3 for all models at every bridge and causeway RS. The most notable increase in velocity, as well as the greatest velocities in general, occurs at RS 8279.2 BR D (downstream of the causeway) for all models. Also at RS 8279.2 BR D, an increase in WSE is observed during each construction stage for the mean flow return period, while a decrease in WSE is observed for the 100-year flood event. Because this RS experiences the greatest velocities and volatile WSEs, care will be taken not to disturb the area downstream of the causeways any more than necessary. The WSE at RS 8277.9 (downstream of the bridge) decreases in all models because water is making its way through the bridge opening more quickly, while the WSE at RS 8279.6 (upstream of the bridge) increases in all models because of the reduced area through which water can travel (Table 2).

It is noted that the HEC-RAS outputs are more consistent in demonstrating expected channel behavior for higher flows (i.e. 100-year flood event). The mean flow return period represents normal conditions, and related output values are more impacted by variables other than flow. Values for the slope of this energy grade line are observed to be much more variable for the mean flow return period.

By definition, there is a 1 percent probability that a 100-year flood will occur during any one year period. It is not possible to predict the duration of the water level for a flood event since there are an infinite number of precipitation durations and intensities that can cause the water level to rise. For these reasons, smaller variations to the mean WSE with the causeway in place are more likely to have an effect on French Broad River habitat over the projected three to four years of construction. As shown in Table 4, a mean hydraulic event would cause an increase in WSE 0.02 miles (approximately 106 feet) upstream of the causeway (RS 8280) of approximately 9 inches for the majority of the construction duration (Stages 1A, 2A, 3A). This increase is less than the average seasonal WSE, which varies by more than 1 foot at this location on the French Broad River. Consequently, the 9-inch rise is considered insignificant in its effect on the Appalachian elktoe and its habitat. At RS 8280, as WSE increases, the velocity decreases. During mean hydraulic conditions the velocity decreases less than 1 foot per second, which is also considered insignificant in its effect on the mussel.

3.4 Stormwater and Erosion Control

The access road design will use DSSW to mitigate the amount of sediment and erosion material that enters the French Broad River. NCDOT has identified the French Broad River and streams that drain directly into the French Broad River as Environmentally Sensitive Areas (ESAs) due to the presence of the Appalachian elktoe. ESAs require that special procedures must be used for construction activities within a 50-foot zone on both sides of the stream measured from top of bank. The proposed access roads adjacent to I-26 westbound in the southeast and northeast quadrants are within approximately 10 and 30 feet of jurisdictional streams SEE and SFG, respectively. Therefore, there is insufficient space for the 50-foot buffer. To reduce potential sediment and erosion caused by the access roads NCDOT shall temporarily pipe streams SEE and SFG during bridge construction and demolition. USFWS and USACE will have the opportunity to review the design of the SEC measures for streams SEE, SFG, and SFO. A revegetation and stream monitoring plan, to observe vegetation success and stream stability, shall be developed for Streams SEE and SFG. The revegetation and stream monitoring plan shall be approved by the USACE and will commence once the bridge construction and demolition are complete and the pipe is removed.

NCDOT shall provide USFWS with the Sediment and Erosion Control (SEC) plan and allow 15 days for review. The SEC plan will be in place prior to any ground disturbance. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.

NCDOT has committed to monitoring all SEC devices for the life of the project by retaining one dedicated inspector for each project section (I-4400, I-4700) to perform SEC inspections. Inspections of erosion control devices adjacent to the bridge will be completed on a daily basis by the Construction Project Inspector. The Roadside Environmental Unit of NCDOT also has Field Operations Engineers that perform compliance inspections of the erosion control devices a minimum of twice a month during the life of any project. These inspections are generally more frequent on projects within an endangered species habitat.

In addition, NCDOT shall install a rainfall data logger at the French Broad River and other sensitive locations to continuously monitor and record rainfall events. NCDOT shall also commit to self-reporting

SEC device failures to USFWS that result from excessive rainfall events (intensity that exceeds a 25-year storm event). Finally, NCDOT shall commit to collect background data on French Broad River turbidity.

3.5 Staged Construction of the Proposed Structure

As previously mentioned, the proposed bridge installation and demolition of the existing bridges over the French Broad River will occur in four stages, following the construction of the access roads. Required causeways, as discussed above, will be constructed preceding each bridge stage. Each stage is described in detail below. Language outlining the staged construction/demolition will also be included in the construction contract. The total time for replacement of the existing structure is estimated to be three to four years.

Stage 1

Stage 1 consists of construction of the portion of the proposed bridge upstream of the existing bridge carrying eastbound traffic (as shown on Causeway Sketch, Sheets 1 and 2 of 6, Appendix A). While traffic is maintained in the existing pattern, the following steps are proposed for bridge construction:

- With causeways in place, construct three drilled piers (anticipated to be approximately 5 feet in diameter) at each of the two proposed interior bent locations within the river. Once the piers are complete, cast concrete columns and a bent cap at each bent.
- Drive steel sheet piling near the south side of existing End Bent 1 and End Bent 2. Then excavate soil and provide foundation (driven steel piles) at both End Bent 1 and End Bent 2. Cast concrete bent caps at end bents.
- Erect four lines of girders from cranes (two anticipated) located on the causeways. It is anticipated that girders would be delivered at night and picked from a temporary lane closure on the adjacent, existing eastbound I-26 bridge.
- Using stay-in-place metal forms or concrete pre-cast panels to support the new deck, pour the approximately 33-foot wide concrete deck. Then pour the barrier and approach slabs.
- This stage of the construction is anticipated to take approximately 9 months.

Stage 2

Stage 2 consists of construction of the portion of the proposed bridge that will occupy the space of the existing eastbound bridge (Causeway Sketch, Sheets 3 and 4 of 6, Appendix A). I-26 eastbound traffic will be shifted to the Stage 1 constructed portion of the proposed bridge from the existing eastbound bridge while maintaining I-26 westbound traffic on the existing westbound bridge. Stage 2 construction may follow the proposed steps:

- Construct two drilled piers at each of the two proposed interior bent locations within the river. Once this is complete, cast concrete columns and continue bent cap construction at each bent.
- Excavate soil and provide foundation (driven steel piles) to extend both End Bent 1 and End Bent 2. Cast concrete bent cap extensions at end bents.
- Erect four lines of girders from cranes (two anticipated, one on each side) located on the causeways. Girders are anticipated to be delivered at night and picked from a temporary lane closure on the adjacent, new I-26 eastbound bridge portion constructed during Stage 1.
- Pour the approximately 34-foot wide concrete deck followed by the barrier and approach slabs.
- This stage of the construction is anticipated to take approximately 9 months.

Stage 3

Stage 3 consists of constructing the final portion of the new bridge adjacent to the section constructed in Stage 2 (as shown on Causeway Sketch, Sheet 5 of 6, Appendix A). I-26 westbound traffic will be shifted to the new bridge portion constructed in Stage 2 from the existing bridge while maintaining I-26 eastbound traffic in the Stage 2 configuration. Stage 3 construction may follow the proposed steps:

- Construct five drilled piers at each of the two interior bent locations within the river. Once complete, cast concrete columns and bent caps at each bent.
- Excavate soil and provide foundation (driven steel piles) to extend both End Bent 1 and End Bent 2. Cast concrete bent cap extensions at end bents.
- Erect nine lines of girders from cranes (two anticipated, one on each side) located on the causeways. Girders are anticipated to be delivered at night and picked from a temporary lane closure on the adjacent, new I-26 westbound bridge portion constructed in Stage 2.
- Pour the approximately 87-foot wide concrete deck followed by the barrier and approach slabs.
- This stage of the construction is anticipated to take approximately 17 months.

Stage 4

Stage 4 consists of removing the remaining Stage 1A causeway on the End Bent 1 side of the river, removing Stages 2A ,3A, and a portion of 1A on the End Bent 2 side of the river, and constructing the Stage 4 causeway to demolish the center bents from the existing bridge (as shown on Causeway Sketch, Sheet 6 of 6, Appendix A). I-26 westbound traffic will be shifted to the 2 outside lanes on the new bridge portion constructed in Stage 3. The center lanes of the bridge will be closed to traffic in order to complete median work in the roadway approaches.

- Remove the Stage 1A causeway adjacent to End Bent 1 and the Stage 2A, 3A, and a portion of 1A causeways adjacent to End Bent 2. Construct the temporary 'L' causeway (shown as Stage 4 on Causeway Sketch Sheet 6 of 6, Appendix A). Remove the center bents in the river. This temporary 'L' causeway is expected to be in place for approximately 4 weeks.
- Once the center bents are demolished, remove all remaining causeways and access roads.
- Once median work is complete, open I-26 traffic to final configuration.

3.6 Construction Activities

Night Work

During construction of the I-26 bridge over the French Broad River, some work will need to be completed at night. The following is a list of some construction operations that may occur at night, as well as the likelihood and/or circumstances under which the operation may occur. Lighting considerations for each night operation are also included.

- Causeway construction – Will occur – Access road and causeway construction and removal may take place at night throughout the life of the project. This will allow the contractor to utilize the lower traffic volume to access the site. Installing the access roads and causeways at night allows longer-term operations to be constructed during daylight hours. Due to the easier site access the contractor may be able to construct the access roads and causeways more quickly. Constructing the access roads and causeways will be at the discretion of the contractor and not required at night.

  - Lighting for this operation will likely consist of one to two light plants that will be used to directly light up the construction area. Care will be taken to not shine light directly out into the river or into the adjacent forest.
- Drilled shafts – Possible – This is dependent upon construction schedule, contract, and availability of the concrete plant.
  - Lighting for this operation will be at water level. Lights on the drill rig will be used, and one light plant may be used if needed. Only the active work area (where the hole is currently being drilled) will be lit. No lights will be shining down from the bridge deck during this operation.
- Concrete pours during hot weather – Will occur – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include elements such as bent caps, end bents, and barrier rail wall.
  - The use of lights for this operation will be minimal. Because these will be small area and short duration (six hours or less) pours. Lights will generally be set up on the causeway, shining upward at the bridge member being poured. Small lights, such as headlamps, will be used on the structure. There will be pump truck and concrete trucks with headlights either on the bridge deck or on the causeway.
- Deck concrete pours from May to November (summer) – Will occur – Deck concrete pours are generally larger, more complex, and more time consuming than other types of concrete pours. Consequently, they will need to occur at night between May and November depending on temperature and weather. These pours may be able to begin at midnight and pour into the morning hours.
  - Of all potential night time operations, this will be the operation with the most lighting. It is important to note that these operations will consist of one night of activity at a time; there will be no long term consecutive nights of operation. The majority of lighting will be at bridge deck level, with lights shining toward the bridge rather than down toward the river. Any lighting that shines down toward the river or adjacent woods will be indirect and minimal.
  - A pump truck will be positioned either at the end of the bridge at road surface elevation, or on the causeway. The vehicle’s headlights will be used. Headlights on concrete delivery trucks will also be used.
  - Two to four light plants will be used on the bridge deck, depending on the size of the pour. These will most likely be positioned at either end of the pour shining down toward the deck and in toward the bridge; not facing toward the river. Small lights, similar to headlights, may be used to illuminate the screed (concrete surface), if needed.
- Beam setting – Will occur – Setting beams at night is required due to the volume of daytime traffic and the need to maintain traffic.
  - Cranes sitting on either of the causeways or on the new or existing bridges will be used to set the beams for the new bridges. There will be a light plant on the structure where the truck with the beams is parked, either on the new or existing structure. These lights

  - will be shining toward the truck. There will also be lights shinning toward each structure where the beam ends sit.
  - It is difficult to determine if the lights will be placed on the causeway shining up toward the structure, or on the bridge deck shining down. This decision will need to be made on site at the time of the activity.
  - It is important to note that this operation will happen once every 1-2 months only during certain periods of construction. For each new span, this operation will occur for one to two nights, and for roughly six hours or less.
- Traffic shifts – Will occur – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and be of short duration, and will likely require minimal lighting on the bridge. All other activities with traffic shifts will occur beyond the end bents of the bridge and will not be part of the work on the bridge or in the area of the river.

There are other operations that may occur at night; however, this would be unusual and evaluated on a case-by-case basis. The previously listed operations are not operations that occur on a regular schedule. In addition, NCDOT shall place solar-powered, steady-state, red, safety lights on the causeways for river user safety. Generators will not be used to provide power.

NCDOT shall make the following commitments where construction of the access roads, causeways, and bridge is concerned:

- Between June 1 and August 1 each year, NCDOT shall commit to restrict the construction contractor to no more than 28 total nights of work, and no more than four consecutive nights within a two-week period.

Other Techniques

- When constructing drilled bents, a containment system will be developed so that substrate material does not enter the river. Any material by-product will be pumped out of the shaft to an upland disposal area and treated through a proper stilling basin or silt bag.
- The SEC plan will be in place prior to any ground disturbance. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- Construction of new bridges will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river.
- The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time he begins the work until completion of each phase of structure construction, demolition and completion. The Contractor will not be permitted to suspend his operations except for reasons beyond his control or except where the Engineer has authorized a suspension of the Contractor's operations in writing.
- In the event that the Contractor's operations are suspended in violation of the above provisions or it is determined the Contractor is not deemed to be pursuing the work in a continuous manner in accordance with his submitted and approved schedule, the sum of $1,000 per day will be charged the Contractor for each and every calendar day that such suspension takes place. The said amount is hereby agreed upon as liquidated damaged due to extra engineering

and maintenance costs and due to increased public hazard resulting from a suspension of the work. Liquidated damages chargeable due to suspension of the work will be additional to any liquidated damages that may become chargeable due to failure to complete the work on time.

3.7 Demolition of the Existing Structure

During demolition, removal of the bents will be accomplished by tipping them over and removing the entire bent, or by cutting the bent off at stream bed elevation or, if the bent is on land, 1 foot below ground elevation. Because the base of the remaining bent in the stream is at stream elevation, no material will be put back over the remaining bent. The method of removal will be dependent on the foundation conditions present at the site. According to existing bridge plans, the structure is supported by spread footings (no piles underneath). The new structure will place the bents directly adjacent to the existing bents. No loose portion of the existing bents can remain in the streambed.

Removal of the existing bridge shall be performed in a manner that prevents debris from falling into the water. The Contractor shall remove the bridge and submit plans for demolition in accordance with Article 402-2 of the Standard Specifications. However, if bridge material inadvertently ends up in the river, it will be removed.

NCDOT shall provide USFWS with copies of the bridge demolition plan and allow 15 days for review. Other resource agencies will also be invited to review the demolition plan. USFWS and other resource agencies will also be notified prior to the start of bridge demolition, so they may have a representative on-site during that stage of the project.

4 River User Safety

Because the French Broad River is regularly used for recreation, it cannot be closed for the life of construction (three to four years). There are no options for portage due to the location of the bridge. The nearest public pull-out is at Bent Creek River Park, 1 river mile upstream of the I-26 bridge, and the next public put-in is at Hominy Creek River Park, approximately 5.2 river miles downstream of the bridge. The distance by road between these two locations is 5.9 miles on NC 191 (Brevard Road). This is not a feasible portage option. It would be possible to provide a pull-out and put-in at the bridge; however, this would require users to walk through an active construction zone. This was deemed to be less safe than leaving the river open to water traffic throughout construction.

NCDOT shall commit to providing a safe passage lane for river users. As shown in the rendering on the next page, thishis lane will be located in the center of the river away from the causeways for the majority of the life of the project. In the final stage, Stage 4, the safe passage lane will shift to the right side of the river, near end bent 1, away from the center bents being removed. This stage is expected to last approximately four weeks. NCDOT shall use a floating navigational aid to guide river users to the safe passage lane.

NCDOT shall commit to including a rigid, non-drooping, catchment device on the overhead structure from south of Old River Road to the opposite side of the river to prevent material from falling on river users, equestrians, bicyclists, or in the water. NCDOT shall place steady-state red lights that are solar-powered on the causeway to alert river users to its location. Generators will not be used to provide power. These lights will be atop permanent structures, such as a pole, on each causeway for the duration of the project. The contractor will be responsible for maintaining these lights at all times during construction, replacing them as necessary.

It is expected that there will be times when the river and Old River Road must be closed for the safety of river users, equestrians, and bicyclists due to the type of work being done (e.g. setting girders, removal

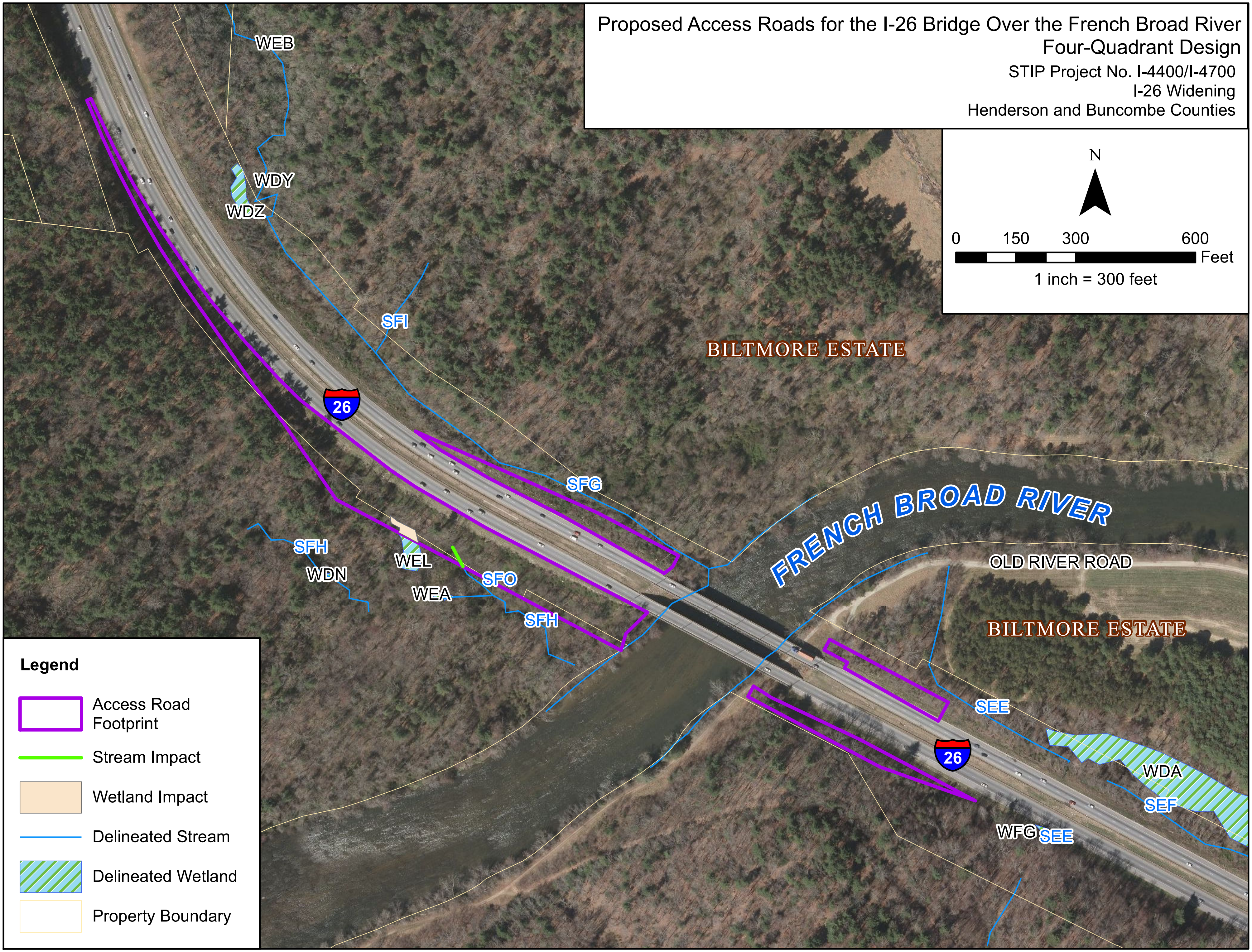
of bent caps). These closures are not expected to last more than two days and are expected to occur predominantly at night. Care will be taken to not close the river during known peak business times, particularly the Memorial Day, Fourth of July, and Labor Day weekends.

NCDOT has written a Communication Plan for the Construction of the I-26 Bridge over the French Broad River. This plan focuses on specific activities to alert river users to the hazards of bridge construction and will be appended to larger communication plan for the entire I-26 widening project. Communication plans include holding small group meetings; placing signage upstream of the construction zone at river inputs; and alerting river users, equestrians, and bicyclists through various traditional and social media outlets of construction schedules, including closures and other pertinent information.

River User Safety, Concept Drawing

I-26 Bridge Over the French Broad River Proposed Construction and Demolition

APPENDIX A



Proposed Access Roads for the I-26 Bridge Over the French Broad River
Four-Quadrant Design
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties
N
0 150 300 600
Feet
1 inch = 300 feet
WEB
WDY
WDZ
SFI
BILTMORE ESTATE
26
SFG
FRENCH BROAD RIVER
SFH
WDN
WEL
SFO
WEA
SFH
OLD RIVER ROAD
BILTMORE ESTATE
SEE
26
WDA
SEF
WFG
SEE
Legend
Access Road Footprint
Stream Impact
Wetland Impact
Delineated Stream
Delineated Wetland
Property Boundary

HNTB

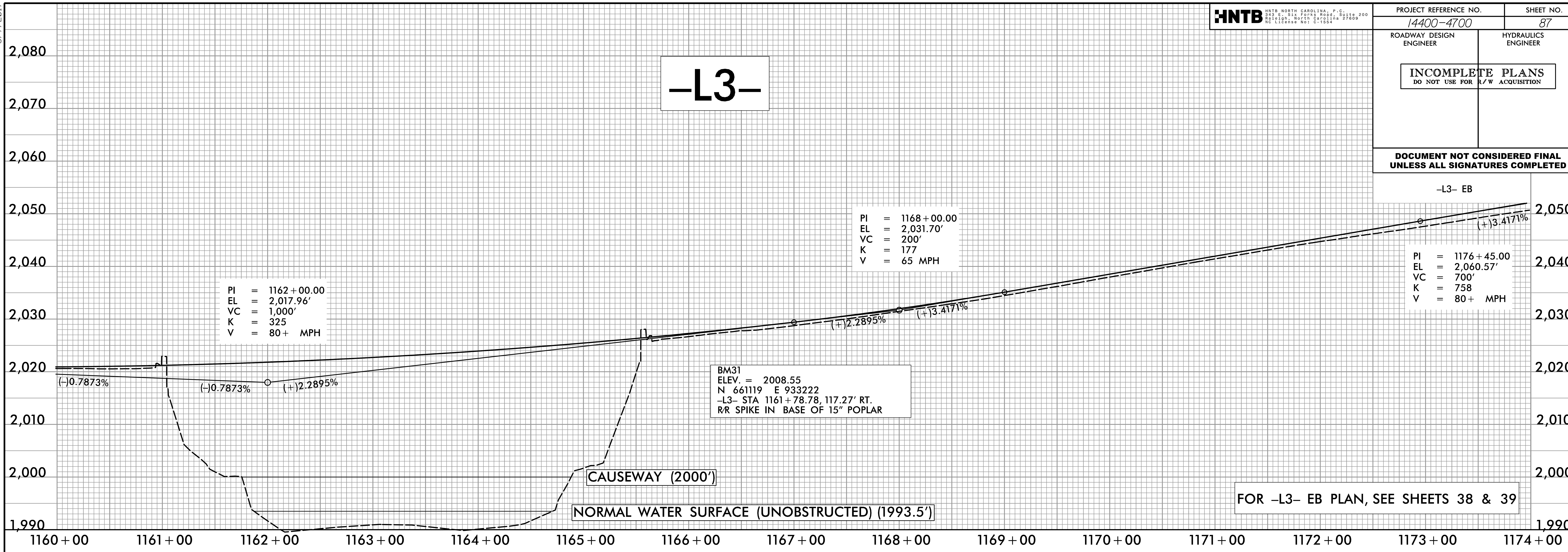
PROJECT REFERENCE NO.	SHEET NO.
I4400–4700	87

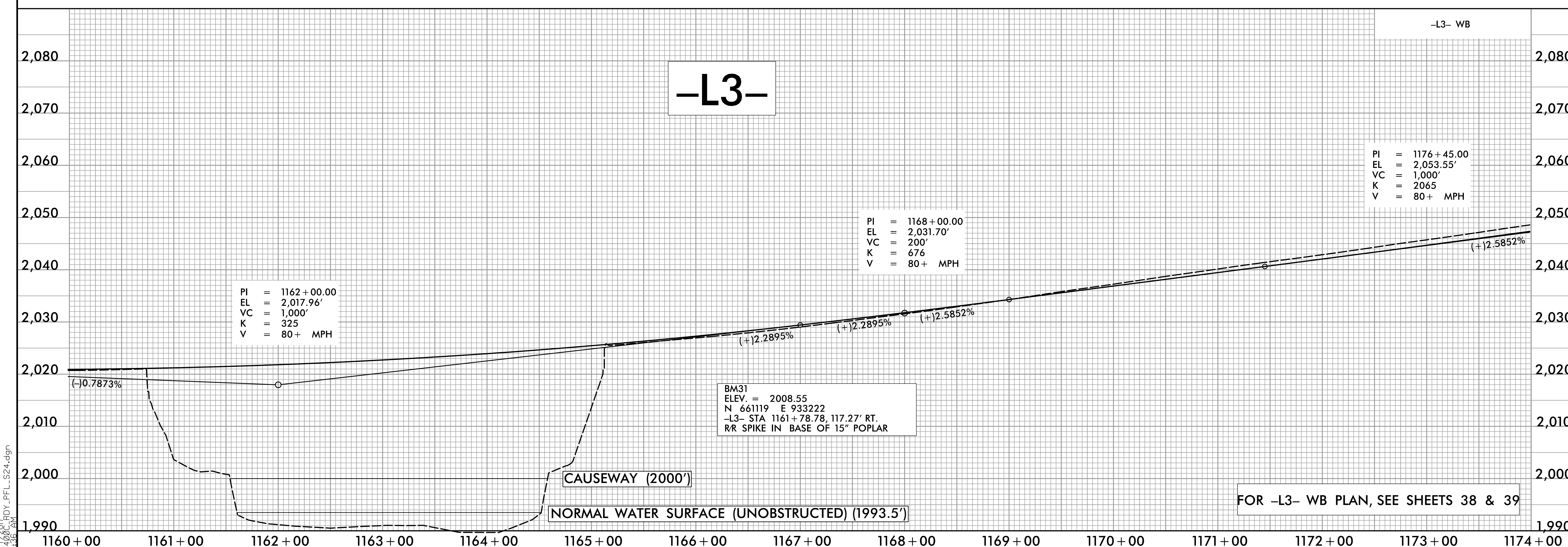
ROADWAY DESIGN ENGINEER

HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED





8/7/2017
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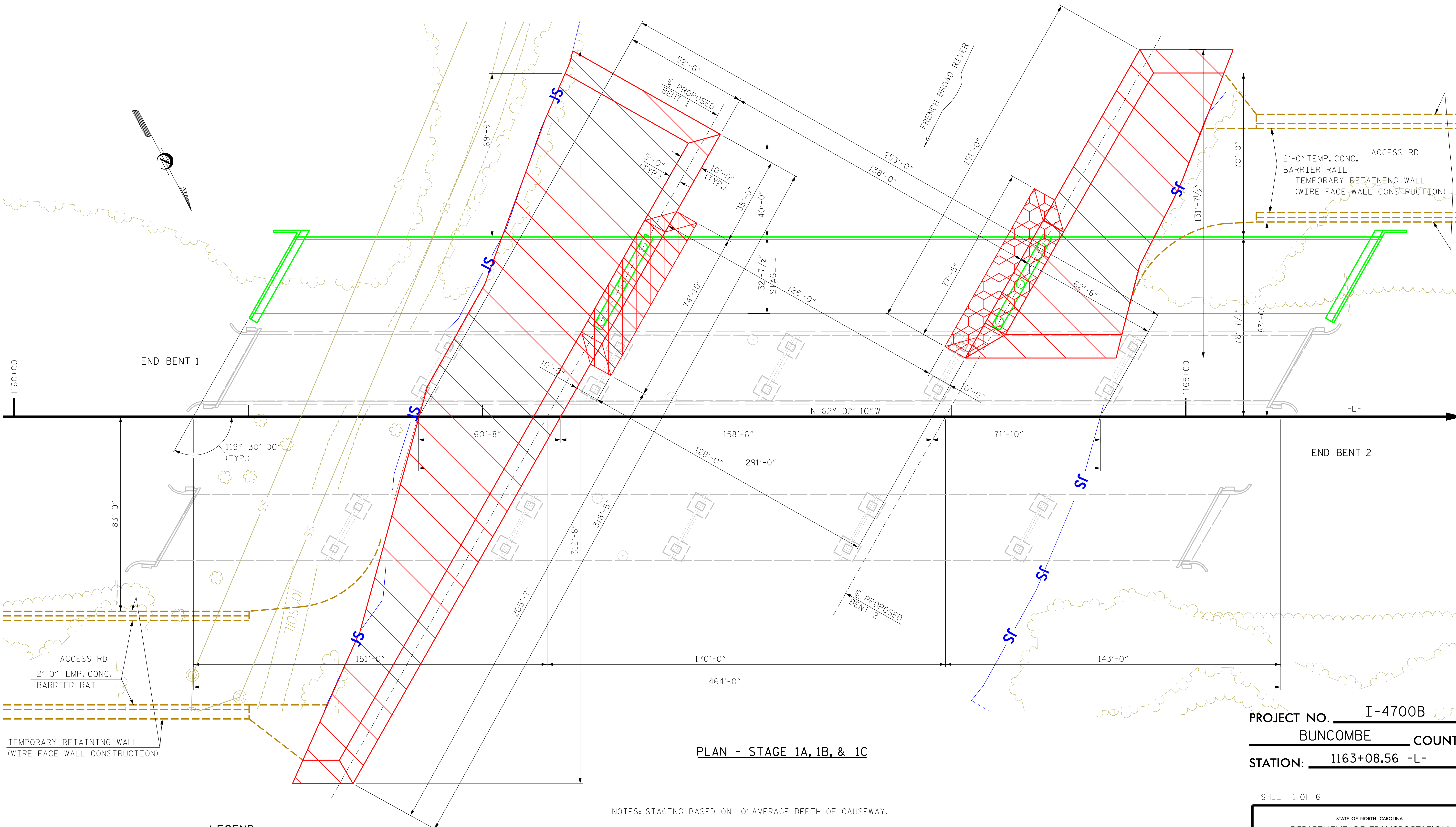

PLAN - STAGE 1A, 1B, & 1C

NOTES: STAGING BASED ON 10' AVERAGE DEPTH OF CAUSEWAY.

