

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

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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 I-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 I-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 I-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	<i>Etheostoma zonale</i>
Wounded Darter	<i>Etheostoma vulneratum</i>
Greenfin Darter	<i>Etheostoma chlorbranchium</i>
Tangerine Darter	<i>Percina aurantiaca</i>
Mottled Sculpin	<i>Cottus bairdi</i>
Black Redhorse	<i>Moxostoma duquesnei</i>
River Redhorse	<i>Moxostoma carinatum</i>
Sicklefin Redhorse	<i>Moxostoma sp.</i>
Northern Hog Sucker	<i>Hypentelium nigricans</i>
Warpaint Shiner	<i>Luxilus coccogenis</i>

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	<i>Percina evides</i>	6
Banded Darter	<i>Etheostoma zonale</i>	8
Wounded Darter *	<i>Etheostoma vulneratum</i>	17
Greenfin Darter *	<i>Etheostoma chlorbranchium</i>	32
Greenside Darter *	<i>Etheostoma blennioides</i>	3
Olive Darter	<i>Percina squamata</i>	1
Mottled Sculpin *	<i>Cottus bairdi</i>	19
Rock Bass	<i>Ambloplites rupestris</i>	1
River Chub *	<i>Nocomis micropogon</i>	20
Northern Hogsucker *	<i>Hypentelium nigricans</i>	3
Central Stoneroller *	<i>Campostoma anomalum</i>	6
Longnose Dace *	<i>Rhinichthys cataractae</i>	9
Rosyside Dace *	<i>Clinostomus funduloides</i>	1
Mirror Shiner	<i>Notropis spectrunculus</i>	3

Common Name	Scientific Name	Number
Tennessee Shiner	<i>Notropis leuciodus</i>	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	<i>Cottus bairdi</i>
Mottled Sculpin	<i>Cottus carolinae</i>
Greenside Darter	<i>Etheostoma blennioides</i>
Fantail Darter	<i>Etheostoma flabellare</i>
Redline Darter	<i>Etheostoma ruflineatum</i>

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 *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
<i>Alasmidonta raveneliana</i>	Appalachian Elktoe	1	0.57/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	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
<i>Alasmidonta raveneliana</i>	Appalachian Elktoe	1	0.31/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	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 to 110 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
<i>Elliptio complanata</i>	Eastern Elliptio	20	1.87/hr
<i>Strophitus undulatus</i>	Creeper	1	0.09/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	C
<i>Elimia proxima</i>	Sprite Elimia	~	P-U

5.12 French Broad River Site 170824.Itws

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
<i>Elliptio complanata</i>	Eastern Elliptio	14	3.89/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	C
<i>Elimia proxima</i>	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
<i>Elliptio complanata</i>	Eastern Elliptio	2	0.147/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	C
<i>Elimia proxima</i>	Sprite Elimia	~	P-U
<i>Campeloma decisum</i>	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
<i>Alasmidonta raveneliana</i>	Appalachian Elktoe	2	0.5/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	C
<i>Elimia proxima</i>	Sprite Elimia	~	P-C
<i>Campeloma decisum</i>	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
<i>Elliptio complanata</i>	Eastern Elliptio	8	0.7/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	C
<i>Elimia proxima</i>	Sprite Elimia	~	P-U
<i>Campeloma decisum</i>	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
<i>Alasmidonta raveneliana</i>	Appalchian Elktoe	1	0.278/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	A
<i>Elimia proxima</i>	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
<i>Elliptio complanata</i>	Eastern Elliptio	3	0.548/hr
Freshwater Snails and Clams			Relative Abundance
<i>Corbicula fluminea</i>	Asian Clam	~	C
<i>Elimia proxima</i>	Sprite Elimia	~	P-C
<i>Campeloma decisum</i>	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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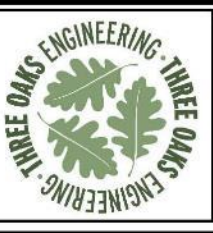