ROCK SLOPES ASSUMED TO BE 1:1.

STAGE 1B & 1C ARE SHORT DURATION CAUSEWAY PORTIONS PLACED TO CONSTRUCT DRILLED SHAFTS.

TIME RANGES SHOWN IN LEGEND ARE APPROXIMATE.

LEGEND

STAGE 1A (35 MONTHS✻)

STAGE 1B (6 WEEKS)

STAGE 1C (6 WEEKS)

PROPOSED BRIDGE CONSTRUCTION (ALTERNATE 2)

PROPOSED ACCESS ROAD CONSTRUCTION

EXISTING BRIDGE

✻ STAGE 1 OF THE CONSTRUCTION IS ANTICIPATED TO TAKE APPROXIMATELY 9 MONTHS; HOWEVER, STAGE 1A CAUSEWAY WILL REMAIN IN PLACE THROUGH SUBSEQUENT STAGES.

PROJECT NO. I-4700B

BUNCOMBE COUNTY

STATION: 1163+08.56 -L-

SHEET 1 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

CAUSEWAY SKETCH
FOR I-26 OVER
FRENCH BROAD RIVER

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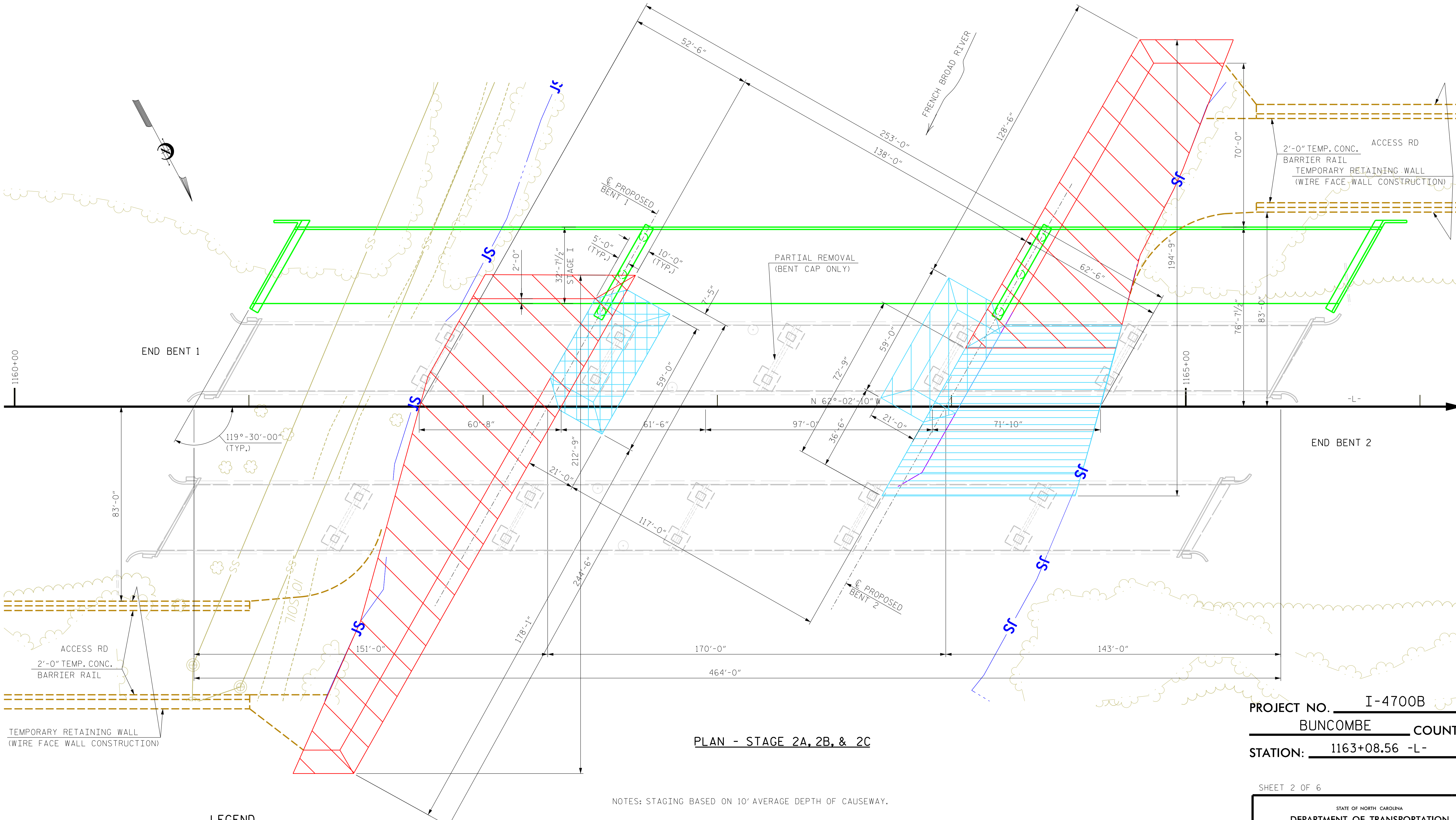
2			4			



PLAN - STAGE 2A, 2B, & 2C

NOTES: STAGING BASED ON 10' AVERAGE DEPTH OF CAUSEWAY.

ROCK SLOPES ASSUMED TO BE 1:1.

STAGE 2B AND 2C ARE FOR SHORT DURATION CAUSEWAY PORTION PLACED TO REMOVE EXISTING BRIDGE BENTS.

TIME RANGES SHOWN IN LEGEND ARE APPROXIMATE.

LEGEND

- STAGE 1A (35 MONTHS)
- STAGE 2A (9 MONTHS)
- STAGE 2B (3 WEEKS)
- STAGE 2C (3 WEEKS)
- PROPOSED BRIDGE CONSTRUCTION (ALTERNATE 2)
- PROPOSED ACCESS ROAD CONSTRUCTION
- EXISTING BRIDGE

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PROJECT NO. I-4700B

BUNCOMBE COUNTY

STATION: 1163+08.56 -L-

SHEET 2 OF 6

STATE OF NORTH CAROLINA
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RALEIGH

CAUSEWAY SKETCH FOR I-26 OVER FRENCH BROAD RIVER

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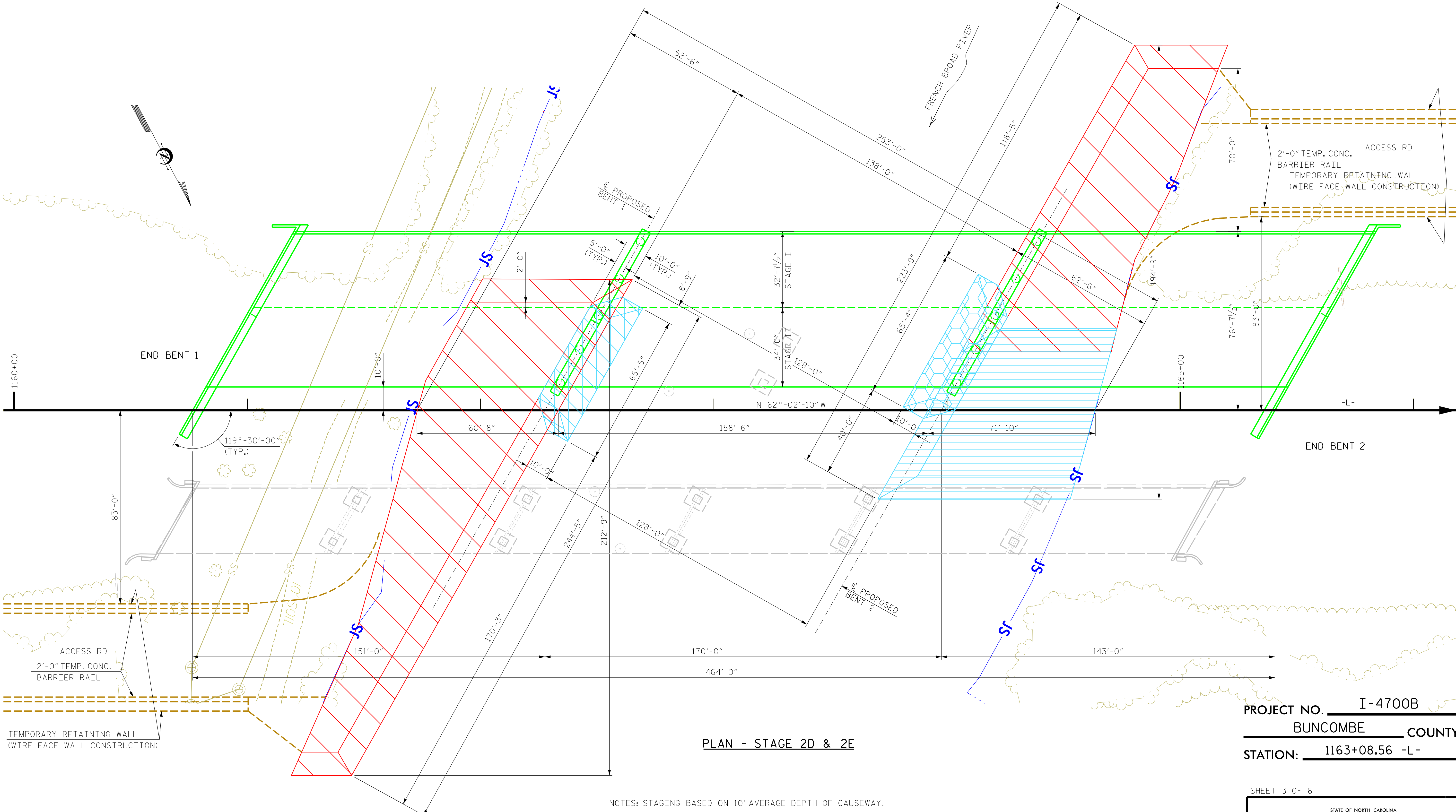

PLAN - STAGE 2D & 2E

NOTES: STAGING BASED ON 10' AVERAGE DEPTH OF CAUSEWAY.

ROCK SLOPES ASSUMED TO BE 1:1.

STAGE 2D & 2E ARE SHORT DURATION CAUSEWAY PORTIONS PLACED TO CONSTRUCT DRILLED SHAFTS.

TIME RANGES SHOWN IN LEGEND ARE APPROXIMATE.

LEGEND

- STAGE 1A (35 MONTHS)
- STAGE 2A (9 MONTHS)
- STAGE 2D (5 WEEKS)
- STAGE 2E (5 WEEKS)
- PROPOSED BRIDGE CONSTRUCTION (ALTERNATE 2)
- PROPOSED ACCESS ROAD CONSTRUCTION
- EXISTING BRIDGE

PROJECT NO. I-4700B

BUNCOMBE COUNTY

STATION: 1163+08.56 -L-

SHEET 3 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

CAUSEWAY SKETCH
FOR I-26 OVER
FRENCH BROAD RIVER

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DWG. NO. 3

REVISIONS						
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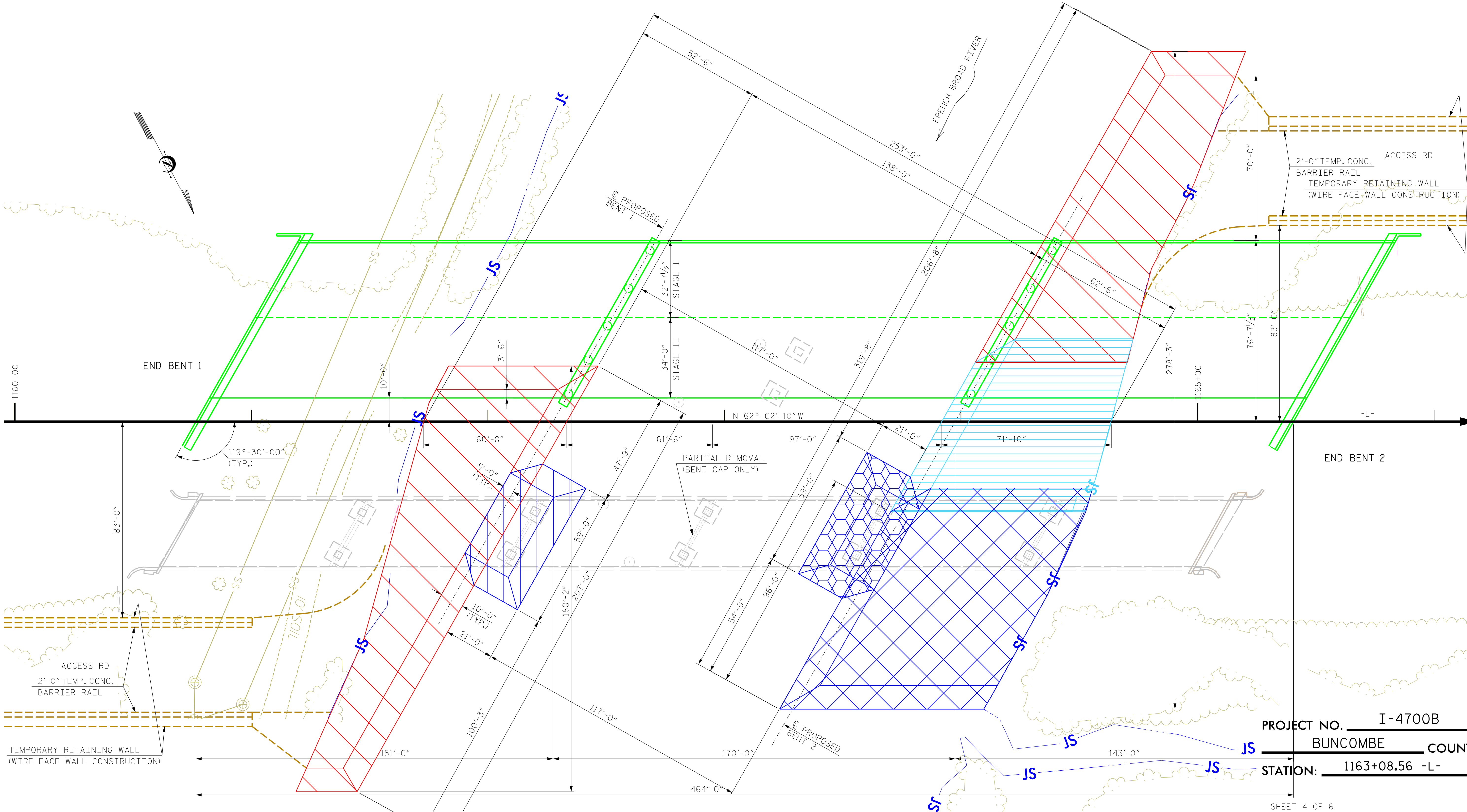

PROJECT NO. I-4700B

BUNCOMBE COUNTY

STATION: 1163+08.56 -L-

PLAN - STAGE 3A, 3B, & 3C

LEGEND

- STAGE 1A (35 MONTHS)
- STAGE 2A (9 MONTHS)
- STAGE 3A (17 MONTHS)
- STAGE 3B (3 WEEKS)
- STAGE 3C (3 WEEKS)
- PROPOSED BRIDGE CONSTRUCTION (ALTERNATE 2)
- PROPOSED ACCESS ROAD CONSTRUCTION
- EXISTING BRIDGE

NOTES: STAGING BASED ON 10' AVERAGE DEPTH OF CAUSEWAY.

ROCK SLOPES ASSUMED TO BE 1:1.

STAGE 3B AND 3C ARE SHORT DURATION CAUSEWAY PORTIONS PLACED TO REMOVE EXISTING BRIDGE BENTS.

TIME RANGES SHOWN IN LEGEND ARE APPROXIMATE.

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

CAUSEWAY SKETCH
FOR I-26 OVER
FRENCH BROAD RIVER

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REVISIONS					
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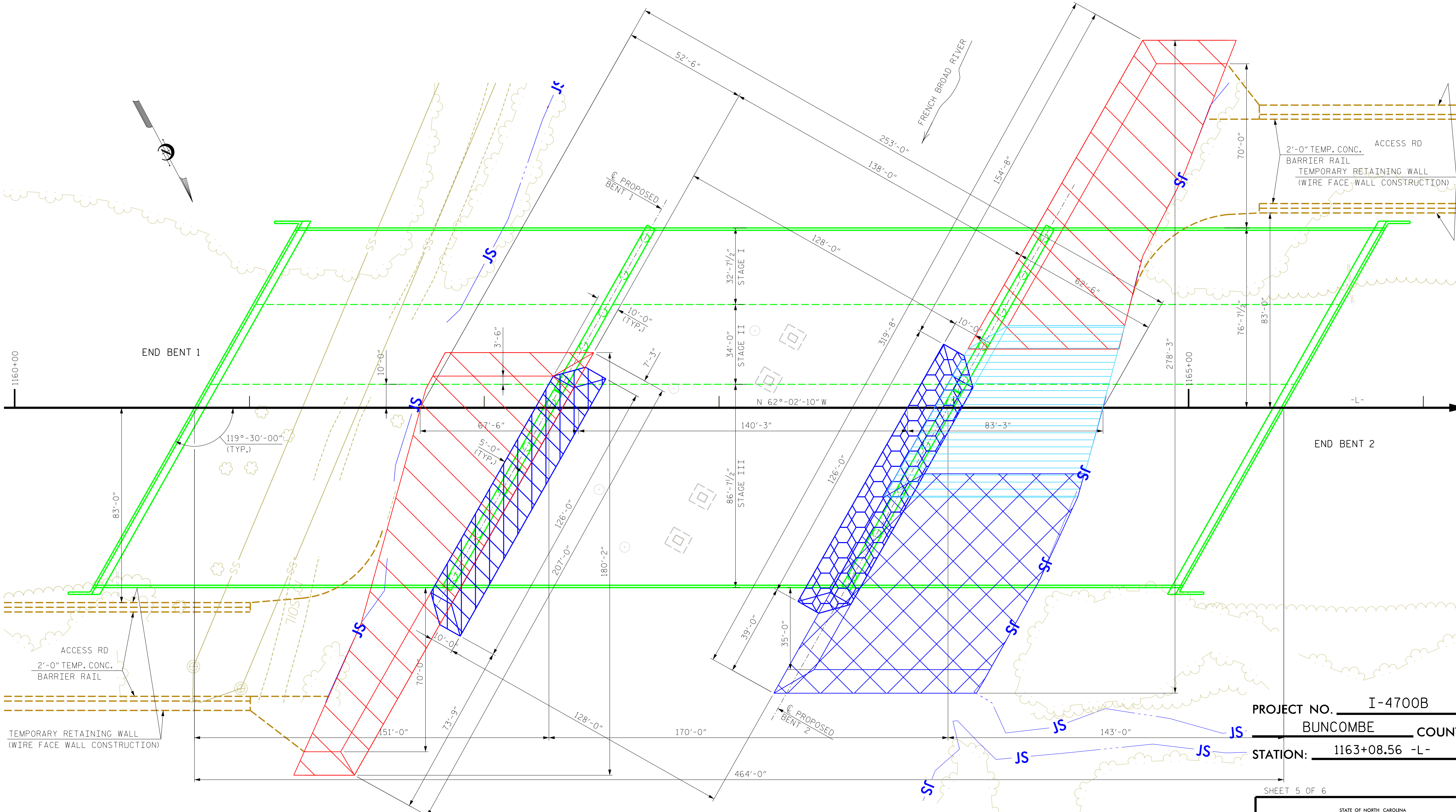
TOTAL SHEETS



PLAN - STAGE 3D & 3E

LEGEND

Symbol	Stage
	STAGE 1A (35 MONTHS)
	STAGE 2A (9 MONTHS)
	STAGE 3A (17 MONTHS)
	STAGE 3D (9 WEEKS)
	STAGE 3E (9 WEEKS)

PROPOSED BRIDGE CONSTRUCTION (ALTERNATE 2)
PROPOSED ACCESS ROAD CONSTRUCTION
EXISTING BRIDGE

NOTES: STAGING BASED ON 10' AVERAGE DEPTH OF CAUSEWAY.

ROCK SLOPES ASSUMED TO BE 1:1.

STAGE 3D & 3E ARE SHORT DURATION CAUSEWAY PORTIONS PLACED TO CONSTRUCT DRILLED SHAFTS.

TIME RANGES SHOWN IN LEGEND ARE APPROXIMATE.

PROJECT NO. I-4700B
BUNCOMBE COUNTY
STATION: 1163+08.56 -L-

SHEET 5 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

CAUSEWAY SKETCH
FOR I-26 OVER
FRENCH BROAD RIVER

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DWG. NO. 5

REVISIONS

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2			4		

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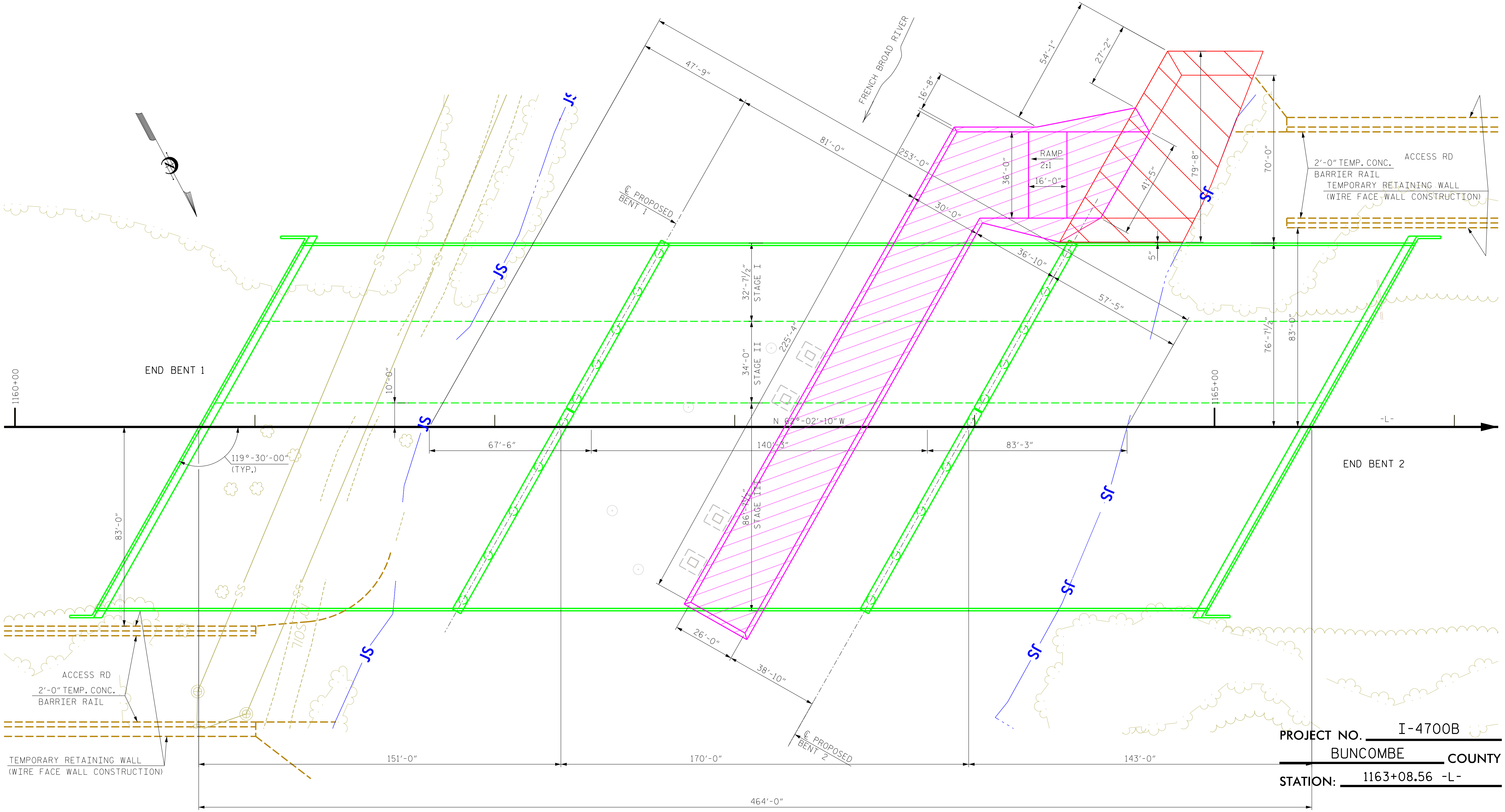

PROJECT NO. I-4700B

BUNCOMBE COUNTY

STATION: 1163+08.56 -L-

SHEET 6 OF 6

PLAN - STAGE 4

NOTES: STAGE 4 BASED ON 2' AVERAGE DEPTH OF CAUSEWAY.

ROCK SLOPES ASSUMED TO BE 1:1.

STAGE 4 IS A SHORT DURATION CAUSEWAY PORTION PLACED TO REMOVE EXISTING BRIDGE BENTS.

TIME RANGES SHOWN IN LEGEND ARE APPROXIMATE.

LEGEND

STAGE 1A (35 MONTHS)

STAGE 4 (1 MONTH)

PROPOSED BRIDGE CONSTRUCTION (ALTERNATE 2)

PROPOSED ACCESS ROAD CONSTRUCTION

EXISTING BRIDGE

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DEPARTMENT OF TRANSPORTATION
RALEIGH

CAUSEWAY SKETCH FOR I-26 OVER FRENCH BROAD RIVER

REVISIONS					
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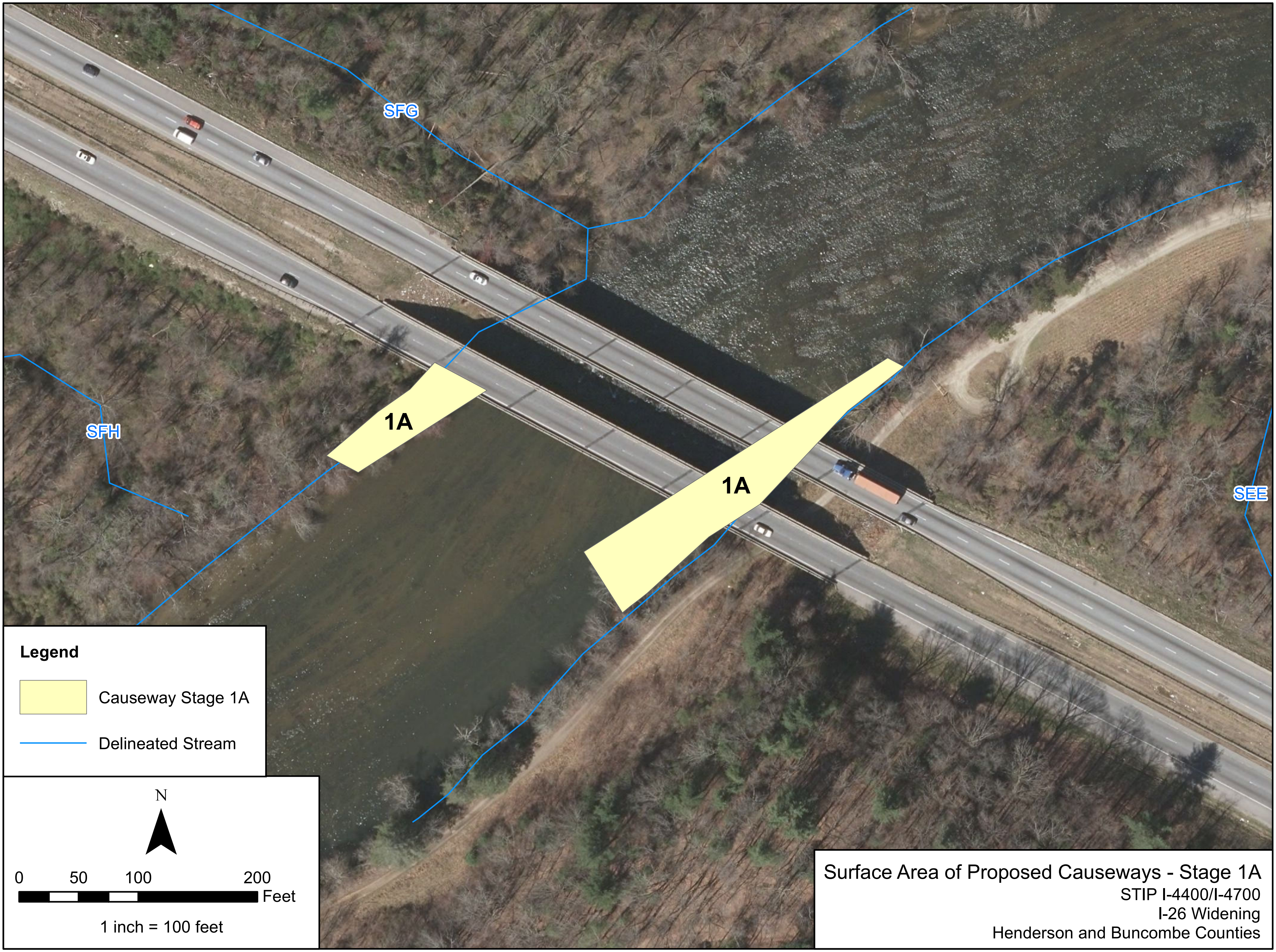
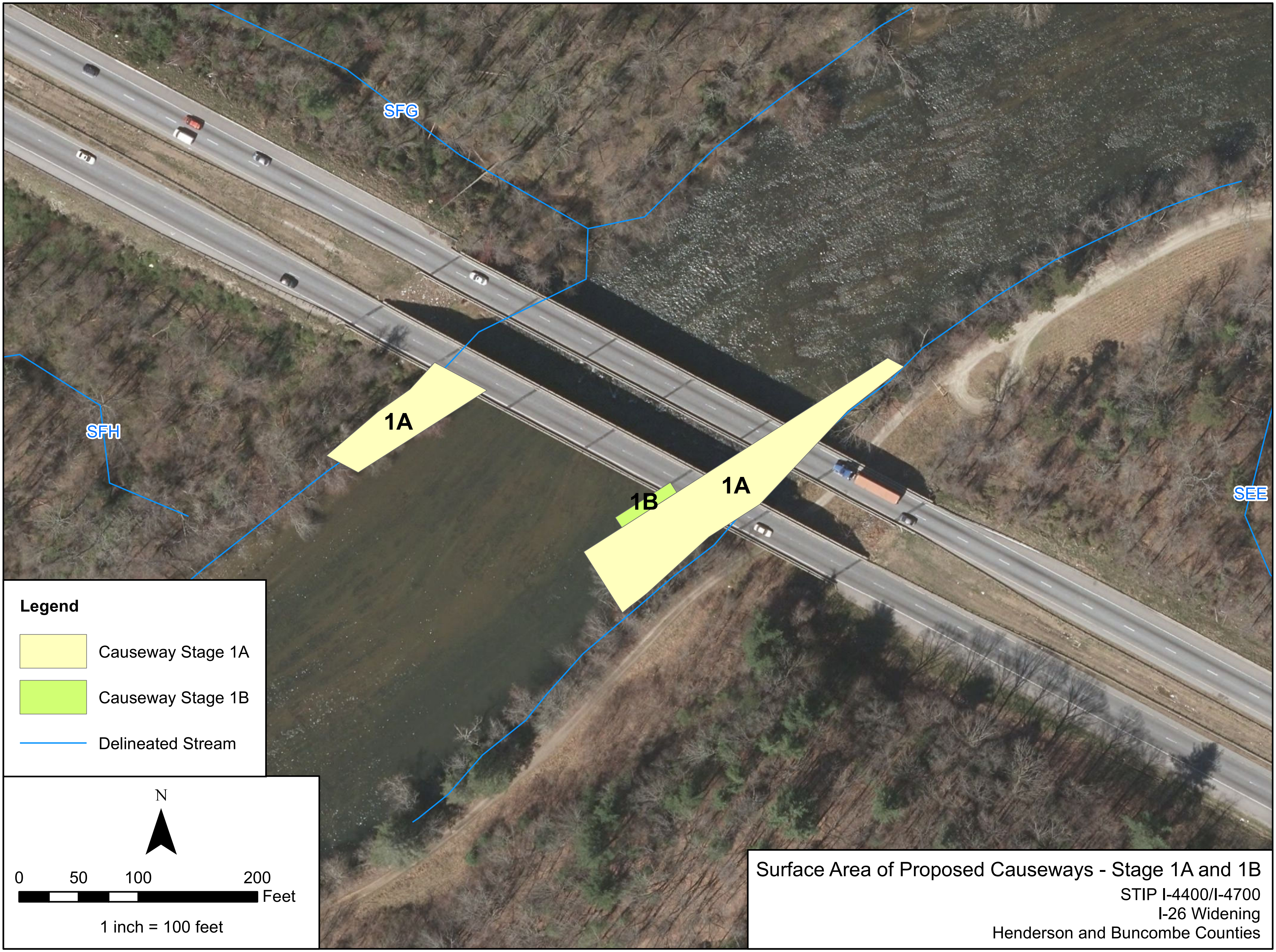
1			3		
2			4		

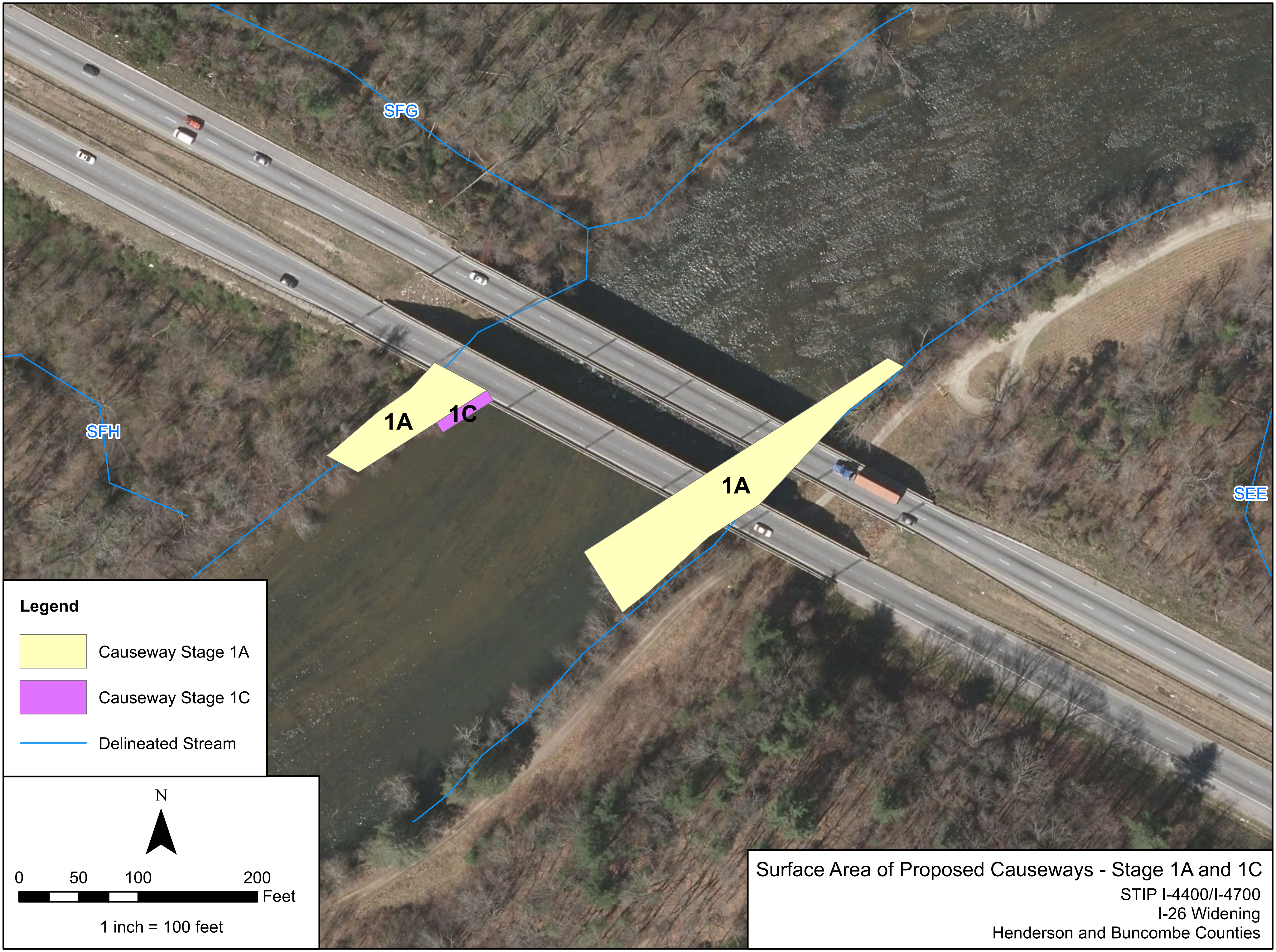
SHEET NO.

TOTAL SHEETS



Surface Area of Proposed Causeways - Stage 1A
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties


SFG
SFH
SEE
1A
1A
1B
Legend
Causeway Stage 1A
Causeway Stage 1B
Delineated Stream
N
0 50 100 200
Feet
1 inch = 100 feet
Surface Area of Proposed Causeways - Stage 1A and 1B
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties



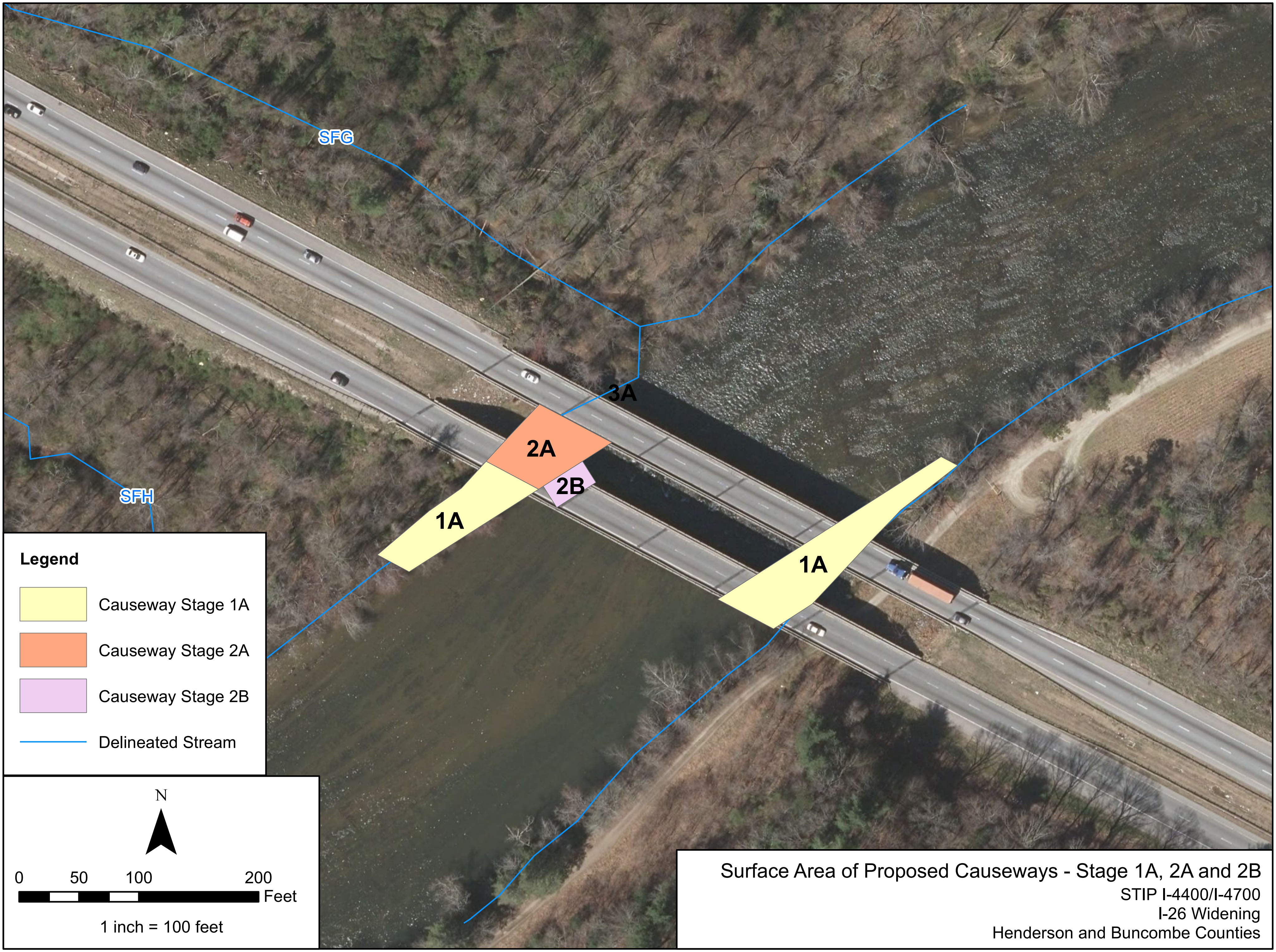
Surface Area of Proposed Causeways - Stage 1A and 1C

STIP I-4400/I-4700

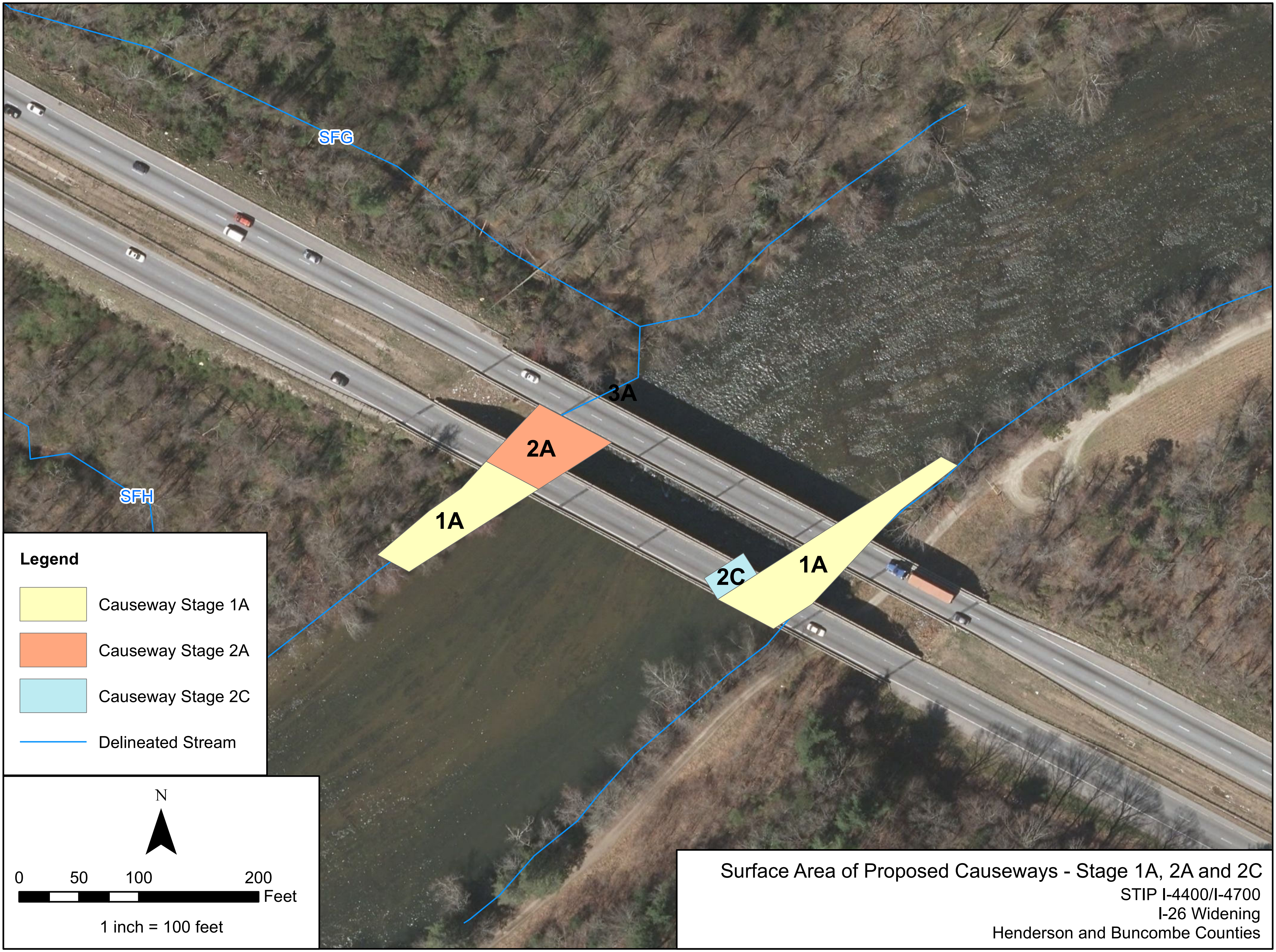
I-26 Widening

Henderson and Buncombe Counties


SFG
SFH
2A
1A
1A
Legend
Causeway Stage 1A
Causeway Stage 2A
Delineated Stream
N
0 50 100 200 Feet
1 inch = 100 feet
Surface Area of Proposed Causeways - Stage 1A, 2A
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties



Surface Area of Proposed Causeways - Stage 1A, 2A and 2B
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

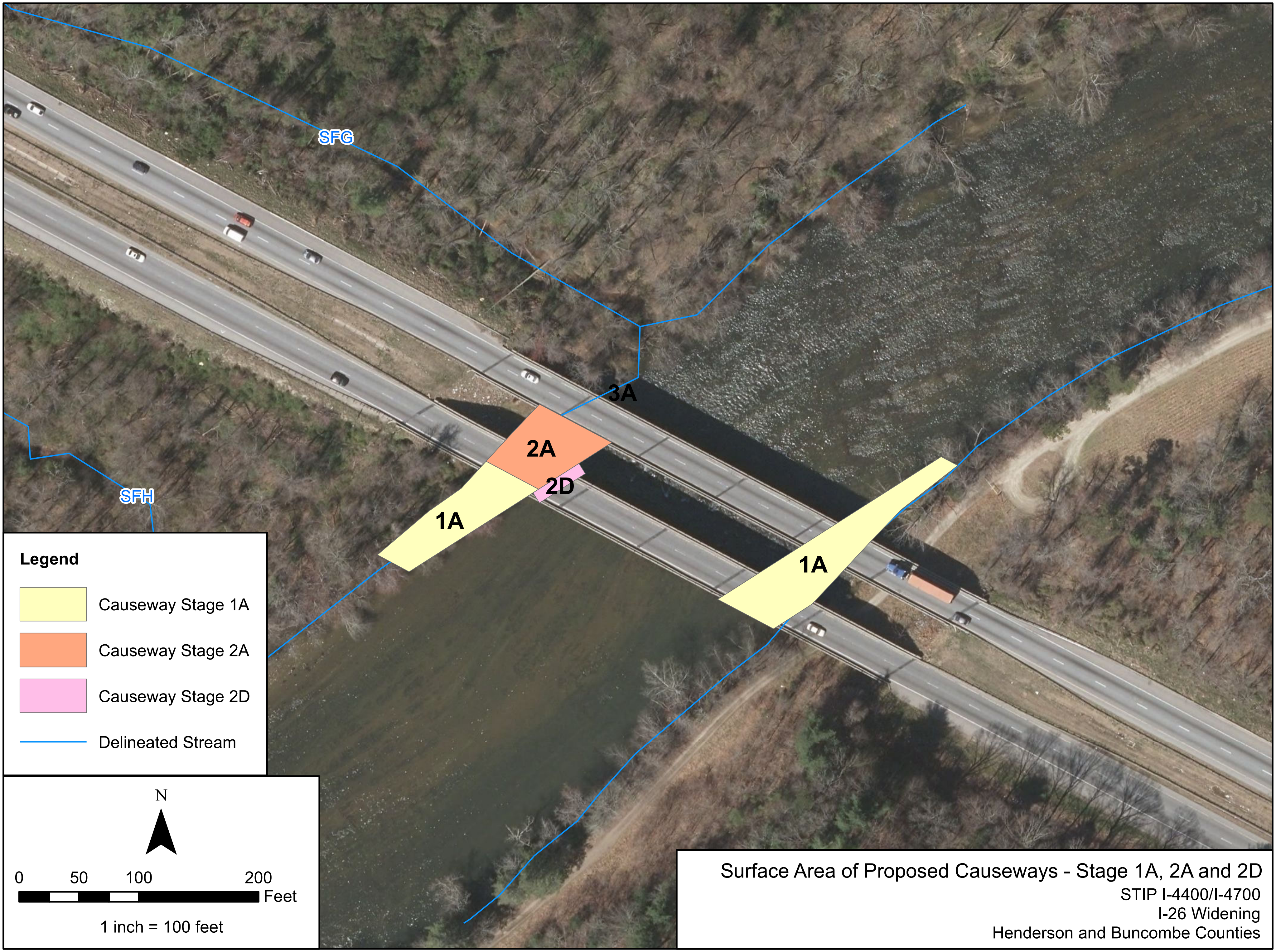


Surface Area of Proposed Causeways - Stage 1A, 2A and 2C

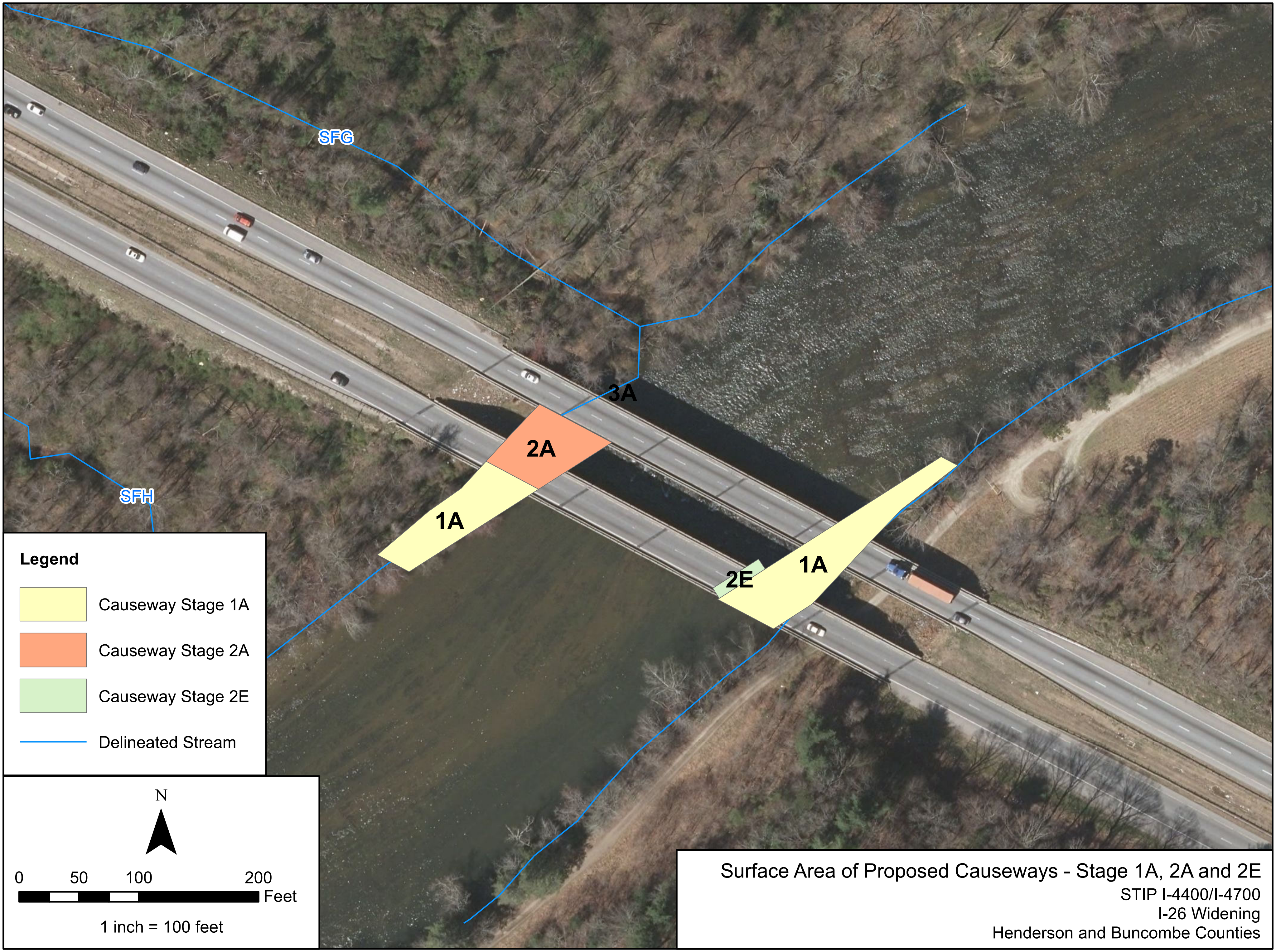
STIP I-4400/I-4700

I-26 Widening

Henderson and Buncombe Counties

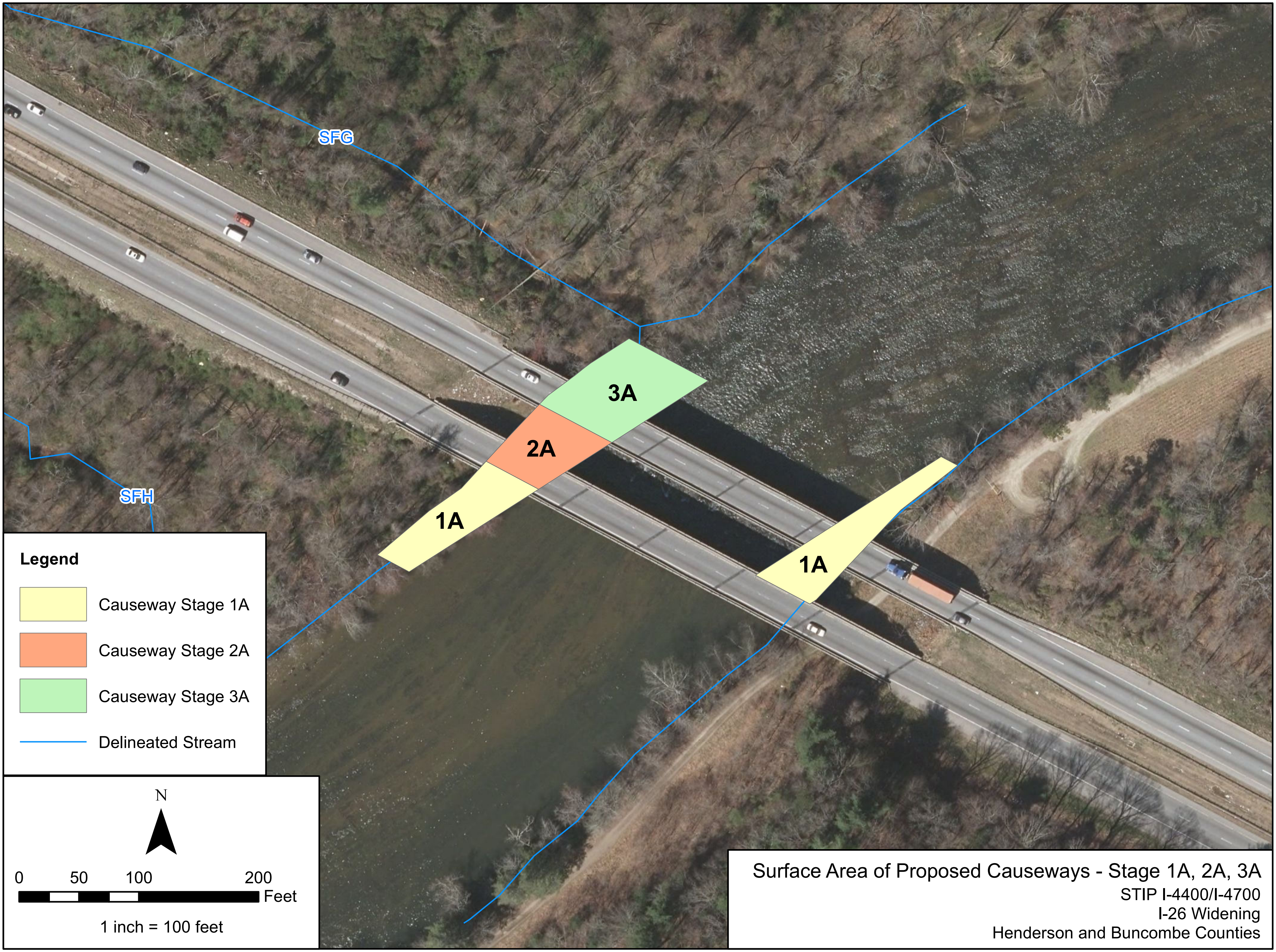


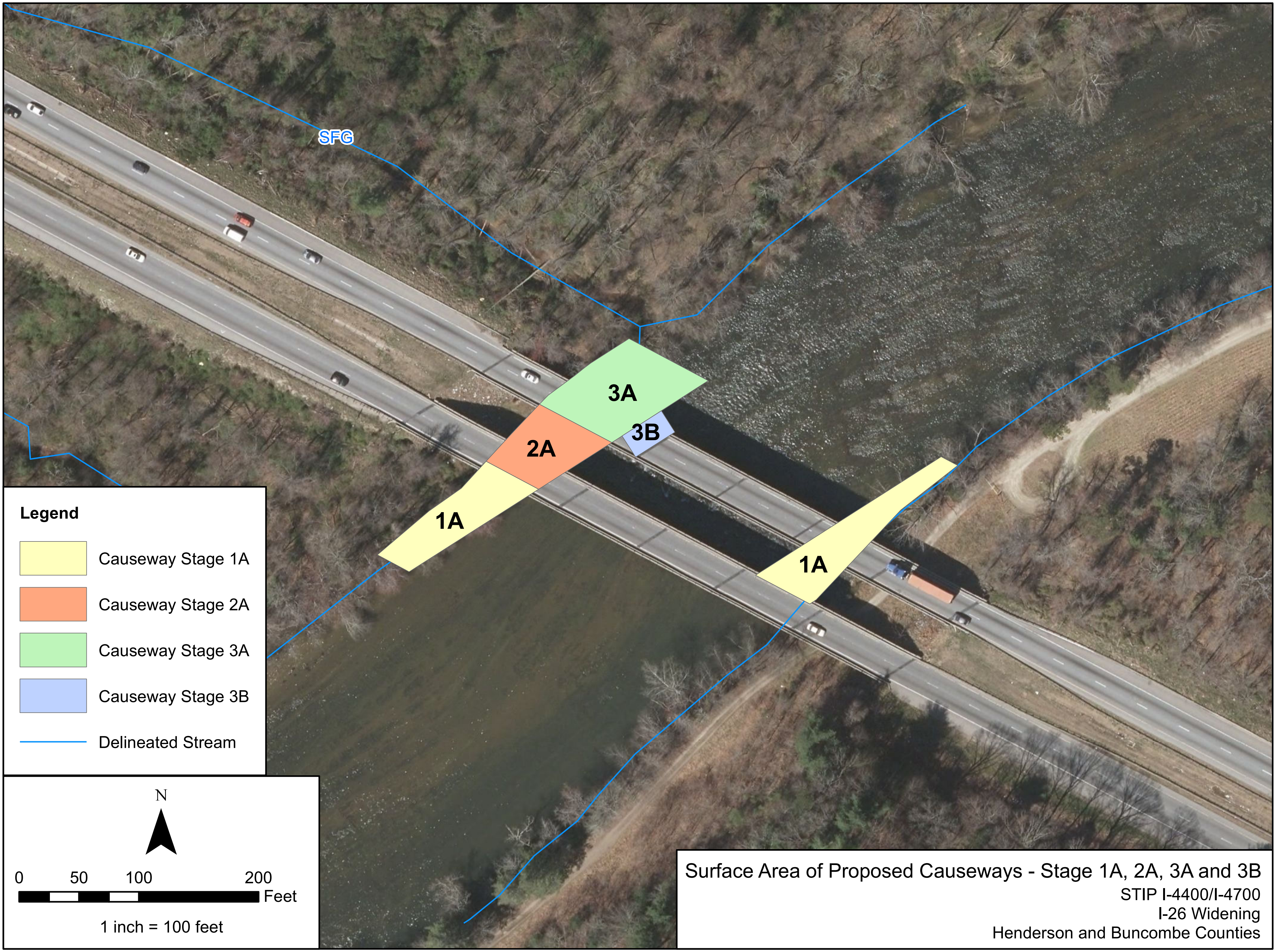
Surface Area of Proposed Causeways - Stage 1A, 2A and 2D
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

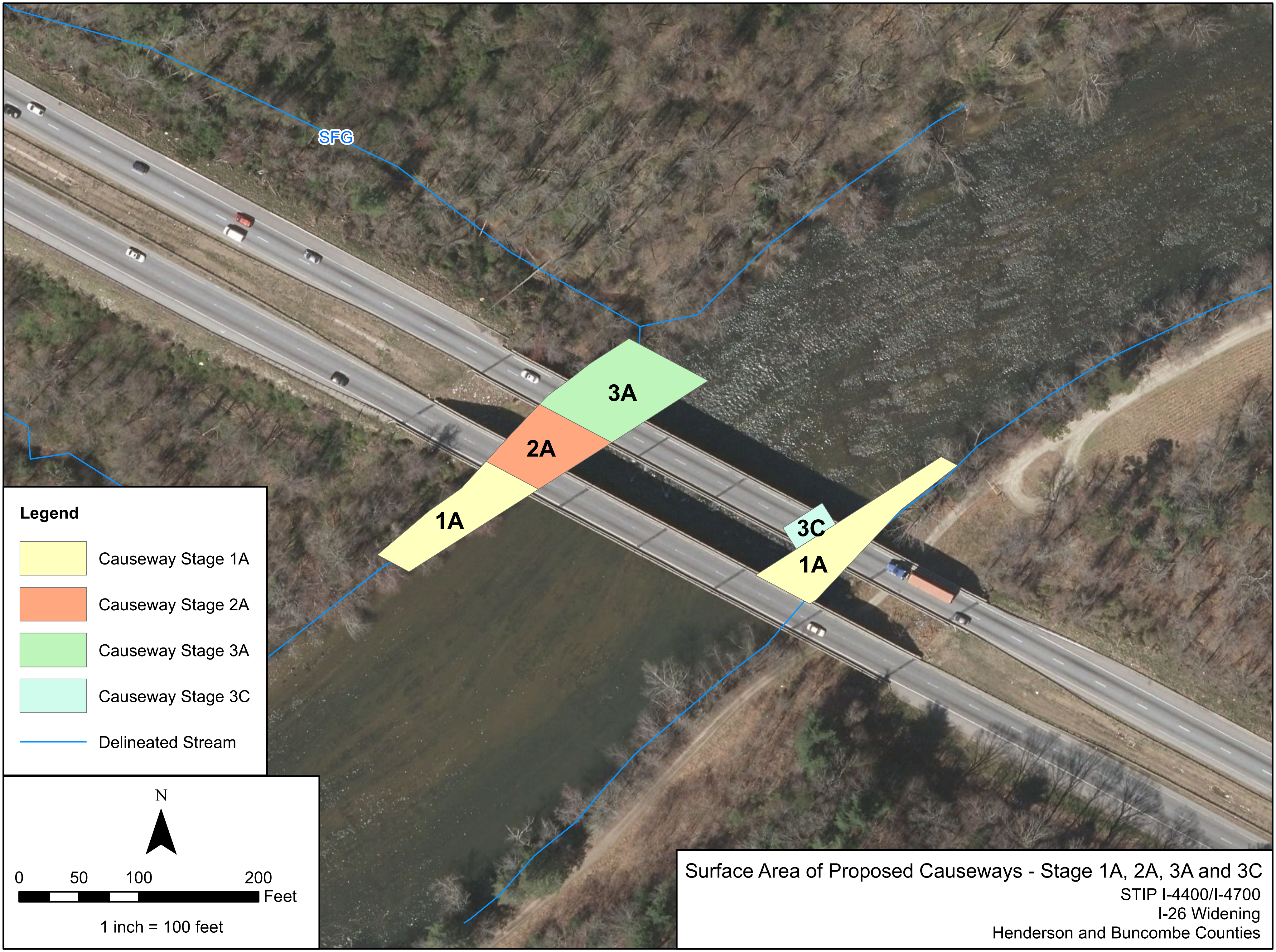


Surface Area of Proposed Causeways - Stage 1A, 2A and 2E

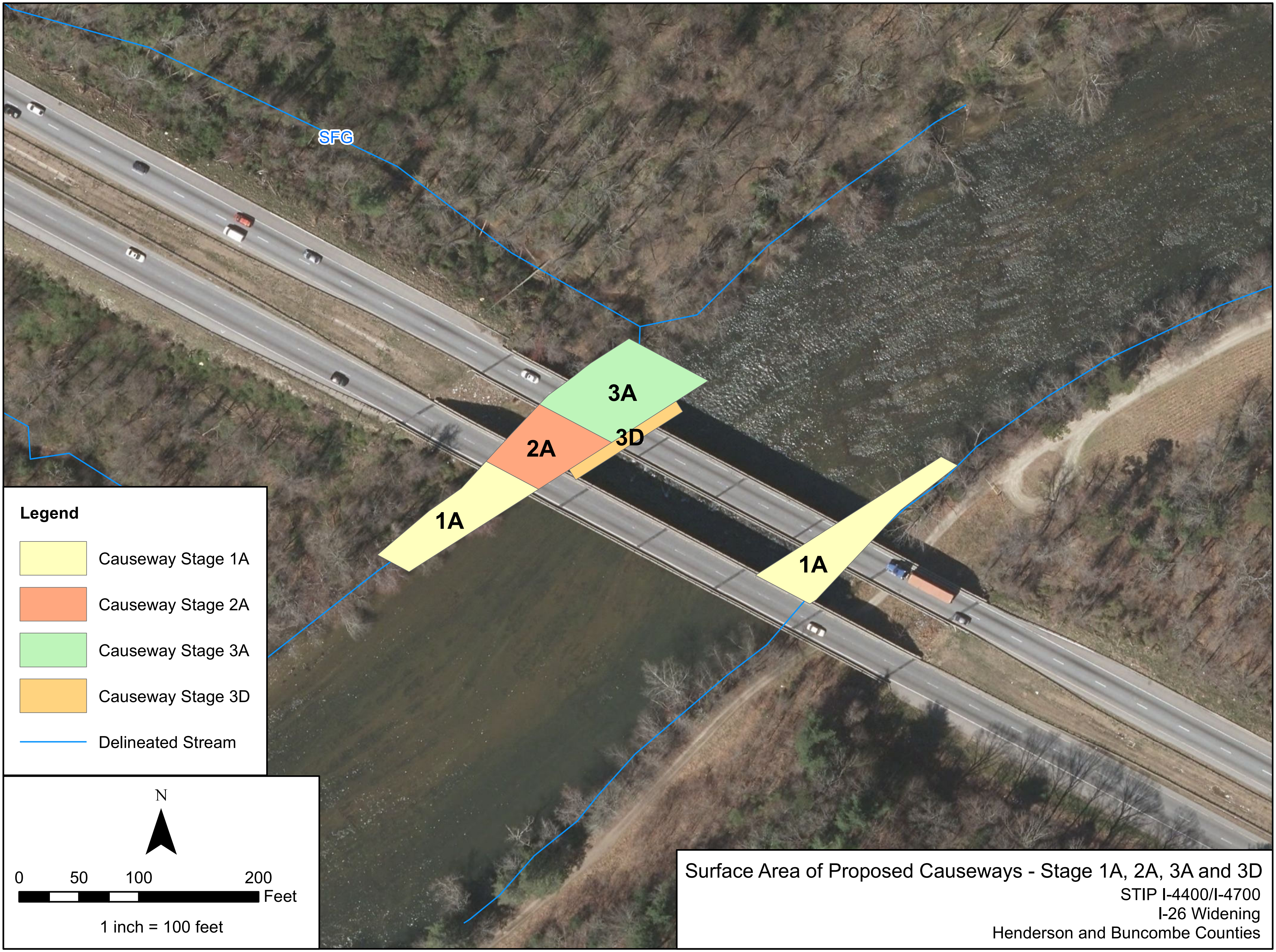
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

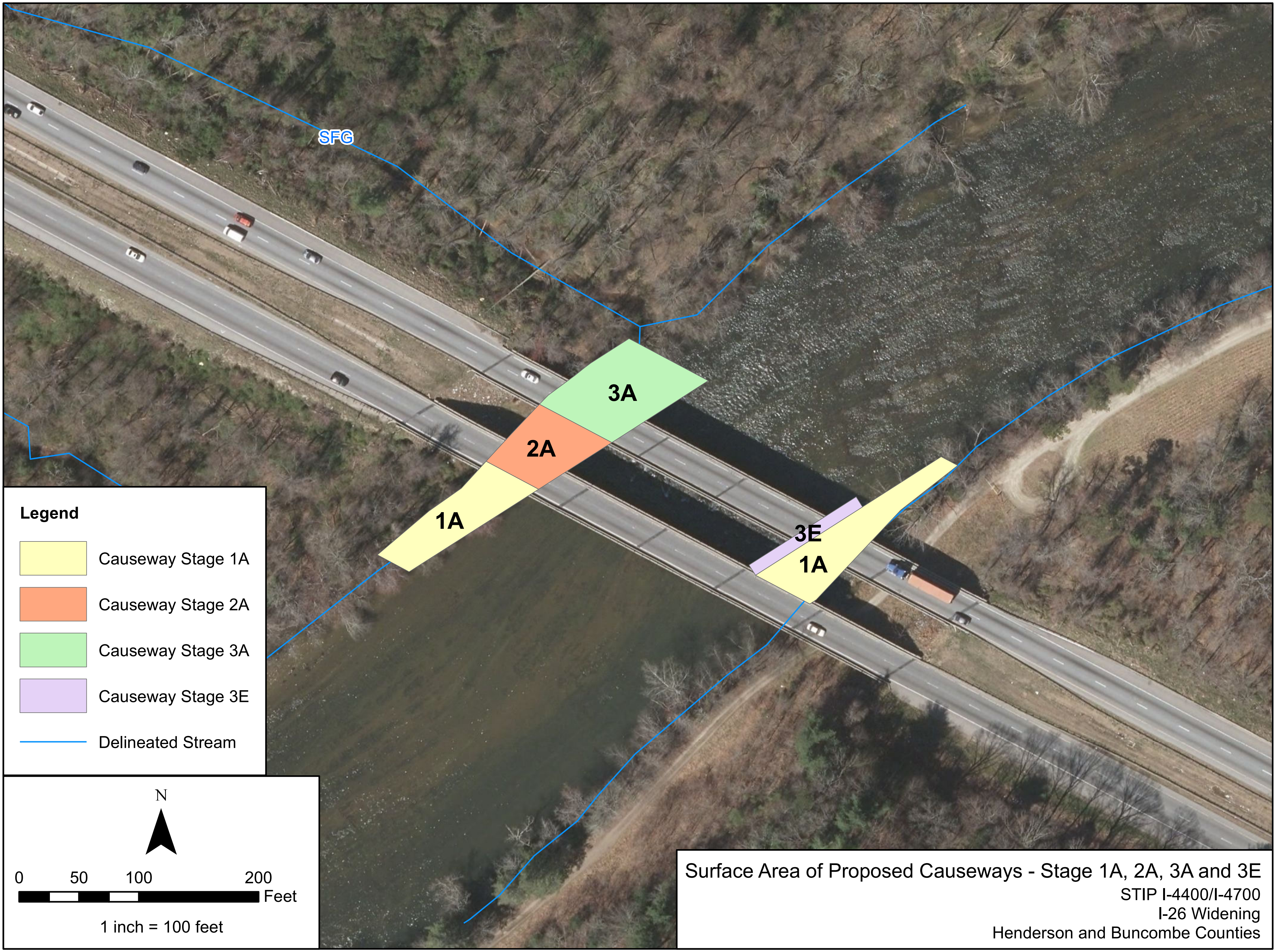

SFG
SFH
3A
2A
1A
1A
Legend
Causeway Stage 1A
Causeway Stage 2A
Causeway Stage 3A
Delineated Stream
N
0 50 100 200
Feet
1 inch = 100 feet
Surface Area of Proposed Causeways - Stage 1A, 2A, 3A
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties


SFG
3A
3B
2A
1A
1A
Legend
Causeway Stage 1A
Causeway Stage 2A
Causeway Stage 3A
Causeway Stage 3B
Delineated Stream
N
0
50
100
200
Feet
1 inch = 100 feet
Surface Area of Proposed Causeways - Stage 1A, 2A, 3A and 3B
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties



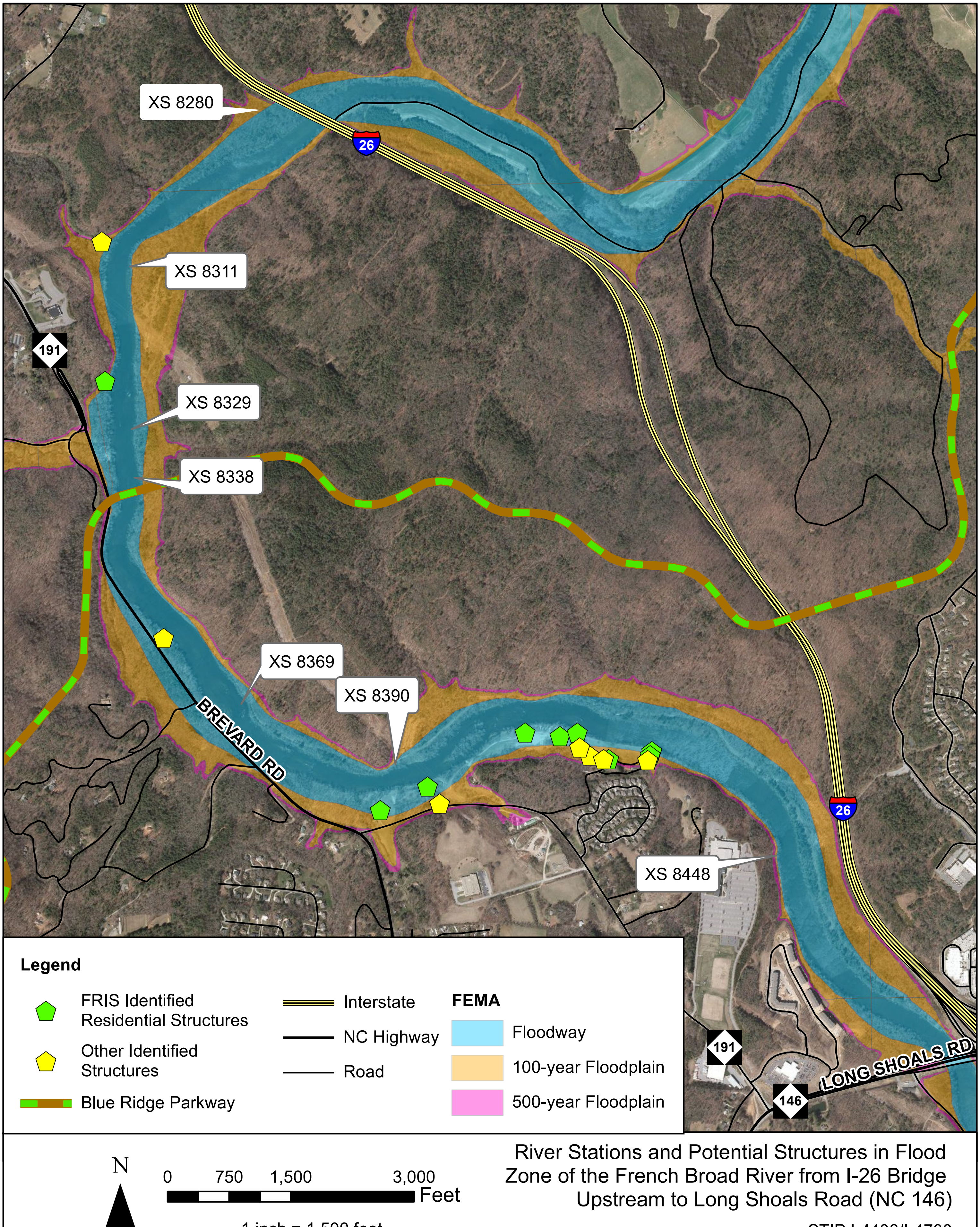
SFG
3A
2A
1A
3C
1A
Legend
Causeway Stage 1A
Causeway Stage 2A
Causeway Stage 3A
Causeway Stage 3C
Delineated Stream
N
0 50 100 200
Feet
1 inch = 100 feet
Surface Area of Proposed Causeways - Stage 1A, 2A, 3A and 3C
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties


SFG
3A
3D
2A
1A
1A
Legend
Causeway Stage 1A
Causeway Stage 2A
Causeway Stage 3A
Causeway Stage 3D
Delineated Stream
N
0 50 100 200
Feet
1 inch = 100 feet
Surface Area of Proposed Causeways - Stage 1A, 2A, 3A and 3D
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties



Surface Area of Proposed Causeways - Stage 1A, 2A, 3A and 3E
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

Surface Area of Proposed Causeways - Stage 1A (reduced) and 4
STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties



River Stations and Potential Structures in Flood Zone of the French Broad River from I-26 Bridge Upstream to Long Shoals Road (NC 146)

STIP I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

Sources: FEMA, FRIS, Buncombe Co, HNTB

Appendix F: I-26 CP4A Merger Meeting Minutes

I-26 Widening

STIP Project Nos. I-4400 & I-4700

US 25 (exit 54) in Henderson County to I-40 in Buncombe County including Blue Ridge Parkway Bridge over I-26

Section 404/NEPA Merger Project Team Meeting Agreement

Concurrence Point 4A

Avoidance and Minimization

Meeting Date:	October 11, 2017
Time:	10:00 a.m. to 12:00 p.m.
Place:	NCDOT Century Center Building B, Hydraulic Design Conference Room
Project:	I-26 Widening in Henderson and Buncombe Counties, Federal Aid Project No. NHF-26-1(62)23/IMNHF-026-1(86)9, WBS No. 34232.1.1/36030.1.1, STIP Project Nos. I-4400/I-4700, NCDOT Divisions 13 and 14
Purpose:	Achieve Merger Team concurrence on Concurrence Point (CP) 4A, Avoidance and Minimization, for the proposed I-26 Widening

Agenda

This meeting is being held to:

- Review the proposed improvements for the Least Environmentally Damaging Practicable Alternative (LEDPA)/ Preferred Alternative and summarize the impacts as disclosed in the Draft Environmental Impact Statement.
- Discuss proposed measures to Avoid and Minimize impacts of the proposed action.
- Reach concurrence on Avoidance and Minimization for the Project.

Previous Merger Team Meetings and Concurrence Points Reached

The Merger Team reached concurrence on the Purpose and Need Statement (CP 1) and Detailed Study Alternatives (CP 2) on June 20, 2013; Bridging Decisions and Alignment Review (CP 2A) on February 11, 2015; and Least Environmentally Damaging Practicable Alternative (LEDPA)/Preferred Alternative (CP 3) on January 18, 2017.

Project Study Area

State Transportation Improvement Program (STIP) Project I-4400 begins at US 25 (Exit 54) near Hendersonville and extends along I-26 west to NC 280 (Exit 40). STIP Project I-4700 extends along I-26 from NC 280 west to the I-40/I-240 interchange. **Figure 1** shows the general project vicinity.

Project Description

The project proposes to improve a 22.2-mile segment of Interstate 26 (I-26). The project is located in Henderson and Buncombe Counties, beginning just south of Hendersonville and ending just south of Asheville.

Purpose of the Proposed Action

The purpose of the proposed improvements to I-26 is to reduce congestion, with a goal of achieving an overall level of service (LOS) D in the design year (2040), and to improve the pavement structure.

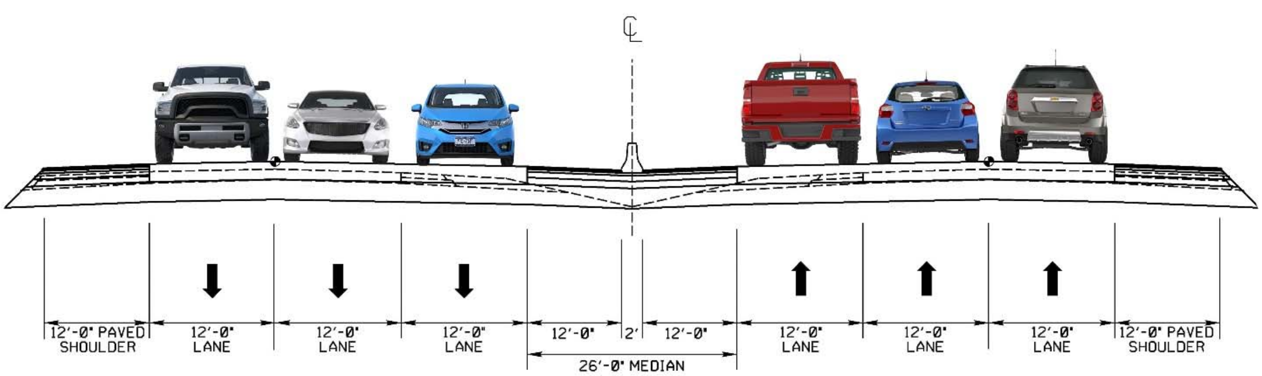
Proposed Improvements

NCDOT proposes to widen I-26 to three lanes in each direction between US 25 and the US 25 (Asheville Highway) interchange and widen I-26 to four lanes in each direction from US 25 (Asheville Highway) to the I-40/I-240 interchange. This is also known as the Hybrid 6/8-Lane Alternative or the Preferred Alternative and was chosen as the LEDPA at the January 2017 Merger Meeting. The widening will be designed to best fit within the existing right of way limits for I-26 to the extent possible; however, some additional right of way will be required.

Typical Sections

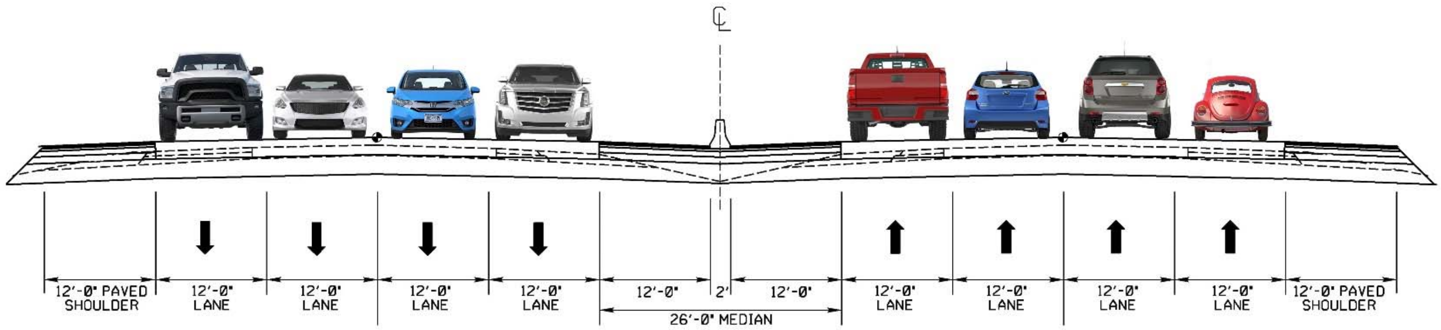
As shown on Inset 1, the proposed typical section for the six-lane section, from US 25 to US 25 (Asheville Highway), of the Preferred Alternative consists of three 12-foot travel lanes in each direction, with a 26-foot median that includes a median barrier wall.

Inset 1. 6-Lane Typical Section



As shown in Inset 2, the eight-lane section of the Preferred Alternative, from US 25 (Asheville Highway) to I-40/I-240, includes four lanes in each direction, with a 26-foot median that includes a median barrier wall. However, there are two areas where the northbound and southbound lanes separate and the median width varies.

Inset 2. 8-Lane Typical Section



The typical width of the outside shoulders for both the six and eight-lane sections is 14 feet; 12 of the 14 feet will be paved. In locations with guardrail, the outside shoulder width is wider.

Interchange Modifications

As part of the Preferred Alternative, the US 25 (Asheville Highway) interchange will be re-designed to a Diverging Diamond Interchange (DDI) type. The US 64 (Four Seasons Boulevard/Chimney Rock Road) interchange would also be improved as part of this project.

The majority of the interchanges along the project would not be modified in a notable way for the six-lane section of the Preferred Alternative; most modifications would be made on the eight-lane section. Ramp acceleration and deceleration lanes would be shifted outward to accommodate the widened roadway and will be tied back into existing ramp alignments.

Blue Ridge Parkway Bridge

The columns supporting the bridge deck of the Blue Ridge Parkway bridge over I-26 are spaced in such a way that they do not accommodate widening of I-26. As a result, the bridge has been proposed for replacement by NCDOT and FHWA as part of this project. NCDOT and FHWA have coordinated with the National Park Service (NPS) in the development and evaluation of bridge replacement options. NPS has chosen Option 4, as its Preferred Option, which would replace the bridge to the south of the current bridge on new alignment, using a segmental concrete box girder bridge type with Caltrans Type 80 bridge rail. The bridge would have two ten-foot travel lanes, three-foot shoulders, and a five-foot sidewalk on the north side (Parkway west) to accommodate the Mountains-to-Sea Trail (MST) as noted in the *Blue Ridge Parkway Bridge Over Interstate 26 Technical Report* (NPS, July 2016).

Structures

Of the 28 stream crossings along the study corridor, four are bridges, 15 are major culvert crossings (conveyance greater than or equal to a 72-inch pipe), and nine are 66-inch pipes. Of these 28 structures, 13 are recommended for replacement or modification, two crossings are no longer part of the project, and the remaining 13 sites will be retained. **Table 1** below shows structures recommended for replacement for the Preferred Alternative as agreed to at CP 2A.

There are also 13 structures, nine bridges and four interchanges, carrying roads over I-26 within the study area. Seven of the bridges will be replaced including: Crest Road, Clear Creek Road, Brookside Camp Road, Naples Road, Butler Bridge Road, Fanning Bridge Road, and the Blue Ridge Parkway.

Table 1: Hydraulic Structures Concurred with at CP2A for the Hybrid 6/8-Lane Widening Alternative (Preferred Alternative/LEDPA)

Site Number[1]	Station	Route	Stream Information							Existing Structure	Preferred Alternative	
			Stream Name NRTR Map ID	NCDWR Stream Index Number	Mitigation Ratio	Perennial/ Intermittent	Stream Length (ft)	Stream Class	Drainage Area (sq mi) [acres]	Number, Size, Structure Type (Existing Length)	Recommended Structure (Additional Length)	Cost Estimate – Culvert Extension (Bridge)
STIP Project Number I-4400A												
3	-L- 79+09	I-26	UT to Dunn Creek SV	6-55-8-1-1	2:1	P	725	C	0.28 [178]	1 @ 6' x 6' RCBC (240')	Retain and extend (18' [RT]/0' [LT])	$100,000 ($1,573,000)
4	-L- 90+32	I-26	Dunn Creek ST	6-55-8-1-1	2:1	P	845	C	2.58 [1,649]	2 @ 8' x 8' RCBC (354')	Retain existing; add supplemental pipe[2]	$248,000 ($1,501,000)
7	-L- 208+70	I-26	Devils Fork SAJ	6-55-8-2	2:1	P	2849	C	6.80 [4,351]	3 @ 9' X 10' RCBC (220')	Retain and extend (42' [RT]/20' [LT])	$285,000 ($1,645,000)
STIP Project Number I-4400B												
11	-L- 334+69	I-26	Clear Creek SBD	6-55-11-(5)	2:1	P	908	C	44.30 [28,352]	Dual 3 - Span RC Deck Bridges; L = 220.14'	Remove and replace; L (Min) = 230'	($3,577,000)
12	-L- 407+69	I-26	UT to Mud Creek SBG	6-55	1:1	P	1,433	C	0.46 [296]	1 @ 7' x 7' RCBC (266')	Retain and extend (18' [RT]/0'[LT])	$40,000 ($2,436,000)
14	-L- 500+94	I-26	Byers Creek SBU	6-55-13	2:1	P	1219	C	2.42 [1,550]	2 @ 8' x 8' RCBC (156')	Retain and extend; add supplemental pipe[2] (21' [RT]/16' [LT])	$285,000 ($1,070,000)
STIP Project Number I-4400C												
16	-L- 669+02	I-26	Cane Creek SCW	6-57-(9)	2:1	P	878	C	83.80 [53,632]	Dual 3 - Span RC Deck Bridges; L = 198.25'	Remove and replace; L (Min) = 210'	($3,876,000)
17	-L- 682+68	I-26	Kimsey Creek SCY	6-57-22	2:1	P	960	C	2.49 [1,594]	3 @ 7' x 7' RCBC (236')	Retain and extend; add supplemental pipe[2] (36' [RT]/48' [LT])	$521,000 ($2,151,000)
18	-Y12- 11+44	SR 1358	UT to French Broad River SDH	6-(54.5)	1:1	P	82	B	0.14 [88]	1 @ 6' x 5' RCBC - 66" RCP w/ HW (540')	Retain and extend (0' [RT]/8' [LT])	$43,000
STIP Project Number I-4700A												
19	-L- 800+81	I-26	UT to French Broad River SDC	6-(54.5)	2:1	P	961	B	0.36 [228]	1 @ 6' x 6' RCBC (220')	Retain and extend; add supplemental pipe[2] (48' [RT]/27' [LT])	$380,000 ($2,236,000)
23	-L47001- 897+06	I-26	Powell Creek SDN	6-62	2:1	P	470	C	5.06 [3,240]	2 @ 10' x 10' RCBC (264')	Retain and extend (80' [RT]/24' [LT])	$390,000 ($2,322,000)
STIP Project Number I-4700B												
25	-L47002- 1076+40	I-26	French Broad River	6-(54.5)	2:1	P	893.5[3]	B	678.00 [433,920]	Dual 6 - Span RC Deck Bridges; L1 = 440.9' L2 = 453.4'	Remove and replace; L (Min) = 460'	($8,074,000)
26[4]	-L47002- 1151+85	I-26	Long Valley Branch SFN	6-75	1:1	P	44	C	0.25 [158]	1 @ 66" SPP w/ HW; 1 @ 14' x 14' RCBC [vehicle underpass] (220')	Retain and extend (20' [RT]/40' [LT])	$171,000 ($2,665,000)

[1] Minimum Supplemental Pipe Size is 48 inches.
[2] Site number referred to in the Hydraulic Technical Memorandum (HNTB, 2014).
[3] This is the average of the length of stream determined on both banks under the French Broad River bridge.
[4] Wetlands are only present at Site 26.

Summary of Impacts from the Draft EIS

Table 2 is a summary of impacts as shown in the Draft EIS (August 2016), which included a proposed partial cloverleaf design for the US 25 (Asheville Highway) interchange improvement. Following the publication of the Draft EIS, public meeting, and comment period, the Merger Team chose the Hybrid 6/8-Lane Widening Alternative as the LEDPA (January 2017) and NCDOT revised the US 25 (Asheville Highway) interchange to a DDI form.

Table 2: Summary of Impacts for the Preferred Alternative in the Draft EIS (August 2016)

IMPACT CATEGORY[1]	Hybrid 6/8-Lane Widening
Human Environment	
Residential Relocations (Minorities)	18 (6)
Business Relocations	1
Grave Site Relocations	0
Disrupts Neighborhood & Community Cohesion	No
Recurring Community / Neighborhood Impacts	Yes; minor relocation impacts to Brickton community.[1]
Low Income / Minority Populations	Yes; not disproportionately high and adverse.
Cultural Resources (Adverse Effect determined)	Yes; Blue Ridge Parkway and Cureton House[2]
Section 4(f)	Yes; Blue Ridge Parkway
Section 4(f) *de minimis*	Yes; Biltmore Estate, Hyder Dairy Farm, Camp Orr (Camp Pinewood), and Mountains to Sea Trail[3]
Visual Resources / Characteristics	No
Traffic Noise Impacts (# of receptors)	315[4]
Air Quality	No
Farmland (acres)	11
Hazardous Materials	Minimal monetary and scheduling impacts.
Natural Resources	
Federal Listed Species Habitat	May affect but not likely to adversely affect the Northern long-eared bat (NLEB)[5,6]. No effect on other species in Henderson and Buncombe Counties.[7]
Jurisdictional Streams (linear feet)[8]	24,650
Jurisdictional Wetlands (acres)[8]	7.7
100-year Floodplain (acres)[8]	41.8
500-year Floodplain (acres)[8]	17.3

Table 2: Summary of Impacts for the Preferred Alternative in the Draft EIS (August 2016)

IMPACT CATEGORY[1]	Hybrid 6/8-Lane Widening
Ponds (acres)[8]	0.05
Indirect and Cumulative Effects	Based on this assessment of the currently identified project alternatives, STIP Project I-4400/I-4700 is not expected to have a notable indirect effect on land use in the FLUSA. Potential land use effects as a result of STIP Project I-4400/I-4700 are somewhat tempered by the fact that the project is not expected to provide any new access or opportunities for traffic exposure to properties in the FLUSA, and will generate marginal travel time savings. Some amount of regional cumulative impacts can be expected for notable cultural, community, water quality, and natural habitat features. This is due to features having minimal incorporation in local planning protections and/or policies. The Cumulative Effects Tool indicated that cumulative effects were rated as a medium level of concern as a result of the reasonably-foreseeable transportation projects in the region.

[1] Following the publication of the Draft EIS, NCDOT determined that the Brickton community will not be affected by the project as documented in the project file and the Final EIS/ROD.
[2] Following the decision to revise the US 25 (Asheville Highway) interchange design to a Diverging Diamond Interchange SHPO and FHWA agreed that the project would have "no effect" on this property.
[3] Following the publication of the Draft EIS, NCDOT was informed that the French Broad River Paddle Trail is a Section 4(f) resource.
[4] Following the publication of the Draft EIS, NCDOT adopted the 2016 Noise Policy and Guidance. An Updated Traffic Noise Report (HNTB, 2017) followed this guidance, and determined that there are 399 impacted noise receptors.
[5] NCDOT will follow NPS mitigation protocol for the NLEB as detailed in the Special Commitments (Green Sheets) and Section 3.8.6.2.2 of the Draft EIS.
[6] May affect, not likely to adversely affect; however, NCDOT has determined that the proposed action does not require separate Section 7 consultation because the proposed action is consistent with the final Section 4(d) rule.
[7] Following the publishing of the Draft EIS, a gray bat roost was found near the project by USFWS and NC WRC and NPS recorded potential Indiana bat calls in the vicinity of the Blue Ridge Parkway. NCDOT is preparing a Biological Assessment (BA) for the threatened and endangered species in the project area. This is documented in the project file and will be included in the Correspondence and Response to Comments in the appendices to the Final EIS/ROD.
[8] Impacts based on current design proposed slope stake limits plus 40 feet.

Avoidance and Minimization

The following discussion and tables identify ways in which NCDOT has avoided and minimized to reduce impacts to the human and natural environment throughout the project development process.

Impacts are calculated based on preliminary design slope stakes plus 25 feet. Preliminary design for the I-26 Widening project was completed on LIDAR mapping and incorporates horizontal and vertical design elements and cross sections. The preliminary designs do not include hydraulic design or utilities design, which will be completed during the final design phase. Utility conflicts are mostly limited to interstate crossings, as opposed to parallel services.

The current designs presented at CP4A incorporate avoidance and minimization measures to the human and natural environment, including threatened and endangered species and jurisdictional streams and wetlands, for the entire project length. The following discussion and data tables quantify the reductions

of jurisdictional impacts from the incorporation of the avoidance and minimization measures summarized above. Once hydraulic design, utilities design, and geotechnical recommendations are complete, there may be further minor refinements at CP4B–30 Percent Hydraulic Review and CP4C–Permit Drawing Review for each project section.

The proposed project minimizes impacts to resources to the extent practicable based on current information and design. However, it is not feasible to completely avoid impacts to Waters of the US, cultural resources, and properties, as well as meet the purpose and need of the project. NCDOT is proposing a best fit widening that includes widening into the median to the maximum extent practicable, which results in avoidance and minimization of impacts and results in a reduced footprint for the overall project. By widening into the median, opportunities for vertical and horizontal changes and alignment shifts are limited and were determined not to be practicable. NCDOT has also reduced slope stake limits from the standard 4:1 to 2:1 slope stake limits to further avoid and minimize impacts. Further, NCDOT selected the DDI at the US 25 Interchange which has fewer impacts than the ParCloB and Synchronized Interchange (discussed below).

The reductions to jurisdictional impacts are as follows (*Note: Reductions to impacts are the difference between current design with 4:1 slope stake limits plus 40 feet and current design with 2:1 slope stake limits plus 25 feet*. *Slope stake limits plus 25 feet are used at CP4A*):

- By reducing the slope stake limits from 4:1 to 2:1, NCDOT:
    - Minimized impacts to streams by approximately 10,000 feet,
    - Avoided impacts to 19 wetlands (approximately 1.2 acres),
    - Minimized impacts to wetlands by approximately 9.6 acres including approximately 2.6 acres to wetland WCH (Biltmore Bog), and
    - Avoided impacts to two ponds (>0.1 acre).
- By selecting the DDI design at US 25 (Asheville Highway) instead of the ParClo B design, NCDOT:
    - Minimized approximately 890 feet of stream impacts, and
    - Minimized approximately 0.2 acre of wetland impacts.

Additional avoidance and minimization measures to the human environment include:

- NCDOT minimized the number of Residential Relocations from 18 (ParClo B) to 8 (DDI) and Business Relocations from 1 (ParClo B) to 0 (DDI).
- NCDOT minimized the design footprint at the US 25 (Asheville Highway) interchange was determined to have “no effect” to the Cureton House property under Section 106 of the National Historic Preservation Act.

NCDOT will continue to coordinate with the Section 404/NEPA Merger Team to identify avoidance and minimization measures to all waters of the U.S. and ensure that major hydraulic structures associated with the project are designed and installed to minimize negative impacts to stream stability (and therefore, water quality) to the extent practicable at CP4B and CP4C.

US 25 (Asheville Highway) Interchange

Following the publication of the Draft EIS, the public and agencies expressed an interest in NCDOT considering other options that would reduce impacts compared with the current partial cloverleaf design for the US 25 (Asheville Highway) interchange. NCDOT conducted a Value Engineering Study following publication of the Draft EIS and a concept for a Synchronized Interchange was put forward. NCDOT chose to study the Synchronized Interchange and the DDI interchange types. Although the

Synchronized Interchange performed slightly better than the DDI in the traffic analysis, it would also require replacement of the current bridge, which would increase cost, and the Division felt that the U-turn movements would be undesirable for the heavy truck traffic at the interchange. Therefore, NCDOT chose to revise the interchange to a DDI interchange type. **Table 3** shows the impacts of the Partial Cloverleaf option presented in the Draft EIS and the DDI.

Table 3: Potential Impacts for Preferred Alternative by Proposed US 25 (Asheville Highway) Interchange Design Concept

Impact Type	ParClo B Interchange	DDI	Percent Difference
Stream (linear feet)[1]	1,966	1,075	-58.6
Wetland (acres)[1]	0.2	0	-100
Pond (acres)[1]	0	0	-
Natural Communities[2]			
Maintained / Disturbed (acres)	34.7	34.0	-2.0
Montane Oak-Hickory Forest (acidic subtype) (acres)	6.6	5.6	-15.2
Montane Oak-Hickory Forest (white pine subtype) (acres)	6.5	2.1	-67.7
Acidic Cove Forest (acres)	3.0	2.9	-3.3
Parcel (number/acres)[3]	41 / 21.3	11 / 1.6	-73.2 / -92.5
Relocations (number)[3]	11	0	-100
Signs (number)[3]	-	1	+100
Estimated Construction Cost[4]	$8,800,000	$6,500,000	-26.1
Estimated Right of Way Cost[4]	$4,536,500	$1,170,500	-74.2

[1] Impacts based on current design proposed slope stake limits plus 25 feet;
[2] Impacts based on current design proposed slope stake limits plus 40 feet;
[3] Impacts based on proposed right of way;
[4] Cost estimated by NCDOT: ParClo B estimate (8/2016) (included in Draft EIS); DDI estimate (4/26/2017 and 6/19/2017).

Cultural Resources

The Cureton House property, located at 48 Cureton Place, was avoided with the DDI design type at the US 25 (Asheville Highway) interchange. The NC Historic Preservation Office (SHPO) and FHWA determined that the project would have "no effect" on this Section 106 resource.

Farmland Resources

The Natural Resource Conservation Service (NRCS) requested that the farmland soils be recalculated in their comments on the Draft EIS. The farmland impacts were re-assessed for the alternatives. **Table 4** shows the reassessed farmland impacts based on current design proposed slope stake limits plus 40 feet.

Table 4: Potential Farmland Impacts

	6-Lane Widening Alternative	8-Lane Widening Alternative	Preferred Alternative Hybrid 6/8-Lane Widening Alternative
Prime Farmland	1.4	3.5	3.6
Farmland of Statewide Importance	1.4	3.2	2.3
Farmland of Local Importance	17.7	22.4	22.4
Total:	20.5	29.1	28.3

The Preferred Alternative may convert approximately 28.3 acres, based on current design proposed slope stake limits plus 40 feet, to non-farmable use. This area is approximately three percent of the project area, most of which is in an US Census Bureau designated Urban Area. This land is currently not farmland, and though heavily wooded, is not in timber production. It is expected that as the design is refined the amount of impacted farmland soils will be reduced. It is not expected that this project will affect the likelihood of future farming along the I-26 corridor. Furthermore, the assessed area received 48 points, which is below the 160-point threshold for recommended mitigation by NRCS.

Natural Resources

Threatened and Endangered Species

There are no known occurrences of rusty-patched bumble bee, tan riffleshell, Spotfin chub, spreading avens, Carolina northern flying squirrel, rock gnome lichen, swamp pink, small whorled pogonia, spruce fir moss spider, bunched arrowhead, mountain sweet pitcher plant, white irisette, Blue Ridge goldenrod, or Virginia spiraea. Therefore, these species are not listed for minimization efforts.

Appalachian elktoe (*Alasmidonta raveneliana*) – Endangered – May Affect Likely to Adversely Affect – NCDOT is working with the US Fish and Wildlife Service (USFWS) and will submit a Biological Assessment (BA) under Section 7 of the Endangered Species Act. A recent survey of streams near the project study area found two individuals upstream and downstream of the I-26 bridge over the French Broad River. Three Oaks was contracted by NCDOT for both the field surveys and the species discussion in the BA.

Bog turtle (*Glyptemys muhlenbergii*) – Threatened due to similarity of appearance T(S/A) – The proposed current design attempted to reduce impacts to the Biltmore Bog by utilizing guardrail and 2:1 fill slopes. This minimization measure limits the extent of the project's slope stake limits to the greatest practicable extent. It is also important to note that the current impacts are based on current design proposed slope stake limits plus a 25-foot buffer. The actual impacts will be based on a more refined design's slope stake limits plus a 10-foot buffer. The greater refinement will reduce the calculated impact area in the Biltmore Bog.

Northern long-eared bat (NLEB) (*Myotis septentrionalis*) – Threatened – May Affect Not Likely to Adversely Affect – As noted in the *US 25 NRTR Addendum* and reviewed in the *NRTR Addendum 4*, the nearest NLEB hibernacula record is 11.5 miles away and no known NLEB roost trees occur within 150 feet of the project area. NCDOT has determined that the proposed action does not require separate consultation because the proposed action is consistent with the final Section 4(d) rule, codified at 50 CFR 17.40(o). However, NCDOT has agreed to limit tree clearing to between August 15 and May 15 within 0.25 mile of the Blue Ridge Parkway, as required by the agreement with the NPS and USFWS.

Indiana bat (*Myotis sodalis*) – May Affect Not Likely to Adversely Affect – The Indiana bat is not federally listed in Buncombe or Henderson County. However, NCDOT has agreed to avoid adverse impacts to Indiana bats within the boundaries of the Blue Ridge Parkway. This commitment is to conduct emergent and/or acoustic surveys prior to removal of trees if construction occurs between April 15 and August 15. Further, no significant tree removal can occur within 5 miles of known hibernacula between April 1 and November 15.

Gray bat (*Myotis grisescens*) – Endangered – May Affect Likely to Adversely Affect – NCDOT is working with the US Fish and Wildlife Service (USFWS) and will submit a Biological Assessment (BA) under Section 7 of the Endangered Species Act.

Calyx Engineers was contracted by NCDOT to perform a survey of the structures within the study area to determine if there was evidence of the gray bat. The field survey included 24 bridges and 18 culverts (at least 5 feet high and 200 feet long) within the project study area. The findings were reported in the Structures Survey Report, and determined that only one structure, the Long Shoals Road bridge over the French Broad River, is a bat roost. The evidence found at this structure indicates that bats may be using this bridge infrequently for night roosting. No maternity roosts were found during the survey.

In addition to the structure survey, Calyx has also performed an acoustic survey. The acoustic survey report will be finalized November 2017.

<u>Streams and Wetlands</u>

Figure 2 shows streams and wetlands within the limits of the current design proposed slope stake limits. Impacts to streams and wetlands have also been developed based on current design proposed slope stake limits plus an additional 25 feet.

Table 5 shows the reduction in impacts from reducing the US 25 (Asheville Highway) design footprint from a Partial Cloverleaf B (ParClo B) to a DDI. This comparison is based on current design proposed slope stake limits plus 25 feet.

Table 5: Comparison of Potential Impacts to Jurisdictional Features for the Preferred Alternative by Interchange Type

	Hybrid 6/8-Lane Widening with ParClo B Design (SS+25')	**Hybrid 6/8-Lane Widening with DDI Design (SS+25')**	**Percent Difference**
Jurisdictional Streams (linear feet)	19,415	18,541	-4.5
Jurisdictional Wetlands (acres)	4.82	4.66	-3.3
Ponds (acres)	0.05	0.05	0
FEMA Floodplain			
100-year Floodplain (acres)	30.4	30.4	0
500-year Floodplain (acres)	17.6	17.6	0

Table 6 compares the individual stream impacts for the I-26 with ParClo B design at US 25 (Asheville Highway) and the I-26 with DDI at US 25 (Asheville Highway). The comparison is of the current design

proposed slope stake limits plus an additional 25-foot buffer. The table also includes a column that tabulates current design with 4:1 slope stake limits plus 40 feet; however, the jurisdictional impacts reported at CP4A are based on current design with 2:1 slope stake limits. Although a project commitment has been added for Beck Creek, implementing *Design Standards in Sensitive Watersheds*, no impacts to this stream or its tributaries are anticipated.

Table 6: Comparison of Stream Impacts for I-26 Widening

Stream	MAP ID	NCDWR Index Number	Perennial (P)/ Intermittent (I)	Best Usage Classification	Mitigation Ratio	Stream Impacts[1] (ft) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)				I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)			
							Stream Impacts[2] (ft) (2:1 SS)	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS+25')	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS)	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS+25')	Mitigation Cost
STIP Project Number I-4400A														
Broad River Basin (HUC 03050105)														
UT to Beck Creek	SA	9-29-27	P	C-Tr	2:1	80.2	3.0	$2,389	40.1	$31,625	3.0	$2,390	40.1	$31,626
French Broad River Basin (HUC 06010105)														
UT to Dunn Creek	SS	6-55-8-1-1	P	C	1:1	318.7	151.6	$59,722	250.5	$98,686	151.6	$59,721	250.5	$98,686
UT to Dunn Creek	SQ	6-55-8-1-1	P	C	2:1	477.2	—	$0	147.9	$116,532	—	$0	147.9	$116,524
UT to Dunn Creek	SW	6-55-8-1-1	P/I	C	1:1	917.6	274.2	$108,016	666.7	$262,664	274.2	$108,022	666.7	$262,664
UT to Dunn Creek	SV	6-55-8-1-1	P	C	2:1	185.3	14.6	$11,512	76.6	$60,357	14.6	$11,512	76.6	$60,357
Dunn Creek	ST	6-55-8-1-1	P	C	2:1	27.7	—	$0	0.6	$494	—	$0	0.6	$494
UT to Dunn Creek	SY	6-55-8-1-1	I	C	1:1	163.0	—	$0	—	$0	—	$0	—	$0
UT to Dunn Creek	SZ	6-55-8-1-1	P/I	C	1:1	854.6	—	$0	234.0	$92,197	—	$0	234.0	$92,192
UT to Dunn Creek	SAA	6-55-8-1-1	I	C	1:1	173.5	63.6	$25,059	143.5	$56,555	63.6	$25,058	143.5	$56,554
UT to Bat Fork	SAH	6-55-8-1	P	C	2:1	34.6	—	$0	14.8	$11,699	—	$0	14.8	$11,700
UT to Devils Fork	SAE	6-55-8-2	P	C	1:1	111.6	22.2	$8,763	111.6	$43,965	22.2	$8,762	111.6	$43,965
UT to Devils Fork	SAB	6-55-8-2	P	C	1:1	1,768.6	144.6	$56,966	1,581.2	$622,980	144.6	$56,960	1,581.1	$622,973
UT to Devils Fork	SAI	6-55-8-2	I	C	1:1	54.7	14.1	$5,545	39.5	$15,559	14.1	$5,545	39.5	$15,559
UT to Devils Fork	SAC	6-55-8-2	P	C	1:1	92.9	25.0	$9,846	77.1	$30,368	25.0	$9,846	77.1	$30,368
UT to Devils Fork	SAL	6-55-8-2	P	C	1:1	138.4	26.0	$10,250	94.3	$37,144	26.0	$10,250	94.3	$37,144
UT to Devils Fork	SAO	6-55-8-2	P	C	1:1	113.4	10.9	$4,280	59.8	$23,553	10.9	$4,280	59.8	$23,553
Devils Fork	SAJ	6-55-8-2	P	C	2:1	1,793.1	75.0	$59,098	1,091.1	$859,821	75.0	$59,096	1,091.1	$859,811
UT to Devils Fork	SAM	6-55-8-2	I	C	1:1	25.9	—	$0	—	$0	—	$0	—	$0
UT to Devils Fork	SAN	6-55-8-2	P	C	2:1	12.4	—	$0	—	$0	—	$0	—	$0
UT to Devils Fork	SAP	6-55-8-2	P	C	2:1	76.7	—	$0	—	$0	—	$0	—	$0
UT to Devils Fork	SAW	6-55-8-2	P	C	1:1	75.5	34.1	$13,445	60.5	$23,826	34.1	$13,445	60.5	$23,826
UT to Devils Fork	SAV	6-55-8-2	P	C	1:1	24.2	—	$0	7.4	$2,917	—	$0	7.4	$2,917
UT to Devils Fork	SBW	6-55-8-2	I	C	1:1	75.4	—	$0	75.4	$29,692	—	$0	75.4	$29,692
UT to Devils Fork (West)	SAR	6-55-8-2	P	C	1:1	54.8	10.6	$4,169	38.2	$15,046	10.6	$4,170	38.2	$15,046
UT to Camp Branch	SAS	6-55-8-2-1	P	B	1:1	90.0	13.3	$5,229	54.6	$21,519	13.3	$5,229	54.6	$21,519
UT to Camp Branch	SBL	6-55-8-2-1	I	B	1:1	143.9	36.6	$14,411	137.1	$54,023	36.6	$14,411	137.1	$54,024
UT to Camp Branch	SAX	6-55-8-2-1	I	B	1:1	101.4	19.0	$7,504	66.4	$26,177	19.0	$7,504	66.4	$26,174
STIP Project Number I-4400B														
UT to Allen Branch	SAZ	6-55-11-14	P/I	C	2:1	251.7	84.9	$66,919	236.7	$186,482	84.9	$66,921	236.7	$186,481
UT to Allen Branch (West)	SBA	6-55-11-14	I	C	1:1	41.7	—	$0	25.8	$10,150	—	$0	25.8	$10,150
UT to Allen Branch (East)	SBA	6-55-11-14	I	C	2:1	26.0	—	$0	10.7	$8,405	—	$0	10.7	$8,405
Clear Creek - BRIDGED	SBD	6-55-11-(5)	P	C	2:1	555.8	—	$0	422.1	$332,631	—	$0	422.1	$332,628
UT to Mud Creek	SBG	6-55	P	C	1:1	1,154.3	79.5	$31,332	449.0	$176,911	79.5	$31,326	449.0	$176,911
UT to Mud Creek	SBF	6-55	P	C	1:1	261.7	36.4	$14,331	169.0	$66,593	36.4	$14,330	169.0	$66,593
Featherstone Creek	SBP	6-55-12	P	C	2:1	74.3	1.9	$1,466	41.0	$32,312	1.9	$1,466	41.0	$32,312
UT to Mud Creek	SBO	6-55	P	C	2:1	83.3	7.6	$5,991	51.9	$40,916	7.6	$5,991	51.9	$40,916

Table 6: Comparison of Stream Impacts for I-26 Widening

Stream	MAP ID	NCDWR Index Number	Perennial (P)/ Intermittent (I)	Best Usage Classification	Mitigation Ratio	Stream Impacts[1] (ft) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)				I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)			
							Stream Impacts[2] (ft) (2:1 SS)	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS+25')	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS)	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS+25')	Mitigation Cost
UT to Mud Creek	SBI	6-55	P	C	2:1	193.1	28.2	$22,260	88.5	$69,737	28.2	$22,260	88.5	$69,737
UT to Mud Creek	SBS	6-55	I	C	1:1	55.4	55.4	$21,811	55.4	$21,811	55.4	$21,811	55.4	$21,811
UT to Byers Creek	SBV	6-55-13	P	C	2:1	225.1	41.8	$32,977	176.2	$138,870	41.8	$32,978	176.2	$138,872
Byers Creek	SBU	6-55-13	P	C	2:1	124.9	36.7	$28,938	89.2	$70,318	36.7	$28,938	89.2	$70,318
UT to Byers Creek	SBT	6-55-13	I	C	1:1	223.1	19.7	$7,770	191.7	$75,549	19.7	$7,770	191.8	$75,550
UT to Byers Creek	SCB	6-55-13	P	C	2:1	79.1	2.4	$1,901	42.7	$33,637	2.4	$1,901	42.7	$33,637
UT to Byers Creek	SCA	6-55-13	P	C	2:1	80.0	6.3	$4,952	49.2	$38,748	6.3	$4,951	49.2	$38,748
UT to Byers Creek	SCD	6-55-13	P	C	2:1	125.7	6.9	$5,401	110.7	$87,204	6.9	$5,400	110.7	$87,203
UT to Mud Creek	SCH	6-55	I	C	1:1	57.3	10.2	$4,001	38.7	$15,234	10.2	$4,000	38.7	$15,234
UT to Mud Creek	SCM	6-55	I	C	1:1	46.7	—	$0	6.1	$2,385	—	$0	6.1	$2,385
UT to Mud Creek	SCN	6-55	P	C	1:1	876.4	397.5	$156,612	705.6	$278,002	397.5	$156,614	705.6	$278,002
UT to Mud Creek	SCK	6-55	P	C	2:1	344.3	87.3	$68,770	139.2	$109,652	87.3	$68,770	139.2	$109,652
UT to Mud Creek	SCI	6-55	P	C	2:1	205.9	—	$0	—	$0	—	$0	—	$0
UT to Mud Creek	SCL	6-55	P	C	2:1	146.2	54.3	$42,810	101.6	$80,047	54.3	$42,810	101.6	$80,046
UT to Mud Creek	SCO	6-55	P	C	2:1	647.7	504.8	$397,748	575.8	$453,692	—	$0	22.0	$17,346
UT to Mud Creek	SCP	6-55	I	C	1:1	149.6	104.4	$41,132	133.5	$52,604	—	$0	—	$0
STIP Project Number I-4400C														
UT to Mud Creek	SEN	6-55	P	C	2:1	341.0	93.8	$73,879	190.1	$149,814	—	$0	335.5	$264,399
UT to Mud Creek	SCR	6-55	P	C	1:1	136.6	129.9	$51,182	136.6	$53,806	60.3	$23,760	92.6	$36,473
UT to Mud Creek	SCQ	6-55	P/I	C	2:1	595.6	546.2	$430,383	576.4	$454,235	408.7	$322,070	433.7	$341,761
UT to Mud Creek	SCT	6-55	P	C	2:1	386.3	201.0	$158,384	354.0	$278,955	75.8	$59,729	191.1	$150,625
UT to Cane Creek[2]	SCU	6-57-(9)	I	C	1:1	218.7	87.9	$34,644	183.4	$72,249	87.9	$34,644	183.4	$72,248
UT to Cane Creek[2]	SCX	6-57-(9)	P	C	2:1	789.1	107.3	$84,578	738.9	$582,262	107.3	$84,564	738.9	$582,261
Cane Creek[2] - BRIDGED	SCW	6-57-(9)	P	C	2:1	411.0	41.7	$32,830	201.2	$158,571	41.7	$32,830	201.2	$158,570
UT to Kimsey Creek	SCZ	6-57-22	P	C	2:1	96.7	15.2	$11,965	40.6	$31,990	15.2	$11,965	40.6	$31,990
Kimsey Creek	SCY	6-57-22	P	C	2:1	336.4	55.2	$43,503	121.2	$95,476	55.2	$43,503	121.2	$95,476
UT to Kimsey Creek	SDR	6-57-22	I	C	2:1	213.5	213.5	$168,256	213.5	$168,256	213.5	$168,256	213.5	$168,256
UT to French Broad River	SDH	6-(54.5)	P/I	B	1:1	624.7	273.2	$107,628	483.1	$190,356	283.0	$111,518	500.3	$197,131
UT to French Broad River	SDI	6-(54.5)	P/I	B	1:1	357.4	254.9	$100,432	342.3	$134,875	254.9	$100,433	342.3	$134,875
UT to Higgins Branch[3]	SZY	6-57-22-2	I	C	2:1	334.5	162.0	$127,641	294.6	$232,120	162.0	$127,641	294.6	$232,120
STIP Project Number I-4700A														
UT to French Broad River	SDD	6-(54.5)	P/I	C	1:1	587.7	135.1	$53,247	587.7	$231,571	135.1	$53,244	587.7	$231,571
UT to French Broad River	SDC	6-(54.5)	P	B	2:1	139.1	44.2	$34,798	102.5	$80,794	44.2	$34,797	102.5	$80,797
UT to French Broad River (West)	SDE	6-(54.5)	P	B	1:1	58.7	16.8	$6,626	43.0	$16,939	16.8	$6,626	43.0	$16,939
UT to French Broad River (East)	SDE	6-(54.5)	P	B	2:1	71.1	30.8	$24,248	56.1	$44,213	30.8	$24,248	56.1	$44,213
UT to French Broad River	SDF	6-(54.5)	P	B	2:1	106.8	61.9	$48,740	91.0	$71,731	61.9	$48,740	91.0	$71,732
UT to French Broad River	SDG	6-(54.5)	P	B	2:1	68.9	43.0	$33,905	68.9	$54,296	43.0	$33,904	68.9	$54,296
UT to French Broad River	SFX	6-(54.5)	I	B	2:1	84.0	47.3	$37,302	72.6	$57,185	47.3	$37,301	72.6	$57,184
UT to French Broad River	SDK	6-(54.5)	P	B	2:1	120.7	48.9	$38,520	75.1	$59,142	48.9	$38,519	75.1	$59,143

Table 6: Comparison of Stream Impacts for I-26 Widening

Stream	MAP ID	NCDWR Index Number	Perennial (P)/ Intermittent (I)	Best Usage Classification	Mitigation Ratio	Stream Impacts[1] (ft) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)				I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)			
							Stream Impacts[2] (ft) (2:1 SS)	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS+25')	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS)	Mitigation Cost	Stream Impacts[2] (ft) (2:1 SS+25')	Mitigation Cost
Powell Creek	SDN	6-62	P	B	2:1	145.6	53.0	$41,789	111.1	$87,517	53.0	$41,789	111.1	$87,516
STIP Project Number I-4700B														
UT to French Broad River (West)	SDU	6-(54.5)	P	B	1:1	30.0	—	$0	14.2	$5,577	—	$0	14.2	$5,577
UT to French Broad River (East)	SDU	6-(54.5)	P	B	2:1	113.6	34.4	$27,075	72.7	$57,292	34.4	$27,075	72.7	$57,288
UT to French Broad River	SDV	6-(54.5)	P	B	2:1	72.4	25.5	$20,082	55.3	$43,592	25.5	$20,082	55.3	$43,591
UT to French Broad River	SDW	6-(54.5)	P	B	2:1	78.0	25.3	$19,975	59.9	$47,213	25.3	$19,974	60.0	$47,292
UT to French Broad River	SDX	6-(54.5)	P/I	B	1:1	2,207.1	399.6	$157,444	1,043.2	$411,017	399.6	$157,443	1,043.2	$411,014
UT to French Broad River	SEU	6-(54.5)	P	B	2:1	18.3	10.6	$8,336	18.3	$14,442	10.6	$8,336	18.3	$14,442
UT to French Broad River	SEW	6-(54.5)	P	B	2:1	107.4	12.8	$10,109	37.9	$29,828	12.8	$10,109	37.9	$29,828
UT to French Broad River	SEV	6-(54.5)	P	B	2:1	58.8	16.8	$13,213	43.7	$34,458	16.8	$13,214	43.7	$34,459
UT to French Broad River	SDY	6-(54.5)	P	B	2:1	72.0	2.3	$1,815	22.5	$17,764	2.3	$1,815	22.5	$17,764
UT to French Broad River	SEQ	6-(54.5)	P	B	2:1	146.5	24.2	$19,070	74.5	$58,671	24.2	$19,070	74.5	$58,671
UT to French Broad River	SED	6-(54.5)	P	B	2:1	130.6	9.4	$7,425	66.7	$52,526	9.4	$7,425	66.7	$52,526
UT to French Broad River	SEF	6-(54.5)	P	B	2:1	520.3	368.1	$290,087	505.3	$398,189	368.1	$290,083	505.3	$398,189
UT to French Broad River (West - roadside)	SEE	6-(54.5)	P	B	0.5:1	18.8	18.8	$0	18.8	$3,706	18.8	$0	18.8	$3,706
UT to French Broad River (East)	SEE	6-(54.5)	P	B	1:1	407.0	—	$0	347.0	$136,736	—	$0	347.0	$136,734
UT to French Broad River (West)	SEE	6-(54.5)	P	B	2:1	0.9	—	$14,824	—	$0	—	$14,824	—	$0
French Broad River - BRIDGED		6-(54.5)	P	B	2:1	355.3	178.7	$140,813	279.2	$220,015	178.7	$140,813	279.2	$220,013
UT to Dellwood Lake	SFG	6-69	P	C	2:1	2,733.8	495.8	$390,719	2,010.0	$1,583,848	495.8	$390,715	2,010.0	$1,583,846
UT to French Broad River	SFO	6-(54.5)	I	B	2:1	161.6	13.3	$10,493	56.7	$44,691	13.3	$10,493	56.7	$44,691
UT to Dellwood Lake	SFI	6-69	I	C	1:1	83.3	—	$0	7.3	$2,884	—	$0	7.3	$2,884
UT to Dellwood Lake	SFR	6-69	P	C	2:1	54.2	27.8	$21,928	46.0	$36,286	27.8	$21,929	46.0	$36,286
UT to Dellwood Lake	SFQ	6-69	P/I	C	1:1	235.7	43.7	$17,233	96.8	$38,133	43.7	$17,233	96.8	$38,133
UT to Dellwood Lake	SFY	6-69	P	C	2:1	36.8	—	$0	—	$0	—	$0	—	$0
UT to Long Valley Branch	SFP	6-75	P	C	1:1	80.0	22.7	$8,934	50.0	$19,711	22.7	$8,934	50.0	$19,712
Long Valley Branch	SFN	6-75	P	C	1:1	43.8	24.9	$9,797	43.8	$17,247	24.9	$9,797	43.8	$17,247
UT to Long Valley Branch	SFM	6-75	I	C	1:1	414.3	29.1	$11,450	382.0	$150,512	29.0	$11,441	382.0	$150,511
					Total:	28,812	6,951	$4,308,627	19,415	$11,649,977	5,926	$3,565,326	18,541	$11,024,287

[1] Impacts calculated based on current design proposed 4:1 slope stake limits plus 40 feet (SS+40) to demonstrate a substantive avoidance and minimization measure implemented prior to the Draft EIS. This includes the ParClo B design at US 25 Interchange.
[2] Impacts calculated based on current design proposed 2:1 slope stake (SS) limits or current design proposed 2:1 slope stake limits plus 25 feet (SS+25).
[3] This stream is designated as a "cold water" stream for purposes of mitigation.
[4] No mitigation ratio has been provided or agreed to for this stream, therefore a 2:1 mitigation ratio was applied.

Table 7 compares the individual wetland impacts for the I-26 with ParClo B design at US 25 (Asheville Highway) and the I-26 with DDI design at US 25 (Asheville Highway), chosen for the Final EIS and ROD. The comparison is of the current design proposed slope stake (SS) limits and current design proposed slope stake limits plus an additional 25-foot buffer. The table also includes a column that tabulates current design with 4:1 slope stake limits plus 40 feet; however, the jurisdictional impacts reported at CP4A are based on current design with 2:1 slope stake limits.

Table 7: Comparison of Wetland Impacts for I-26 Widening

Wetland ID	NCWAM Classification	Hydrologic Classification	NCDWR Wetland Rating	Wetland Impacts[1] (ac) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)		I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)	
					Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')	Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')
STIP Project Number I-4400A								
WE	Headwater Forest	Riparian	29	0.02	<0.01	0.01	<0.01	0.01
WI	Headwater Forest	Riparian	33	0.02	—	0.01	—	0.01
WH	Headwater Forest	Riparian	27	0.07	—	0.02	—	0.02
WK	Bottomland Hardwood Forest	Riparian	79	0.38	—	0.02	—	0.02
WG	Non-tidal Freshwater Marsh	Riparian	34	0.09	0.01	0.06	0.01	0.06
WM	Headwater Forest	Non-Riparian	38	<0.01	—	<0.01	—	<0.01
WW	Headwater Forest	Riparian	34	0.07	—	0.07	0.05	0.07
WN	Headwater Forest	Riparian	30	<0.01	—	<0.01	—	<0.01
WP	Headwater Forest	Riparian	38	<0.01	—	—	—	—
WO	Headwater Forest	Riparian	34	0.04	0.01	0.04	0.01	0.04
WX	Bottomland Hardwood Forest	Riparian	16	0.01	—	<0.01	—	<0.01
WV	Bottomland Hardwood Forest	Riparian	16	0.01	—	<0.01	—	<0.01
WAA	Headwater Forest	Riparian	64	0.49	0.06	0.28	0.06	0.28
WAI	Headwater Forest	Riparian	32	0.05	<0.01	0.02	<0.01	0.02
STIP Project Number I-4400B								
WAJ	Headwater Forest	Riparian	32	0.12	—	—	—	—
WAG	Headwater Forest	Riparian	28	<0.01	—	—	—	—
WAH	Headwater Forest	Non-Riparian	47	0.01	<0.01	0.01	<0.01	0.01
WAM	Headwater Forest	Non-Riparian	47	0.01	—	0.01	—	0.01

Table 7: Comparison of Wetland Impacts for I-26 Widening

Wetland ID	NCWAM Classification	Hydrologic Classification	NCDWR Wetland Rating	Wetland Impacts[1] (ac) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)		I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)	
					Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')	Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')
WAP	Headwater Forest	Non-Riparian	47	0.02	0.01	0.02	0.01	0.02
WAT	Headwater Forest	Riparian	28	0.01	—	<0.01	—	<0.01
WAY	Headwater Forest	Non-Riparian	38	0.01	—	—	—	—
STIP Project Number I-4400C								
WBC	Headwater Forest	Riparian	38	0.22	0.13	0.16	—	—
WBG	Headwater Forest	Riparian	51	0.55	0.18	0.44	0.18	0.44
WBF	Headwater Forest	Riparian	32	<0.01	—	<0.01	—	<0.01
WBI	Headwater Forest	Riparian	44	0.27	—	0.03	—	0.03
WBK	Headwater Forest	Riparian	30	<0.01	—	—	—	—
WBT	Headwater Forest	Riparian	42	0.05	<0.01	0.01	<0.01	0.01
WBL	Headwater Forest	Riparian	32	0.04	—	<0.01	—	<0.01
WBN	Headwater Forest	Riparian	32	0.05	—	—	—	—
WBP	Bottomland Hardwood Forest	Riparian	40	0.39	0.01	0.17	0.01	0.17
WBQ	Bottomland Hardwood Forest	Riparian	40	0.15	—	—	—	—
STIP Project Number I-4700A								
WFD	Headwater Forest	Riparian	24	0.01	—	—	—	—
WBV	Bottomland Hardwood Forest	Riparian	69	2.14	0.33	1.16	0.33	1.16
WBR	Headwater Forest	Riparian	77	0.23	0.14	0.20	0.14	0.20
WBU	Headwater Forest	Riparian	77	0.08	0.05	0.07	0.05	0.07
WBW	Non-tidal Freshwater Marsh	Riparian	65	0.09	0.07	0.09	0.07	0.09
WCB	Bottomland Hardwood Forest	Riparian	24	<0.01	—	—	—	—
WCC	Bottomland Hardwood Forest	Riparian	48	0.22	—	0.04	—	0.04
WCE	Bottomland Hardwood Forest	Riparian	48	0.11	<0.01	0.05	<0.01	0.05

Table 7: Comparison of Wetland Impacts for I-26 Widening

Wetland ID	NCWAM Classification	Hydrologic Classification	NCDWR Wetland Rating	Wetland Impacts[1] (ac) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)		I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)	
					Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')	Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')
WCG	Bottomland Hardwood Forest	Riparian	78	0.46	—	—	—	—
STIP Project Number I-4700B								
WCH[3]	Bottomland Hardwood Forest	Riparian	78	3.36	0.04	0.39	0.04	0.39
WDV	Headwater Forest	Riparian	37	0.07	—	0.02	—	0.02
WCU	Headwater Forest	Riparian	43	<0.01	—	—	—	—
WCV	Headwater Forest	Riparian	43	0.01	—	<0.01	—	<0.01
WCT	Headwater Forest	Riparian	43	<0.01	—	—	—	—
WCS	Headwater Forest	Riparian	43	0.05	—	0.02	—	0.02
WCQ	Headwater Forest	Riparian	43	<0.01	—	<0.01	—	<0.01
WCW	Bottomland Hardwood Forest	Riparian	69	2.78	0.41	1.14	0.41	1.14
WDR	Headwater Forest	Riparian	30	<0.01	—	—	—	—
WCZ	Headwater Forest	Riparian	43	0.02	0.02	0.02	0.02	0.02
WDA	Bottomland Hardwood Forest	Riparian	69	1.16	—	0.05	—	0.05
WFG	Headwater Forest	Riparian	21	0.01	0.01	0.01	0.01	0.01
WEA	Headwater Forest	Riparian	51	0.01	—	—	—	—
WEL	Headwater Forest	Riparian	48	0.12	<0.01	0.04	<0.01	0.04
WDZ	Bottomland Hardwood Forest	Riparian	38	0.09	0.05	0.07	0.05	0.07
WDY	Bottomland Hardwood Forest	Riparian	38	<0.01	—	—	—	—
WEG	Bottomland Hardwood Forest	Riparian	31	0.11	—	<0.01	—	<0.01
WET	Headwater Forest	Riparian	52	0.08	<0.01	0.06	<0.01	0.06
WEU	Headwater Forest	Riparian	52	<0.01	—	—	—	—
WEV	Headwater Forest	Riparian	52	0.01	—	—	—	—
WEW	Headwater Forest	Riparian	52	0.11	—	—	—	—

Table 7: Comparison of Wetland Impacts for I-26 Widening

Wetland ID	NCWAM Classification	Hydrologic Classification	NCDWR Wetland Rating	Wetland Impacts[1] (ac) (4:1 SS+40')	I-26 Widening Draft EIS Impacts Including ParCloB Design at US 25 (Asheville Highway)			I-26 Widening Updated Impacts Including DDI Design at US 25 (Asheville Highway)	
					Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')		Wetland Impacts[2] (ac) (2:1 SS)	Wetland Impacts[2] (ac) (2:1 SS+25')
WER	Headwater Forest	Riparian	38	0.01	—	—		—	—
WEE	Non-tidal Freshwater Marsh	Riparian	47	0.30	—	0.01		—	0.01
WZZ	Headwater Forest	Riparian	N/A	0.01	0.01	0.01		0.01	0.01
			Total Riparian:	14.75	1.52	4.78		1.44	4.62
			Total Non-Riparian:	0.05	0.01	0.04		0.01	0.04
			Total Impacts:	14.80	1.58	4.82		1.45	4.66
			Riparian Mitigation	—	$108,961	$343,063		$107,658	$331,518
			Non-Riparian Mitigation	—	$12,946	$12,946		$12,946	$12,946
			Total Mitigation	—	$121,907	$356,009		$120,604	$344,464

[1] Impacts calculated based on current design with 4:1 slope stake limits plus 40 feet (SS+40) to demonstrate a substantive avoidance and minimization measure implemented prior to the Draft EIS. This includes the ParClo B design at US 25 Interchange.

[2] Impacts calculated based on current design proposed 2:1 slope stake (SS) limits or current design proposed 2:1 slope stake limits plus 25 feet (SS+25').

[3] WCH is also identified by USFWS and NCWRC as the Biltmore Bog, with habitat for the Bog Turtle (T(S/A)).

When using 4:1 slope stake limits plus a 40-foot buffer, two additional ponds are impacted. The amount of pond impacts increased by 0.02 acre to 0.07 acre, when using 4:1 slope stake limits plus a 40-foot buffer.

Summary of Impact Avoidance and Minimization

Table 8 shows a comparison of impacts determined in the Draft EIS and the minimization or avoidance of those impacts at the present time. As the designs are refined, it is expected that stream and wetland resource impacts, for example, will also be reduced.

Table 8: Comparison Summary of Impacts for the Preferred Alternative from the Draft EIS to Present

IMPACT CATEGORY[1]	Hybrid 6/8-Lane Widening in Draft EIS	Preferred Alternative Refined
Human Environment		
Residential Relocations (Minorities)	18 (6)	8 (2)
Business Relocations	1	0
Grave Site Relocations	0	0
Disrupts Neighborhood & Community Cohesion	No	No
Recurring Community / Neighborhood Impacts	Yes; minor relocation impacts to Brickton community.[1]	No
Low Income / Minority Populations	Yes; not disproportionately high and adverse.	Yes; not disproportionately high and adverse.
Cultural Resources (Adverse Effect determined)	Yes; Blue Ridge Parkway and Cureton House	Yes; Blue Ridge Parkway
Section 4(f)	Yes; Blue Ridge Parkway	Yes; Blue Ridge Parkway
Section 4(f) *de minimis*	Yes; Biltmore Estate, Hyder Dairy Farm, Camp Orr (Camp Pinewood), and Mountains to Sea Trail[2]	Yes; Biltmore Estate, Hyder Dairy Farm, Camp Orr (Camp Pinewood), French Broad River Paddle Trail, and Mountains to Sea Trail
Visual Resources / Characteristics	No	No
Traffic Noise Impacts (# of receptors)	315[3]	399
Air Quality	No	No
Farmland (acres)	11	28[4]
Hazardous Materials	Minimal monetary and scheduling impacts.	Minimal monetary and scheduling impacts.
Natural Resources		
Federal Listed Species Habitat	May affect but not likely to adversely affect the Northern long-eared bat (NLEB)[5, 6]. No effect on other species	May Affect, Likely to Adversely Affect the gray bat and Appalachian elktoe. Northern long-eared bat (NLEB)[5, 6]. No

Table 8: Comparison Summary of Impacts for the Preferred Alternative from the Draft EIS to Present

IMPACT CATEGORY[1]	Hybrid 6/8-Lane Widening in Draft EIS	Preferred Alternative Refined
	in Henderson/Buncombe Counties.[7]	effect on other species in Henderson/Buncombe Counties.[7]
Jurisdictional Streams (linear feet)[8]	19,415	18,541
Jurisdictional Wetlands (acres)[8]	4.82	4.66
100-year Floodplain (acres)[8]	41.8	30.4
500-year Floodplain (acres)[8]	17.3	17.6
Ponds (acres)[8]	0.05	0.05
Indirect and Cumulative Effects	Based on this assessment of the currently identified project alternatives, STIP Project I-4400/I-4700 is not expected to have a notable indirect effect on land use in the FLUSA. Potential land use effects as a result of STIP Project I-4400/I-4700 are somewhat tempered by the fact that the project is not expected to provide any new access or opportunities for traffic exposure to properties in the FLUSA, and will generate marginal travel time savings. Some amount of regional cumulative impacts can be expected for notable cultural, community, water quality, and natural habitat features. This is due to features having minimal incorporation in local planning protections and/or policies. The Cumulative Effects Tool indicated that cumulative effects were rated as a medium level of concern as a result of the reasonably-foreseeable transportation projects in the region.	STIP Project I-4400/I-4700 is not expected to have a notable indirect effect on land use in the FLUSA. Potential land use effects because of STIP Project I-4400/I-4700 are somewhat tempered by the fact that the project is not expected to provide any new access or opportunities for traffic exposure and will generate marginal travel time savings. Some amount of regional cumulative impacts can be expected for notable cultural, community, water quality, and natural habitat features. This is due to features having minimal incorporation in local planning protections and/or policies. The Cumulative Effects Tool indicated that cumulative effects were rated as a medium level of concern as a result of the reasonably-foreseeable transportation projects in the region.

[1] Following the Draft EIS, NCDOT determined the Brickton community will not be affected. This will be fully documented in the Final EIS/ROD.
[2] Following the Draft EIS, NCDOT was informed that the French Broad River Paddle Trail is a Section 4(f) resource.
[3] Following the Draft EIS, NCDOT adopted the 2016 Noise Policy and Guidance. An Updated Traffic Noise Report (HNTB, 2017) followed this guidance, and determined that there are 399 impacted noise receptors.
[4] NRCS commented on the Draft EIS with request that farmland impacts be recalculated. Impacts were reassessed using the current preferred alternative design proposed slope stake limits plus 40 feet. Correspondence with NRCS will be included in the Final EIS/ROD.
[5] May affect, not likely to adversely affect; however, NCDOT has determined that the proposed action does not require separate Section 7 consultation because the proposed action is consistent with the final Section 4(d) rule.
[6] NCDOT will follow NPS mitigation protocol for the NLEB as detailed in the Special Commitments (Green Sheets) and Section 3.8.6.2.2 of the Draft

Table 8: Comparison Summary of Impacts for the Preferred Alternative from the Draft EIS to Present

IMPACT CATEGORY[1]	Hybrid 6/8-Lane Widening in Draft EIS	Preferred Alternative Refined

EIS and the Indiana bat, which will be included in the Final EIS/ROD. Correspondence with NPS is in the project file and will be included in the Final EIS/ROD.

[7] Following the publishing of the Draft EIS, a gray bat roost was found near the project by USFWS and NC WRC and NPS recorded potential Indiana bat calls near the Blue Ridge Parkway. NCDOT is preparing a Biological Assessment (BA) for the threatened and endangered species in the project area. This is documented in the project file and will be included in the Correspondence and Response to Comments in the appendices to the Final EIS/ROD.

[8] Impacts based on current design proposed slope stake limits plus 25 feet.

October 11, 2017

Merger Project Team Meeting Agreement
Concurrence Point No. 4A – Avoidance and Minimization

Project Name/Description:	I-26 Widening, US 25 in Henderson County to I-40/I-240 in Buncombe County
STIP Project No.:	I-4400/I-4700
WBS No.:	34232.1.1/36030.1.1
Federal Aid Project No.:	NHF-26-1(62)23/IMNHF-026-1(86)9

The Merger Team met on October 11, 2017 and concurs with the following avoidance and minimization measures for STIP Project No. I-4400/I-4700:

Section 404 Avoidance and Minimization Measures

- NCDOT reduced the slopes from 4:1 to 2:1. In so doing, NCDOT:
    - Minimized impacts to streams by approximately 10,000 feet,
    - Avoided impacts to 19 wetlands (approximately 1.2 acres),
    - Minimized impacts to wetlands by approximately 9.6 acres including approximately 2.6 acres to wetland WCH (Biltmore Bog), and
    - Avoided impacts to two ponds (>0.1 acre).
- NCDOT selected the DDI design at US 25 (Asheville Highway) instead of the ParClo B design. In so doing, NCDOT:
    - Minimized approximately 890 feet of stream impacts, and
    - Minimized approximately 0.2 acre of wetland impacts.

(*Note: Reductions to impacts are the difference between current design with 4:1 slope stake limits plus 40 feet and current design with 2:1 slope stake limits plus 25 feet. Slope stake limits plus 25 feet are used at CP4A.*)

Human Environment Avoidance and Minimization Measures

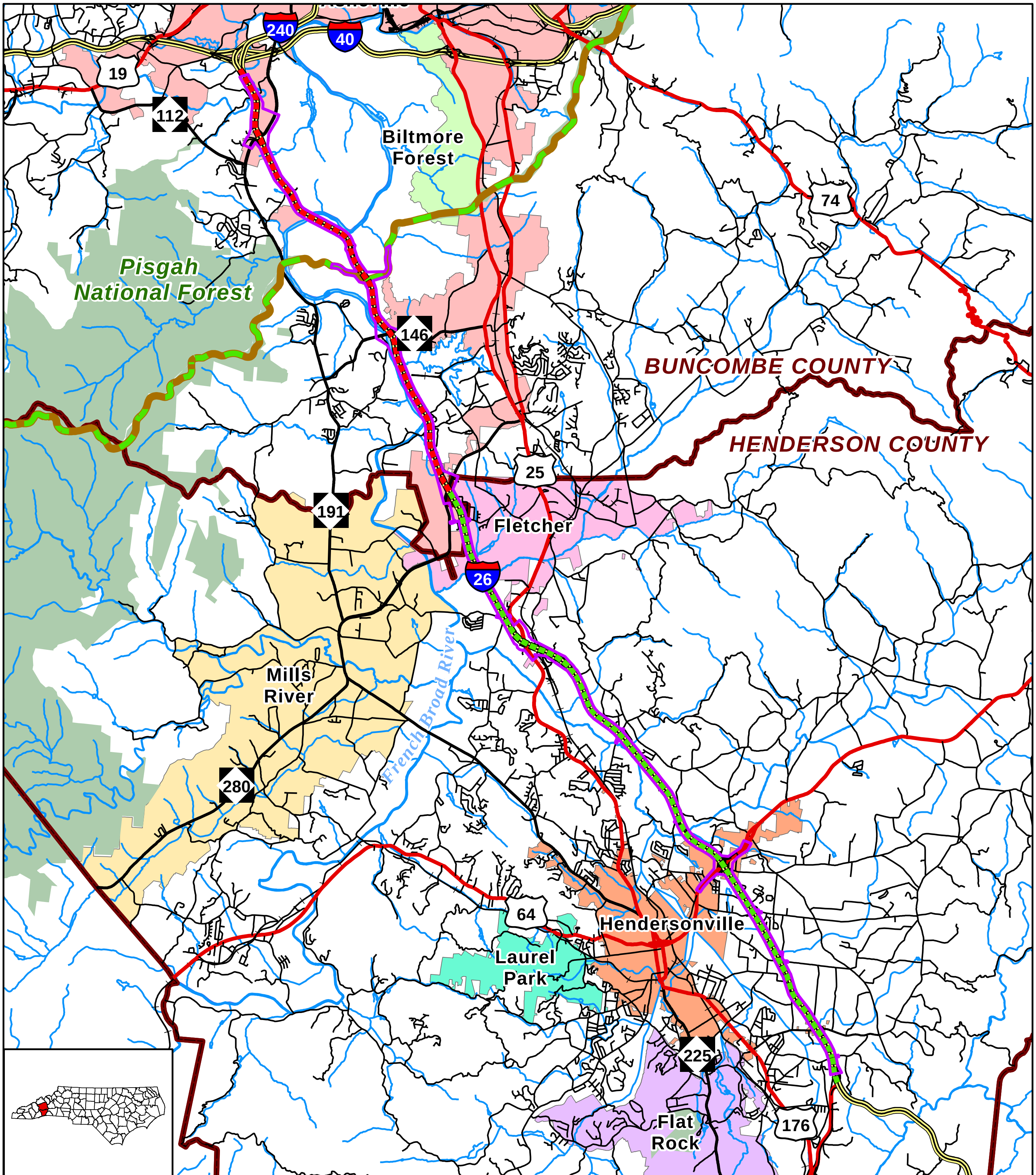
- NCDOT minimized the number of Residential Relocations from 18 (ParClo B) to 8 (DDI) and Business Relocations from 1 (ParClo B) to 0 (DDI).
- NCDOT minimized the design footprint at the US 25 (Asheville Highway) interchange was determined to have "no effect" to the Cureton House property under Section 106 of the National Historic Preservation Act.

Additional Avoidance and Minimization Measures:

NCDOT will continue to coordinate with the Section 404/NEPA Merger Team to identify avoidance and minimization measures to all waters of the U.S. and ensure that major hydraulic structures associated with the project are designed and installed to minimize negative impacts to stream stability (and therefore, water quality) to the extent practicable at Concurrence Point 4B – 30 Percent Hydraulic Review and Concurrence Point 4C – Permit Drawing Review.

October 11, 2017

Federal Highway Administration	______________________________
U.S. Army Corps of Engineers	______________________________
U.S. Environmental Protection Agency	______________________________
U.S. Fish and Wildlife Service	______________________________
N.C. Wildlife Resources Commission	______________________________
N.C. Division of Water Resources	______________________________
State Historic Preservation Office	______________________________
French Broad River MPO	______________________________
N.C. Department of Transportation	______________________________



Legend

- Study Area
- STIP I-4400
- STIP I-4700
- Interstate
- US Route
- NC Route
- Secondary Road
- Blue Ridge Parkway
- Railroad
- Stream
- Water Body
- County Boundary

Figure 1 - Study Area
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 1.25 2.5 5 Miles

1 inch = 2.5 miles

N

Sources: NCDOT, NCOneMap, HNTB

Date: 2017

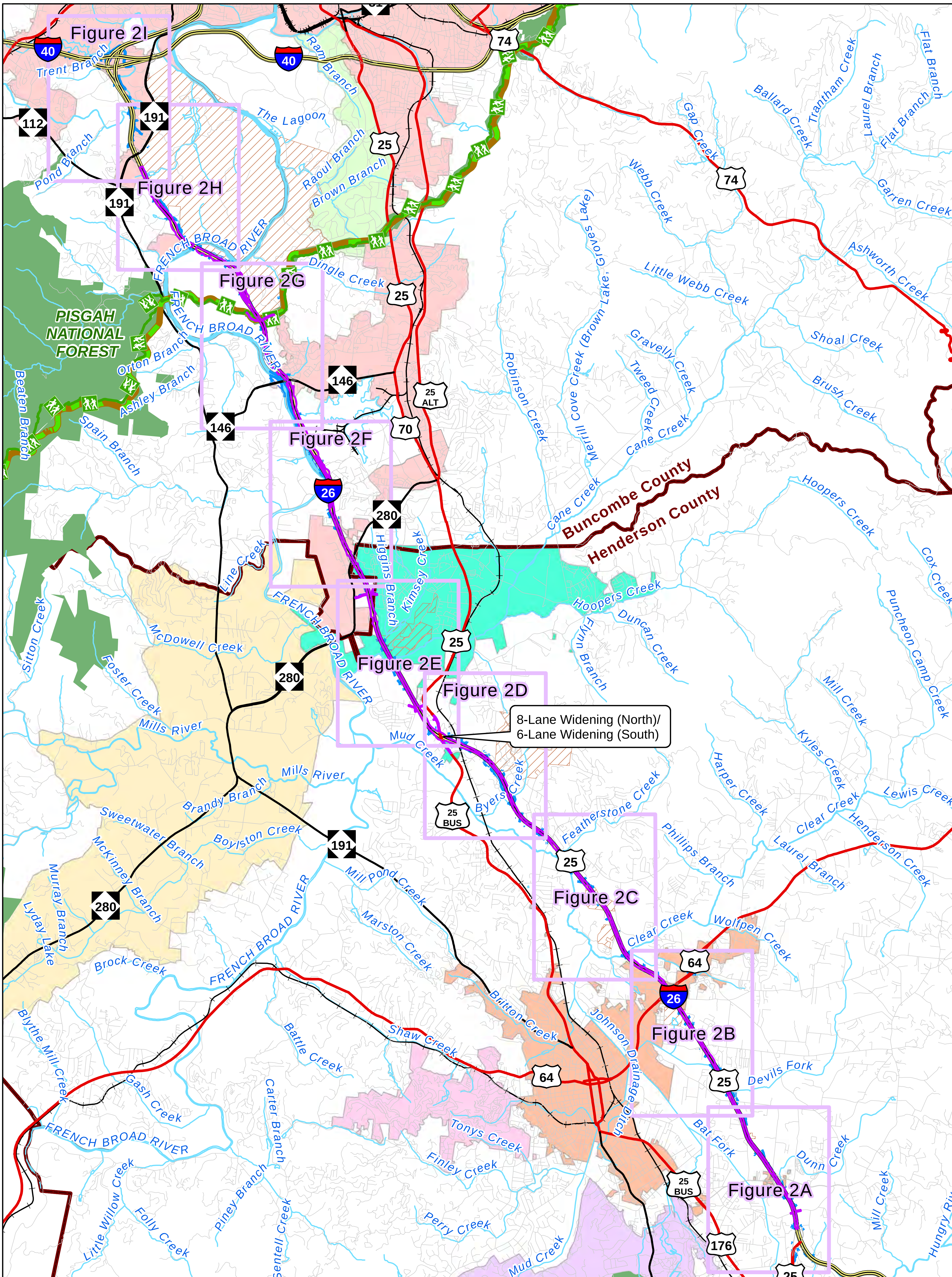


Figure 2 - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

Legend

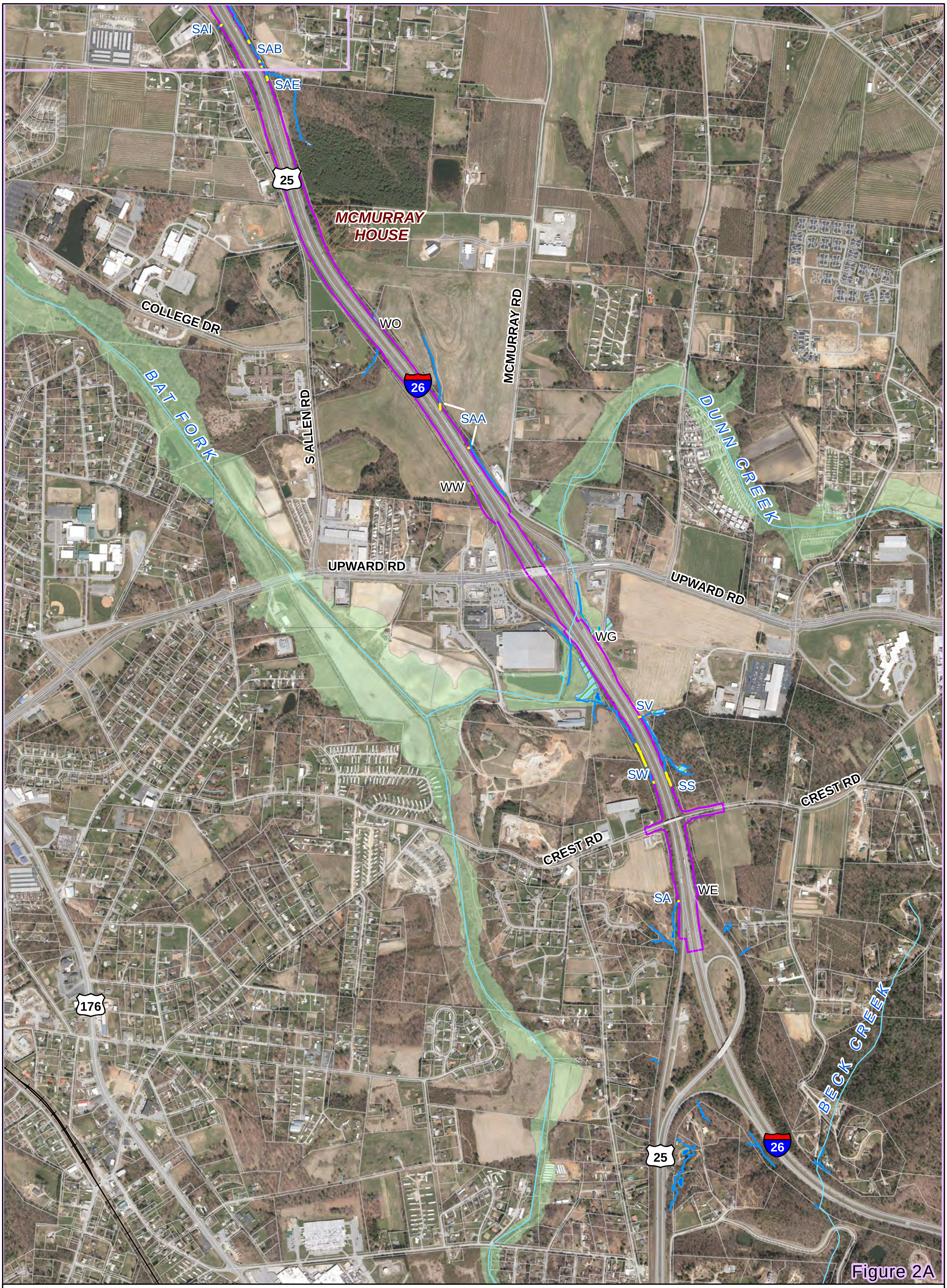
- Functional Slope Stake
- Interstate
- US Highway
- NC Highway
- Road
- Blue Ridge Parkway
- Mountains-to-Sea Trail
- Railroad
- Delineated Stream
- Stream
- Delineated Wetland
- Delineated Pond
- Water Body
- National Register of Historic Places Property
- Pisgah National Forest
- County Boundary
- Asheville
- Biltmore Forest
- Flat Rock
- Fletcher
- Hendersonville
- Laurel Park
- Mills River
- Saluda

0 0.75 1.5 3 Miles

1 in = 1.5 miles

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

- Functional Slope Stake
- SS Stream Impact
- SS Wetland Impact
- Blue Ridge Parkway
- National Register of Historic Places Property
- Delineated Stream
- Delineated Wetland
- Delineated Pond
- Road
- Railroad
- Stream
- Water Bodies
- FEMA Flood Zone
  - Zone A, 100-year Floodplain
  - Zone AE, 100-year Floodplain
  - 500-year Floodplain

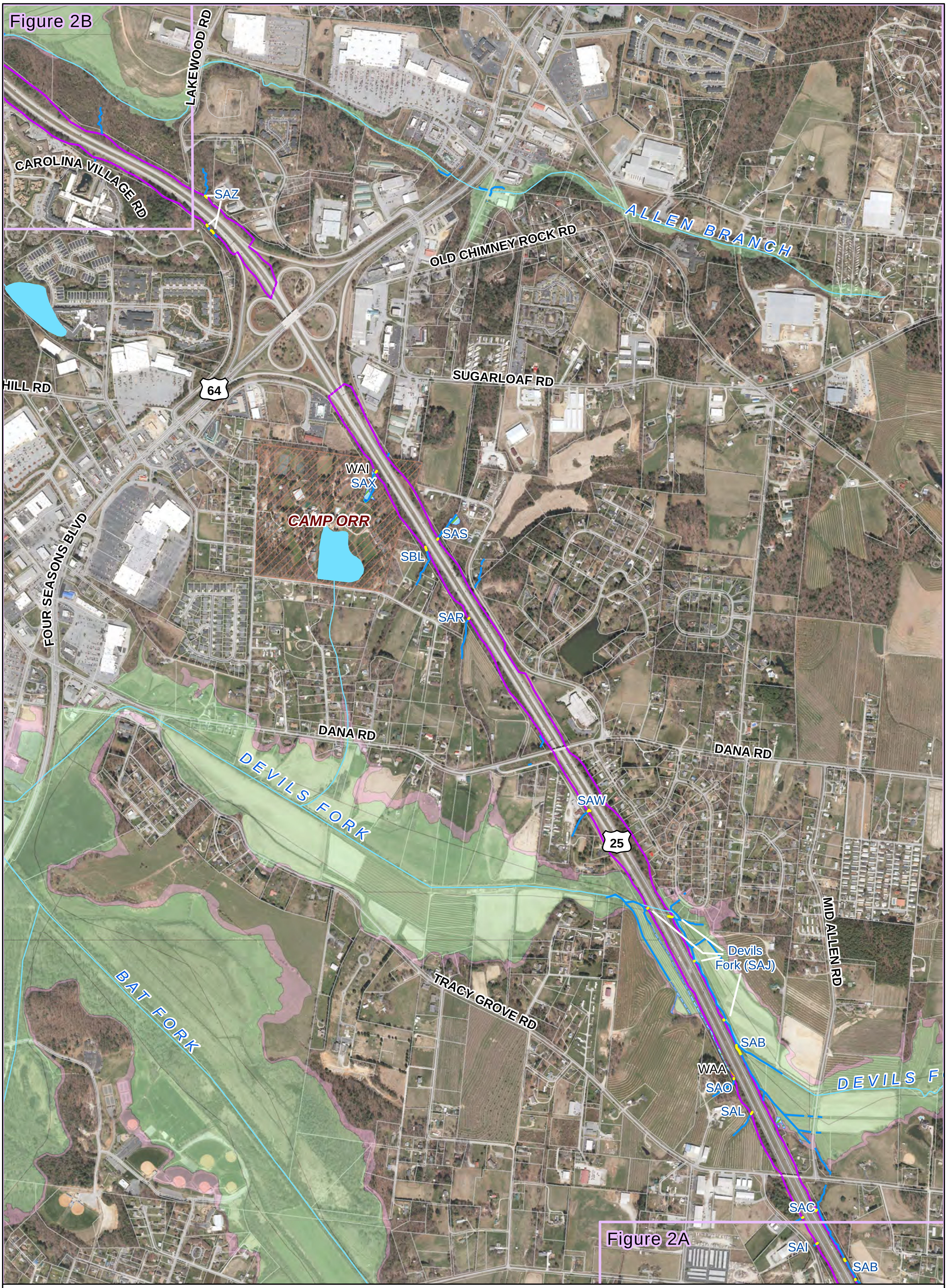
Figure 2A - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

Functional Slope Stake	Delineated Stream	Stream
SS Stream Impact	Delineated Wetland	Water Bodies
SS Wetland Impact	Delineated Pond	FEMA Flood Zone
Blue Ridge Parkway	Road	Zone A, 100-year Floodplain
National Register of Historic Places Property	Railroad	Zone AE, 100-year Floodplain
		500-year Floodplain

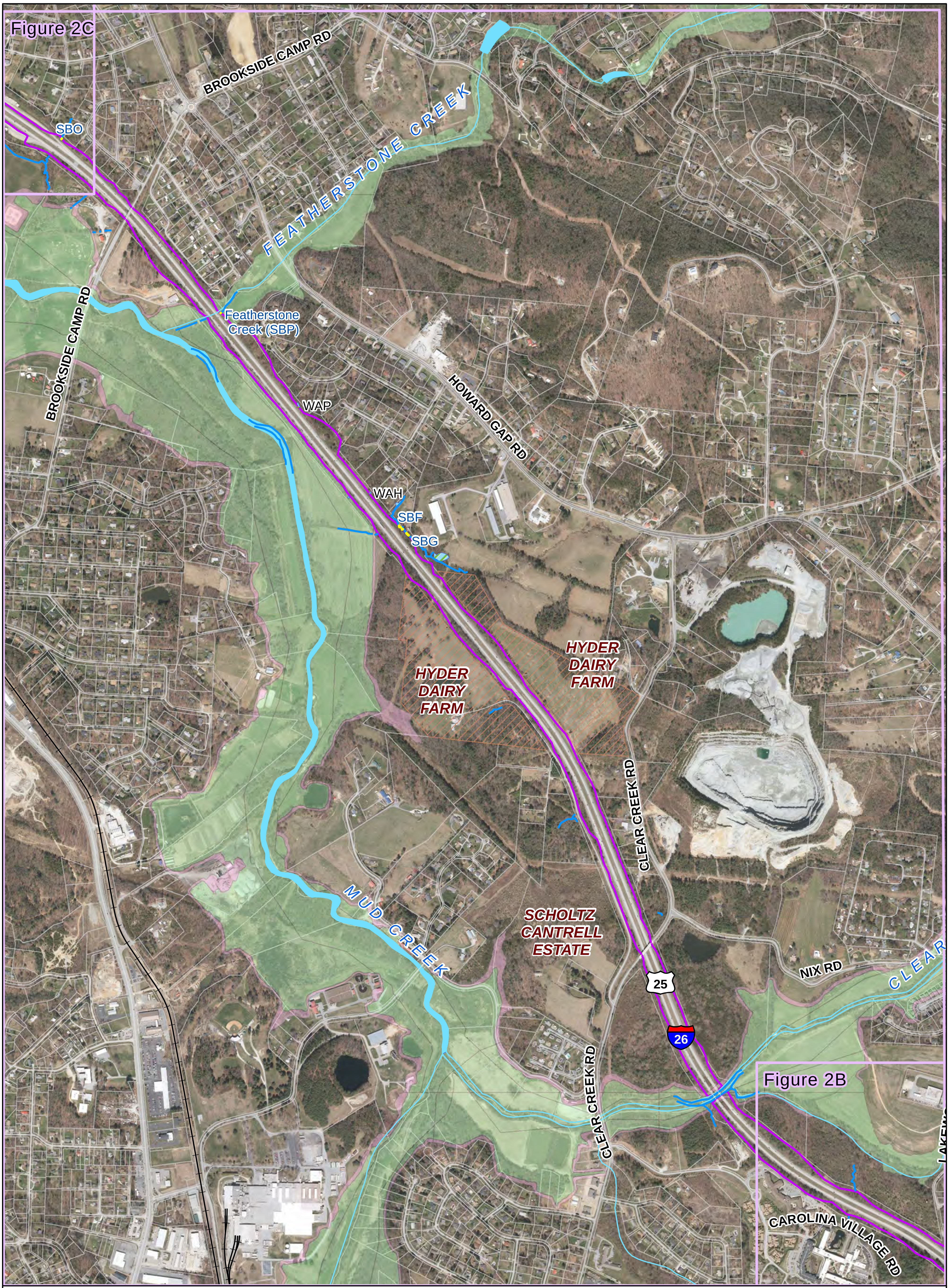
Figure 2B - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

- Functional Slope Stake
- SS Stream Impact
- SS Wetland Impact
- Blue Ridge Parkway
- National Register of Historic Places Property
- Delineated Stream
- Delineated Wetland
- Delineated Pond
- Road
- Railroad
- Stream
- Water Bodies
- FEMA Flood Zone
  - Zone A, 100-year Floodplain
  - Zone AE, 100-year Floodplain
  - 500-year Floodplain

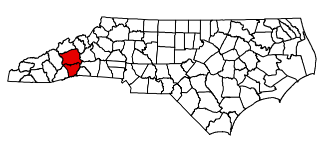


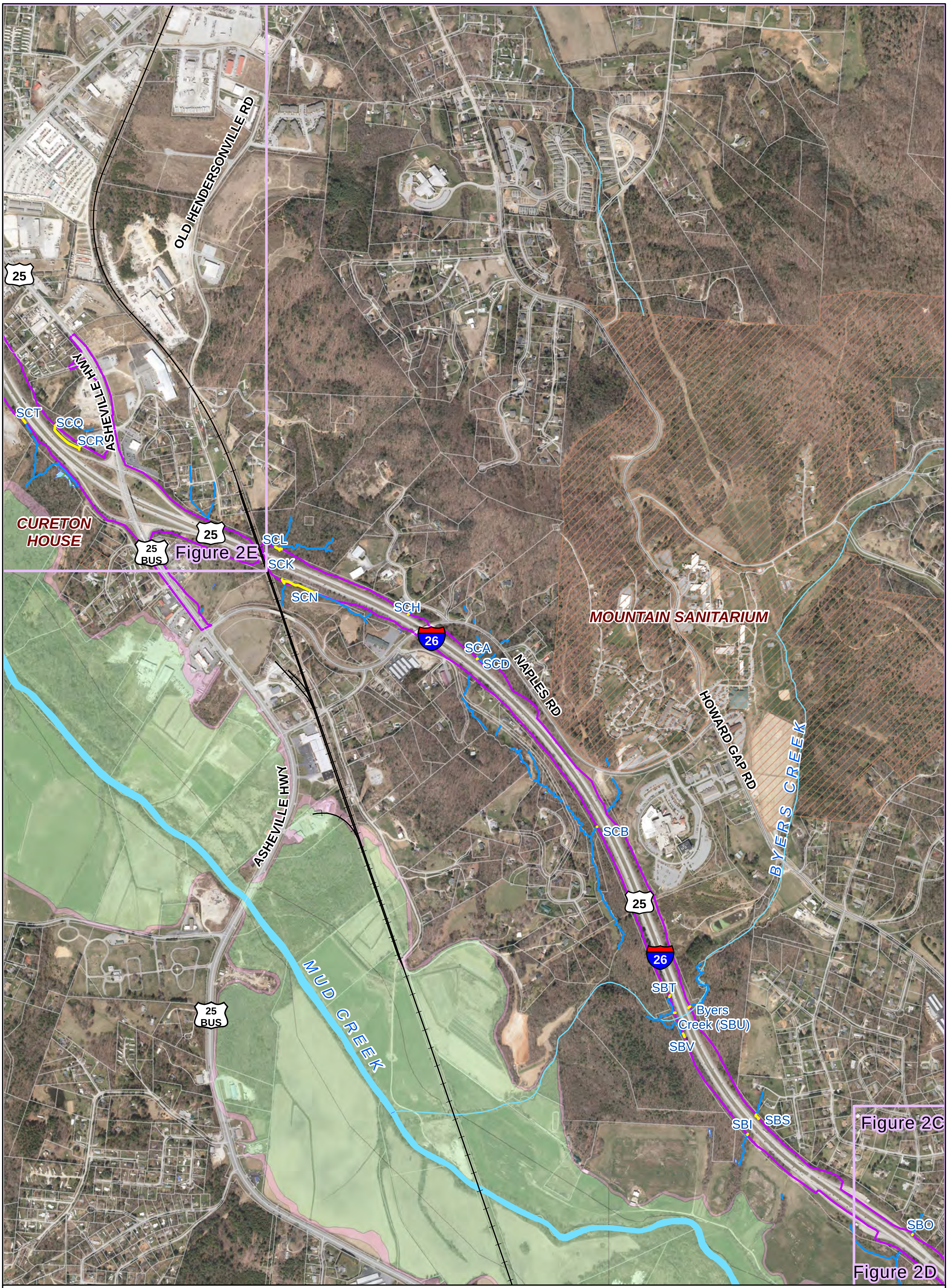
Figure 2C - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,010 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

- Functional Slope Stake
- SS Stream Impact
- SS Wetland Impact
- Blue Ridge Parkway
- National Register of Historic Places Property
- Delineated Stream
- Delineated Wetland
- Delineated Pond
- Road
- Railroad
- Stream
- Water Bodies
- FEMA Flood Zone
  - Zone A, 100-year Floodplain
  - Zone AE, 100-year Floodplain
  - 500-year Floodplain

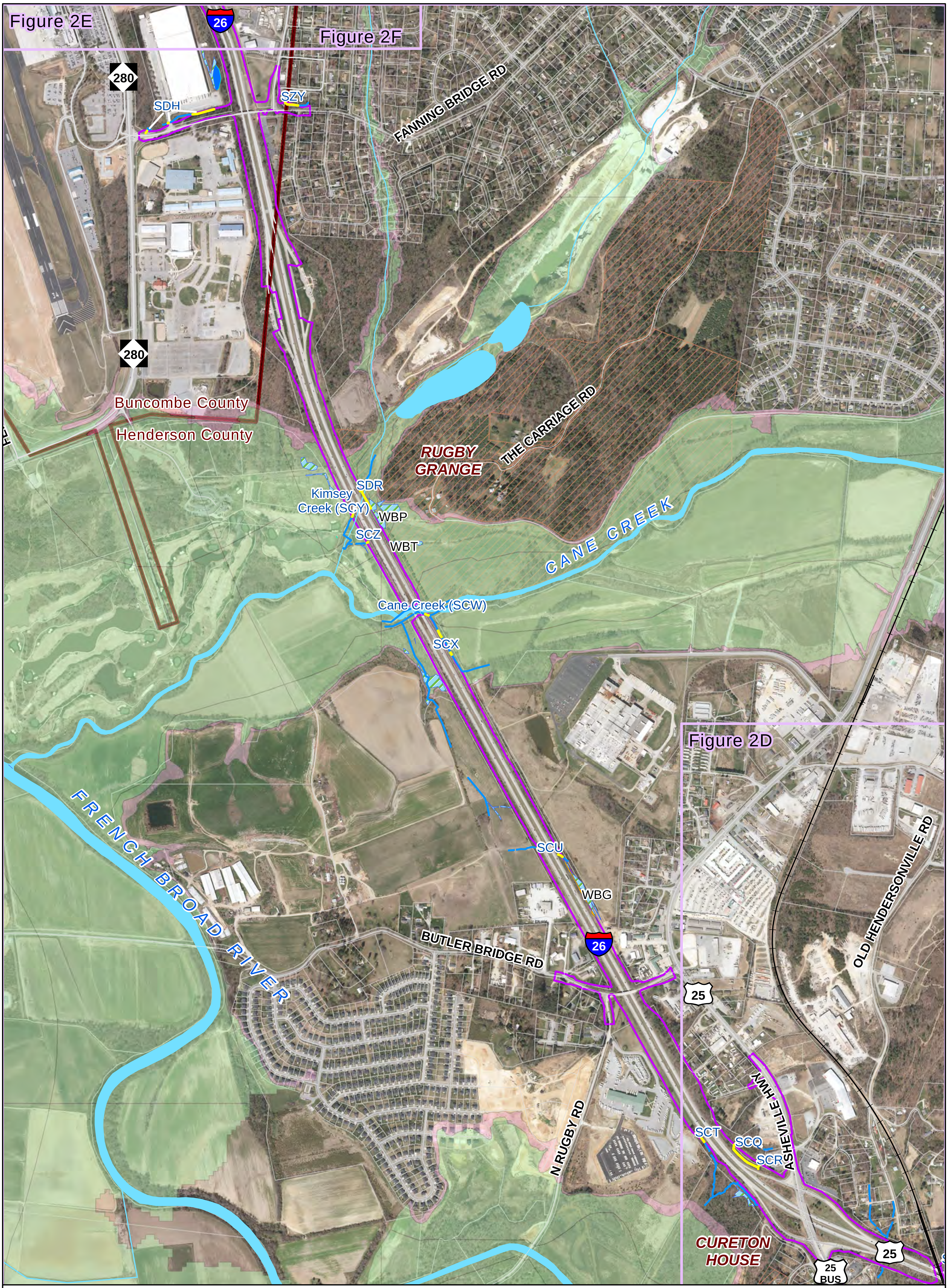
0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Figure 2D - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



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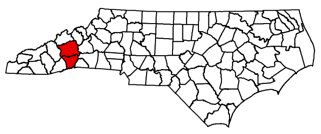


Functional Slope Stake	Delineated Stream	Stream
SS Stream Impact	Delineated Wetland	Water Bodies
SS Wetland Impact	Delineated Pond	FEMA Flood Zone
Blue Ridge Parkway	Road	Zone A, 100-year Floodplain
National Register of Historic Places Property	Railroad	Zone AE, 100-year Floodplain
		500-year Floodplain

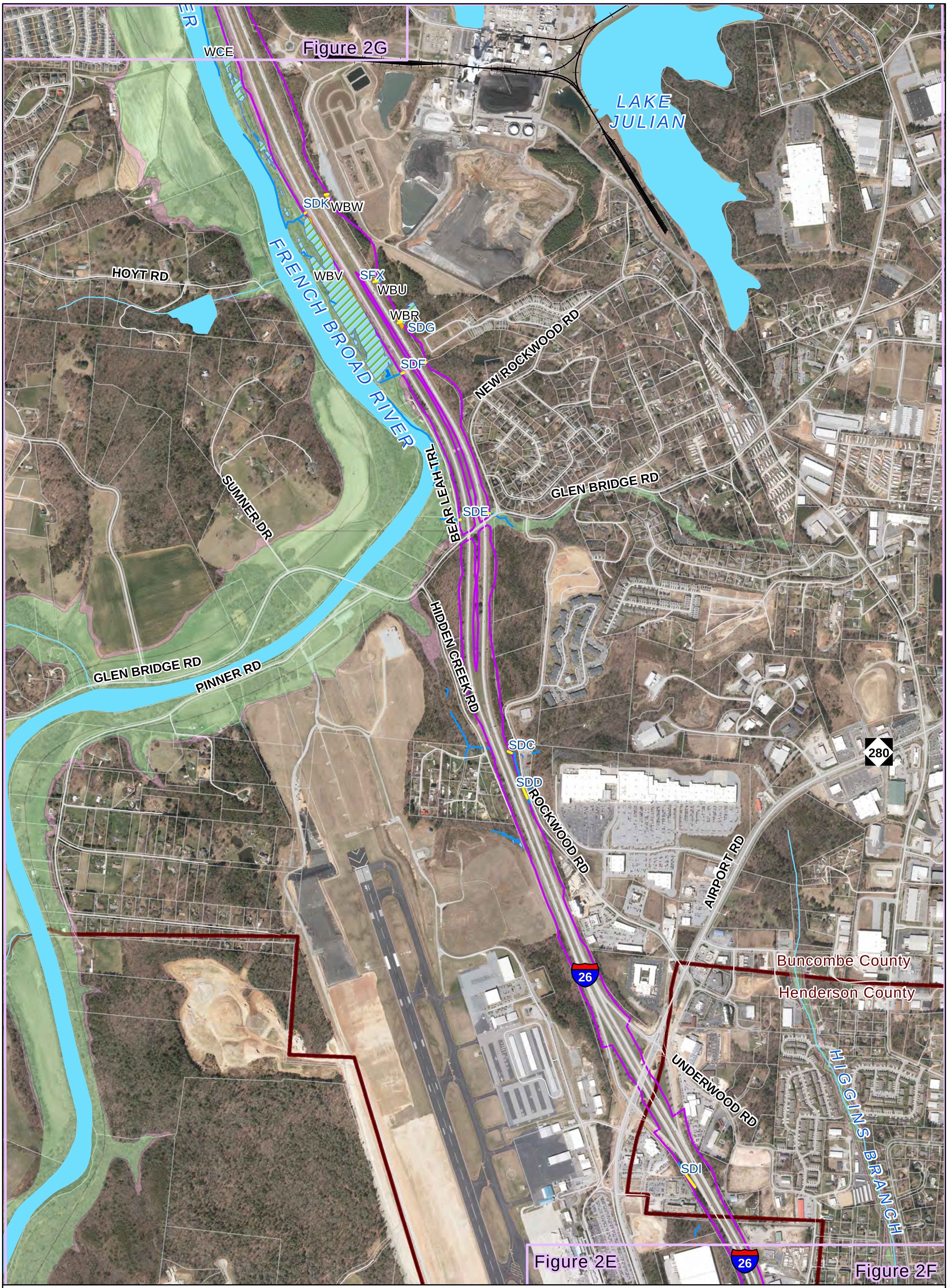
Figure 2E - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

- Functional Slope Stake
- SS Stream Impact
- SS Wetland Impact
- Blue Ridge Parkway
- National Register of Historic Places Property
- Delineated Stream
- Delineated Wetland
- Delineated Pond
- Road
- Railroad
- Stream
- Water Bodies
- FEMA Flood Zone
  - Zone A, 100-year Floodplain
  - Zone AE, 100-year Floodplain
  - 500-year Floodplain

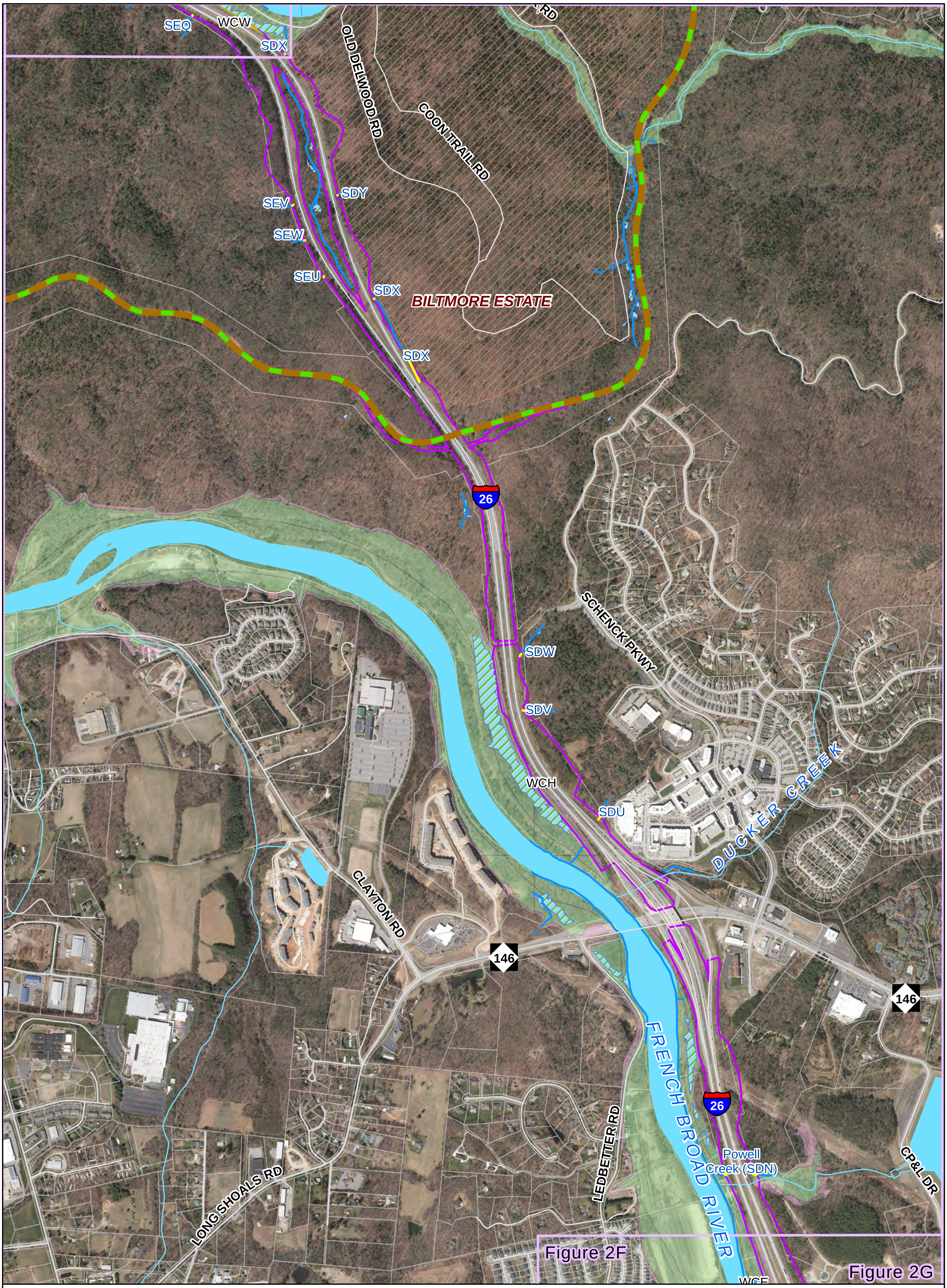
Figure 2F - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

- Functional Slope Stake
- SS Stream Impact
- SS Wetland Impact
- Blue Ridge Parkway
- National Register of Historic Places Property
- Delineated Stream
- Delineated Wetland
- Delineated Pond
- Road
- Railroad
- Stream
- Water Bodies
- FEMA Flood Zone
  - Zone A, 100-year Floodplain
  - Zone AE, 100-year Floodplain
  - 500-year Floodplain

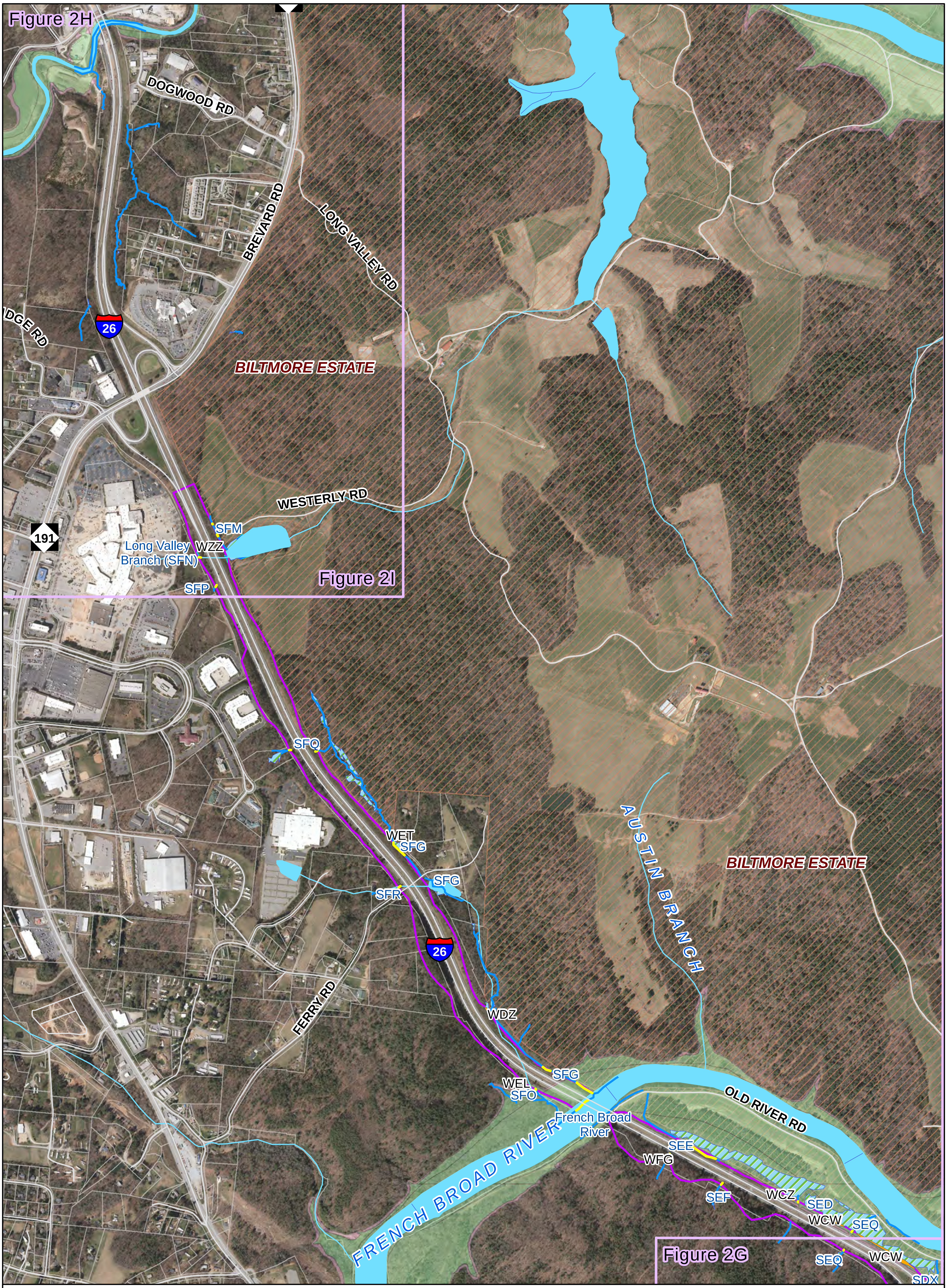
Figure 2G - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

Functional Slope Stake	Delineated Stream	Stream
SS Stream Impact	Delineated Wetland	Water Bodies
SS Wetland Impact	Delineated Pond	FEMA Flood Zone
Blue Ridge Parkway	Road	Zone A, 100-year Floodplain
National Register of Historic Places Property	Railroad	Zone AE, 100-year Floodplain
		500-year Floodplain

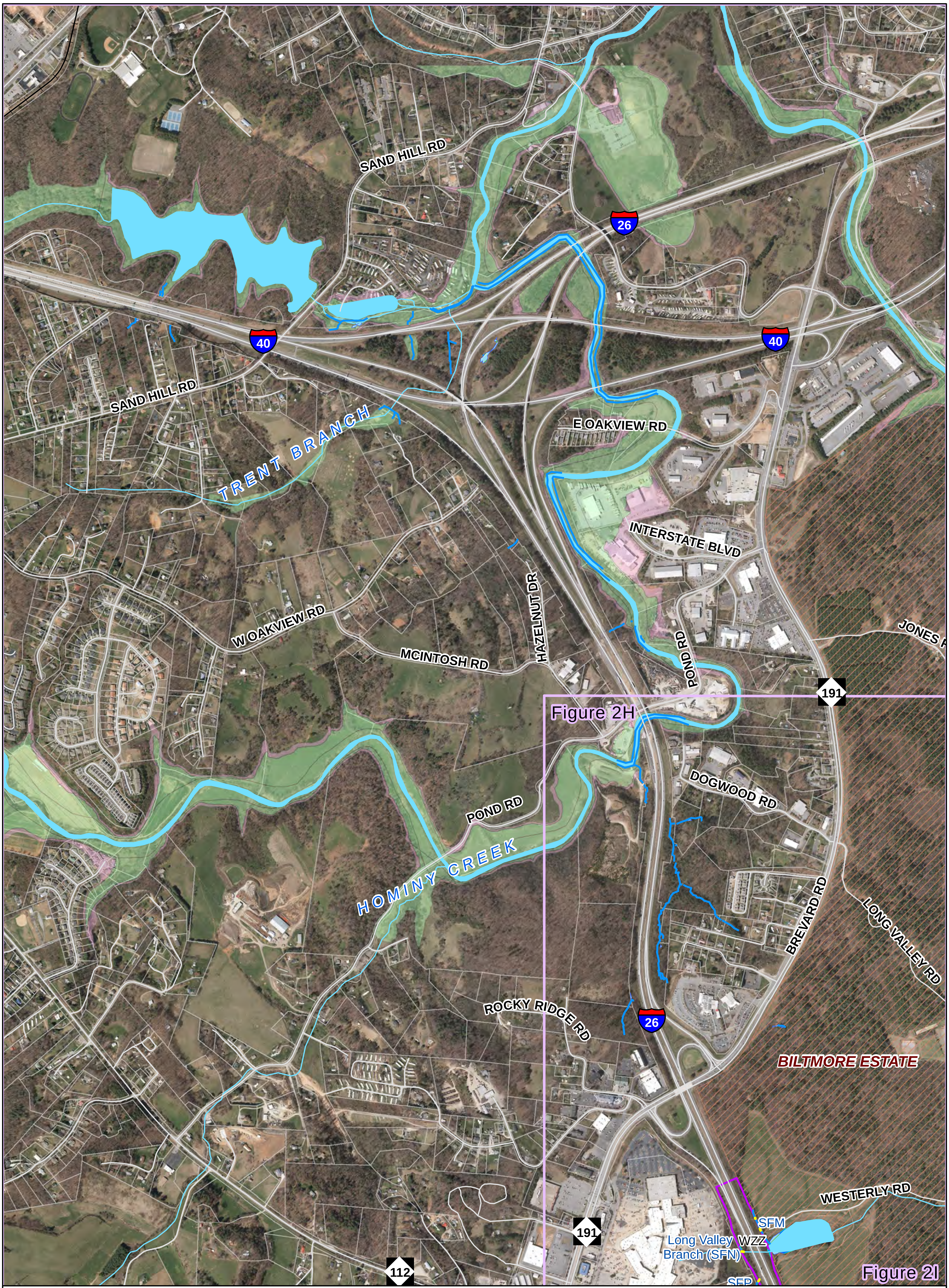
Figure 2H - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017



Legend

- Functional Slope Stake
- SS Stream Impact
- SS Wetland Impact
- Blue Ridge Parkway
- National Register of Historic Places Property
- Delineated Stream
- Delineated Wetland
- Delineated Pond
- Road
- Railroad
- Stream
- Water Bodies
- FEMA Flood Zone
  - Zone A, 100-year Floodplain
  - Zone AE, 100-year Floodplain
  - 500-year Floodplain

Figure 2I - Stream and Wetland Resources
STIP Project No. I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

N

Sources: Buncombe and Henderson Counties, NCDOT, NCOneMap, HNTB Date: 2017

Appendix G: 2016-2017 NCWRC Gray Bat Telemetry Summary

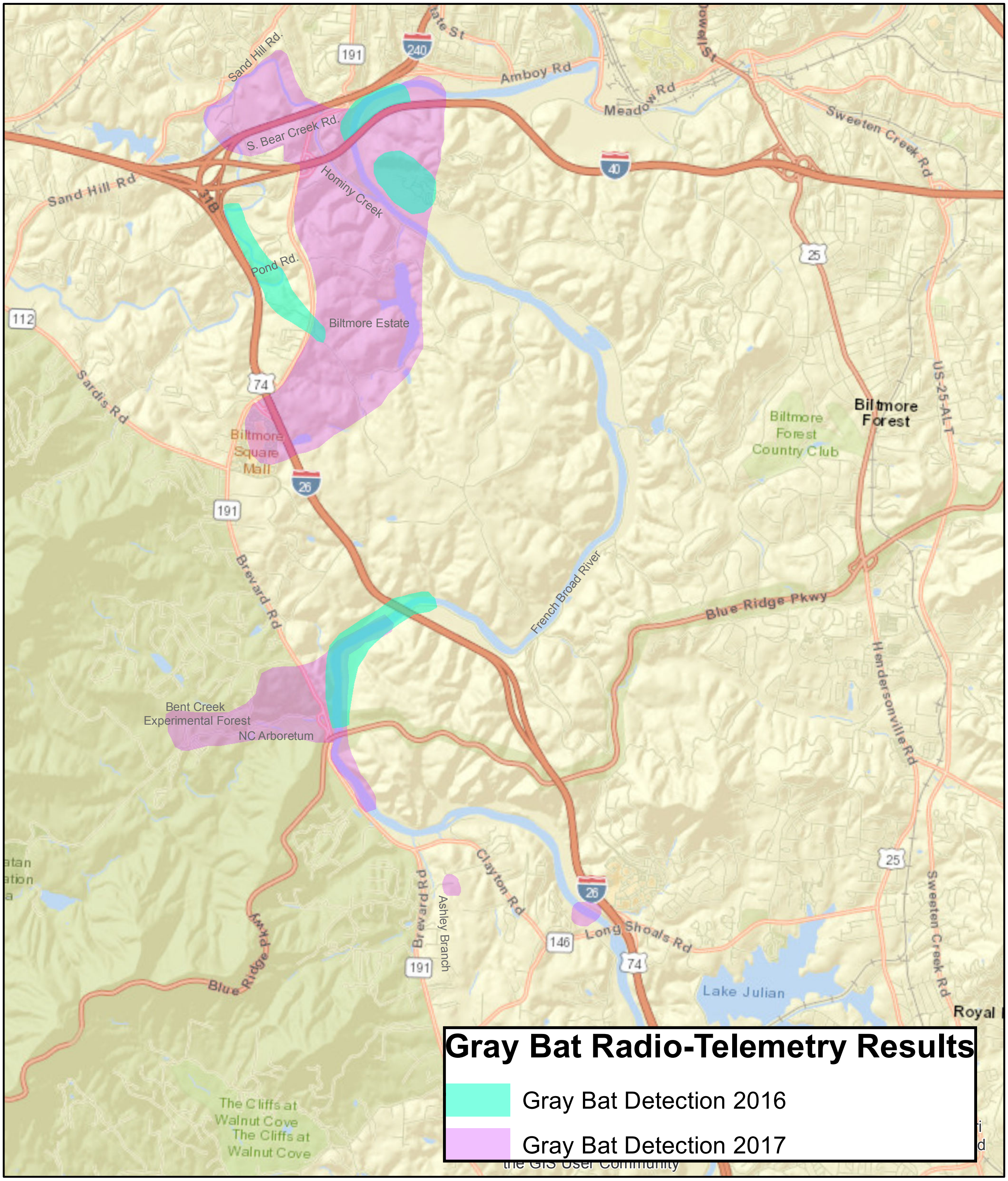
2016-2017 NCWRC Gray Bat Telemetry Summary

2016 Gray Bat Telemetry Summary

Two gray bats were captured and outfitted with radio-transmitters by NCWRC personnel in Buncombe County, NC on August 30, 2016. The bats were tracked for 12 days until the transmitters became inactive (Aug 30 - Sept 12). The bats returned to the primary roost every day and routinely foraged in their respective areas during the seven nights of radio-tracking. Bat A foraged on Hominy Creek in the area where Pond Rd. crosses Hominy Creek and Bat B foraged on the French Broad River just North of the I-40 crossing of the river (Fig 1). During two nights of tracking, Bat B left its typical area and was not detected again that night.

2017 Gray Bat Telemetry Summary

Three gray bats were captured and outfitted with radio-transmitters by NCWRC personnel in Buncombe County, NC on August 9, 2017. The bats were tracked until their signals were no longer detected or until the transmitter fell off (Aug 9 – Aug 21). Bat A returned to the primary roost every day and Bat B returned to the primary roost 8 of the 12 days of tracking (Fig 3). Bat C returned to the primary roost 3 of the 12 days of tracking and was found roosting in Madison County approximately 21 miles straight-line distance (~32 river miles) from the primary roost on 3 of the 12 days (Figs 3-4). On 7 days, roosts for at least one of the bats were not located despite tracking efforts along the entire length of the French Broad River, Swannanoa River, and Hominy Creek and at known roosts in Madison County. In contrast to 2016 tracking results, bats did not routinely forage in the same areas each night or spend a considerable amount of time in one particular area, though many areas where bats were detected were similar to 2016 results. Bats were again detected traveling North on the French Broad River by Hwy 191 in the Bent Creek area, on Hominy Creek in the vicinity of Pond Rd., and on the French Broad River near the I-40 crossing. Additionally, bats were detected using a greater extent of Hominy Creek than in 2016 including the area near the I-240 crossing of Hominy Creek, north of I-240 along Sand Hill Rd., and along Hominy Creek Rd (Figs 1-2). Bats B and C were frequently detected on the Biltmore Estate property adjacent to Hwy 191 on the stretch that extends from I-26 to the area east of the Hominy Creek-French Broad River confluence. Bats B and C were also detected in the vicinity of the Asheville Outlet Mall and seemed to cross I-26 in this area, though without triangulation it is difficult to pinpoint exactly where this crossing occurred. Bat A was detected traveling South on the French Broad River during one night of telemetry. The bat's signal was detected between Clayton Rd. and Hwy 191 near Ashley Branch. This bat was also detected Northwest of the Long Shoals Rd. bridge during the same night. On two other nights, Bat A was detected foraging at the North Carolina Arboretum and Bent Creek Experimental Forest. Finally, Bat C was tracked from the Marshall roost on one night, but was lost approximately 10 minutes after emergence when personnel were delayed from tracking the bat by a train. The bat was last detected heading north, but was not detected after searching the French Broad River to the Tennessee border.



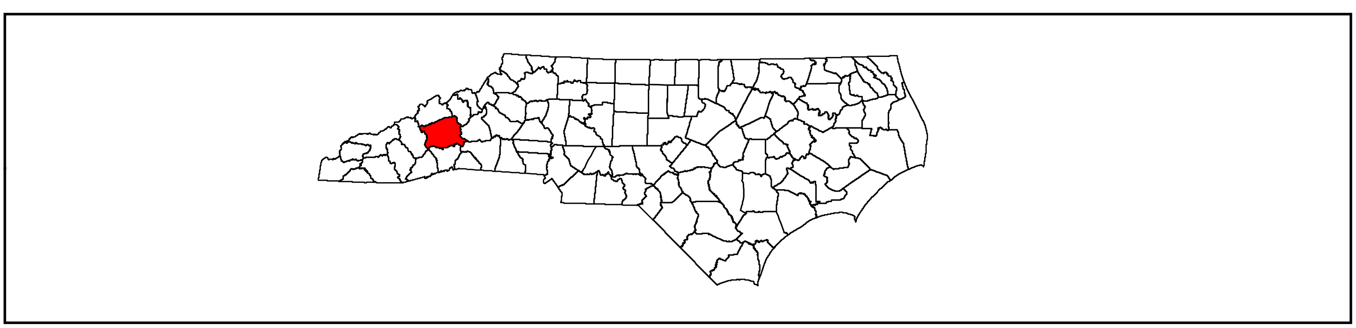


Figure 1. All areas in Buncombe County that radio-tagged gray bats were detected during 2016-2017 tracking efforts.

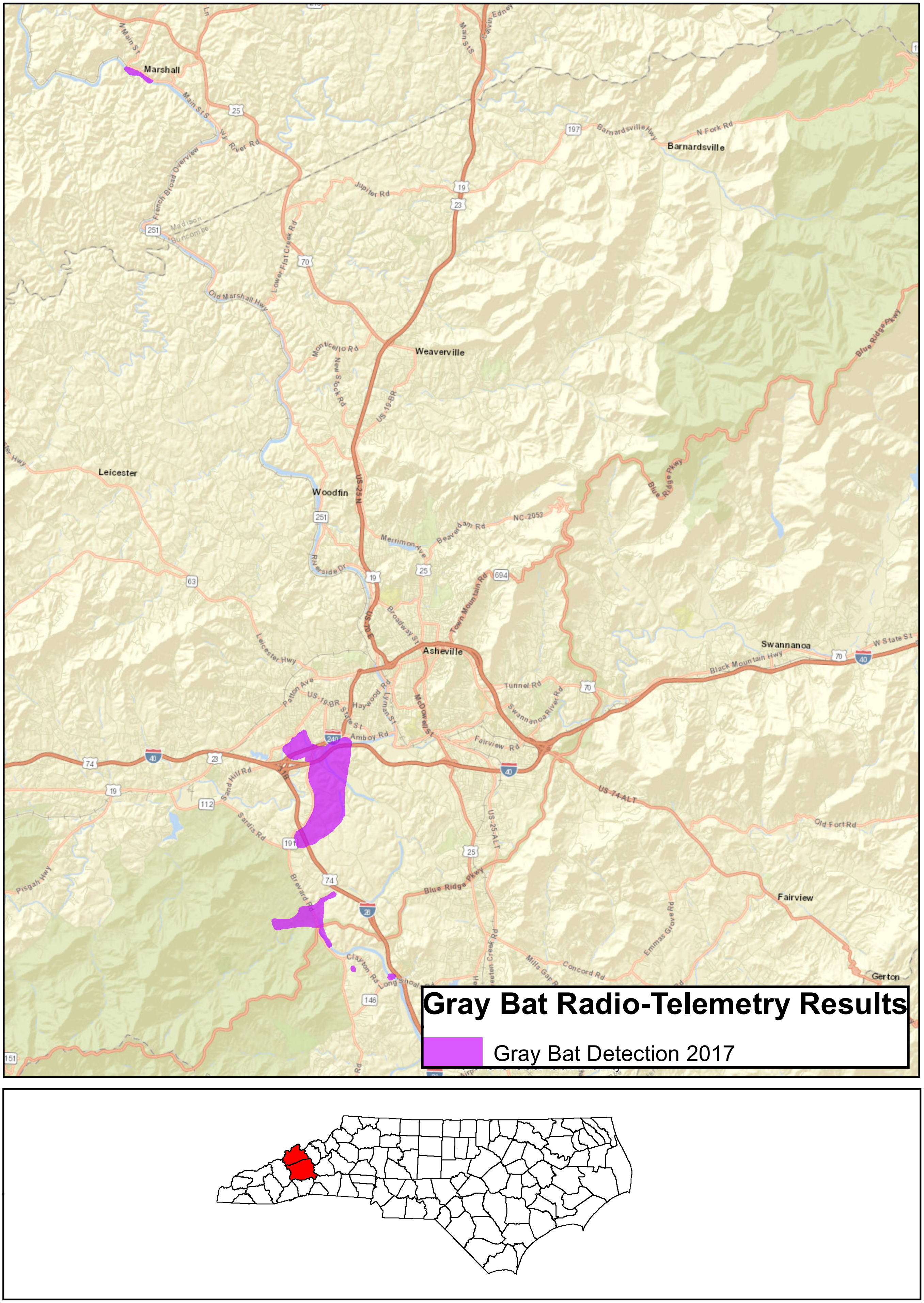


Figure 2. All areas that radio-tagged gray bats were detected during 2017 tracking efforts.

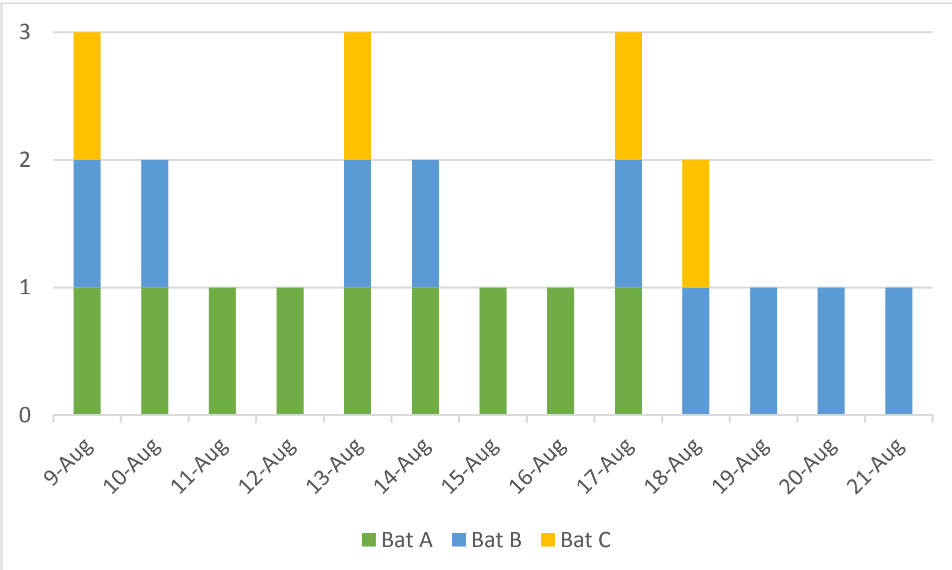


Figure 3. Occupancy of the primary roost by radio-tagged bats during 2017 tracking efforts.

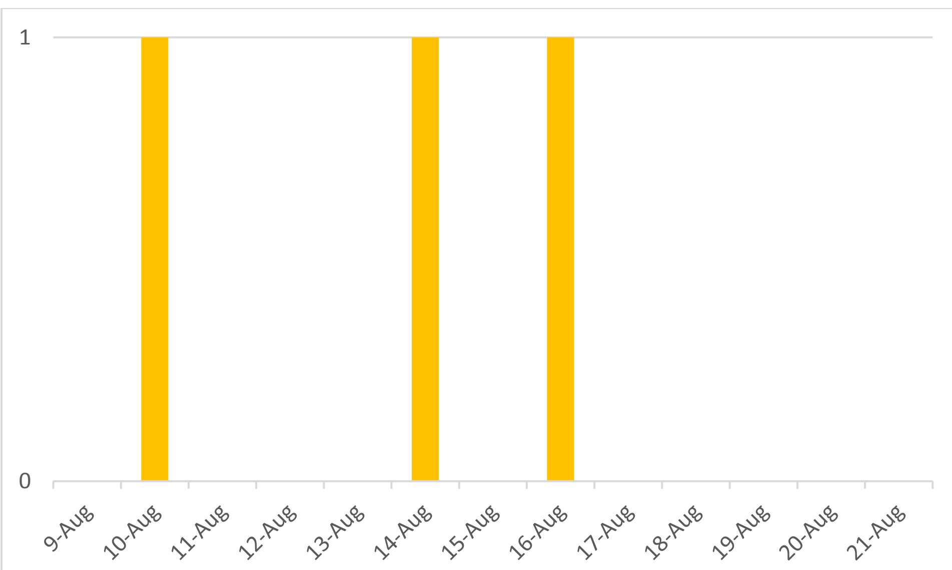


Figure 4. Occupancy of the Madison County roost by Bat C during 2017 tracking efforts.

Appendix H: NCDOT's Commitment to Treat Stormwater Discharges to the French Broad River to Protect Endangered

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

JAMES H. TROGDON, III
SECRETARY

DATE: May 1, 2018

TO: Marissa Rodman Cox
NCDOT Biological Surveys Group Supervisor

FROM: Stephen Morgan, PE DS SRM
NCDOT State Hydraulics Engineer

SUBJECT: Biological Assessment for the STIP I-4400/I-4700 I-26 Widening Project – Clarification of NCDOT's commitment to treat post-construction stormwater discharges to the French Broad River to protect endangered species

Background:

NCDOT is proposing to widen I-26 in Henderson and Buncombe Counties along a 22.2-mile stretch under two STIP projects. Section I-4400 is a 13.6 mile stretch that begins at US 25 (Exit 54) near Hendersonville and extends along I-26 west to NC 280 (Exit 40), south of Asheville. Section I-4700 extends for a distance of 8.6 miles along I-26 from NC 280 west to the I-40/I-240 interchange. Because the planned improvements will result in an increase in built upon area, the Department's Post-Construction Stormwater Program (PCSP) will apply as defined in NPDES stormwater permit NCS000250. The PCSP describes a process by which decisions are made to treat post-construction stormwater runoff to the maximum extent practical (MEP). The MEP standard is intended to be flexible and is allowed to vary between projects and over time. However, given the presence of two endangered species within the project area – the gray bat and the Appalachian elktoe mussel – it is prudent for the Department to clarify the MEP stormwater treatment standard for discharges to the French Broad River in the context of the STIP I-4400/I-4700 project. Due to project documentation requirements and associated scheduling constraints the following stormwater treatment commitment language was developed prior to any drainage design information being available. Hence, it is not appropriate at this time to make commitments for implementation of specific stormwater treatment best management practices (BMPs) at any given location. Instead the commitment language is intended to lead the hydraulic engineer through a thought process for selecting the maximum extent practical stormwater treatment options for a discharge to the French Broad River. **The following commitment guidance is intended to apply to STIP I-4400/I-4700 at the crossing of the French Broad River and to any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the river within the right-of-way.**

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
HYDRAULICS UNIT
1590 MAIL SERVICE CENTER
RALEIGH, NC 27699-1590

Telephone: (919) 707-6700
Fax: (919) 250-4108
Customer Service: 1-877-368-4968

Website: www.ncdot.gov

Location:
1020 BIRCH RIDGE DRIVE
RALEIGH, NC 27610

Post-Construction Stormwater Treatment Commitment:

NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater BMPs to the MEP, which is consistent with the Department's NPDES Post-Construction Stormwater Program. The goal of the SMP is to provide long term protection for federally listed species which depend on the French Broad River. To demonstrate attainment of the MEP standard NCDOT commits to the following set of guidelines for preparation of the SMP:

1. NCDOT recognizes that trees provide important habitat for the gray bat and therefore will minimize the use of large footprint BMPs and associated maintenance access roads if such construction would necessitate permanent clearing beyond the minimum limits needed for roadway construction and erosion control.

2. NCDOT recognizes that most BMPs are designed to treat stormwater by trapping pollutants. BMPs with design features that include a permanent pool of water may have unknown impacts to the gray bat if it was to use the BMP as a drinking water source. Therefore, NCDOT will avoid the use of wet detention basins and stormwater treatment wetlands on the project if these BMPs are judged to be a potential hazard to the gray bat.

3. NCDOT recognizes that the Appalachian elktoe and the gray bat are sensitive to excessive amounts of silt, nutrients, and heavy metals. Therefore, when preparing the SMP NCDOT commits to using a hierarchical BMP selection process that is optimized to treat the above three pollutant categories. At each discharge location, outside of the 100-year floodplain, the hydraulics engineer will evaluate the feasibility of installing either an infiltration basin or a media filter as described in NCDOT's BMP Toolbox. If one of these BMP types are a feasible option, then NCDOT commits to including such BMP in the SMP. If an infiltration basin or a media filter is not feasible because it would either violate guideline #1 above or due to site constraints (e.g. topography, high water table, etc) then NCDOT commits to providing a description of these constraints in the SMP as supporting information for the MEP BMP selection decision. In such cases the hydraulics engineer will select another BMP type from NCDOT's Toolbox that is feasible. Preference will be given to water quality swales, vegetative conveyances, vegetated filter strips, and preformed scour holes (PSHs). In flat, bottomland terrain PSHs will be used to the MEP to eliminate outfalls by converting concentrated flow into distributed flow thus maximizing infiltration and evapotranspiration of the runoff.

4. NCDOT recognizes that the presence of two endangered species - one aquatic and one terrestrial, but aquatic dependent – within the project area presents unique stormwater management challenges. Optimizing BMP selection for one species may be suboptimal or even detrimental to the other. Because of this unique situation, NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has or is currently researching, but has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:

    - ✓ Bioswales
    - ✓ Bioembankments
    - ✓ Biofiltration Conveyances
    - ✓ Soil improvement to maximize infiltration

Because design standards have not yet been formally approved by NC Department of Environmental Quality (NCDEQ) for inclusion in the BMP Toolbox, the hydraulics design engineer will be required to consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP. In consultation with the State Hydraulics Engineer, the hydraulics design engineer will use the following guidelines, in addition to an evaluation of site constraints, to determine the appropriateness of one of these emerging BMP technologies:

Bioswale Guidelines – for typical sections that include a vegetated median, a bioswale may be considered. For vegetated conveyances in other areas of the project where swale criteria can be met (refer to the BMP Toolbox for criteria) the hydraulics engineer should evaluate if a bioswale would be feasible in lieu of a traditional swale. If a bioswale is not feasible then the engineer should document in the SMP the constraints as justification for the MEP decision.

Bioembankment Guidelines – bioembankments can be used on slopes 4:1 or flatter and outside of the clear recovery zone. Discharges of treated runoff should be to a stable conveyance or energy dissipator. A geotechnical engineer should be consulted in the design of the bioembankment to ensure the stability of the side slope.

Biofiltration Conveyance Guidelines – biofiltration conveyances may be used along steep conveyances provided it is outside of the 100-year floodplain. A maintenance access road should be provided in compliance with clearing requirements in guideline #1.

Soil Improvement Guidelines – soil improvement practices may be considered in areas where compacted soil is not required for the structural integrity of the roadway facility. Improved areas should be planted with native, pollinator-friendly plants in consultation with the Division Roadside Environmental Engineer.

These commitments will meet the need for more stringent guidance for the area of environmental concern for the project. It is expected during the design phase additional coordination and clarification of these stormwater best management practices will occur through consultation with the Stormwater group in Hydraulics.

cc: Brian Burch, Division 14
Wanda Austin, Division 14
Randy McKinney, Division 13
David Harris, REU
Kat Bukowy, HNTB
Mary Frazer, Three Oaks Engineering

SRM/ahm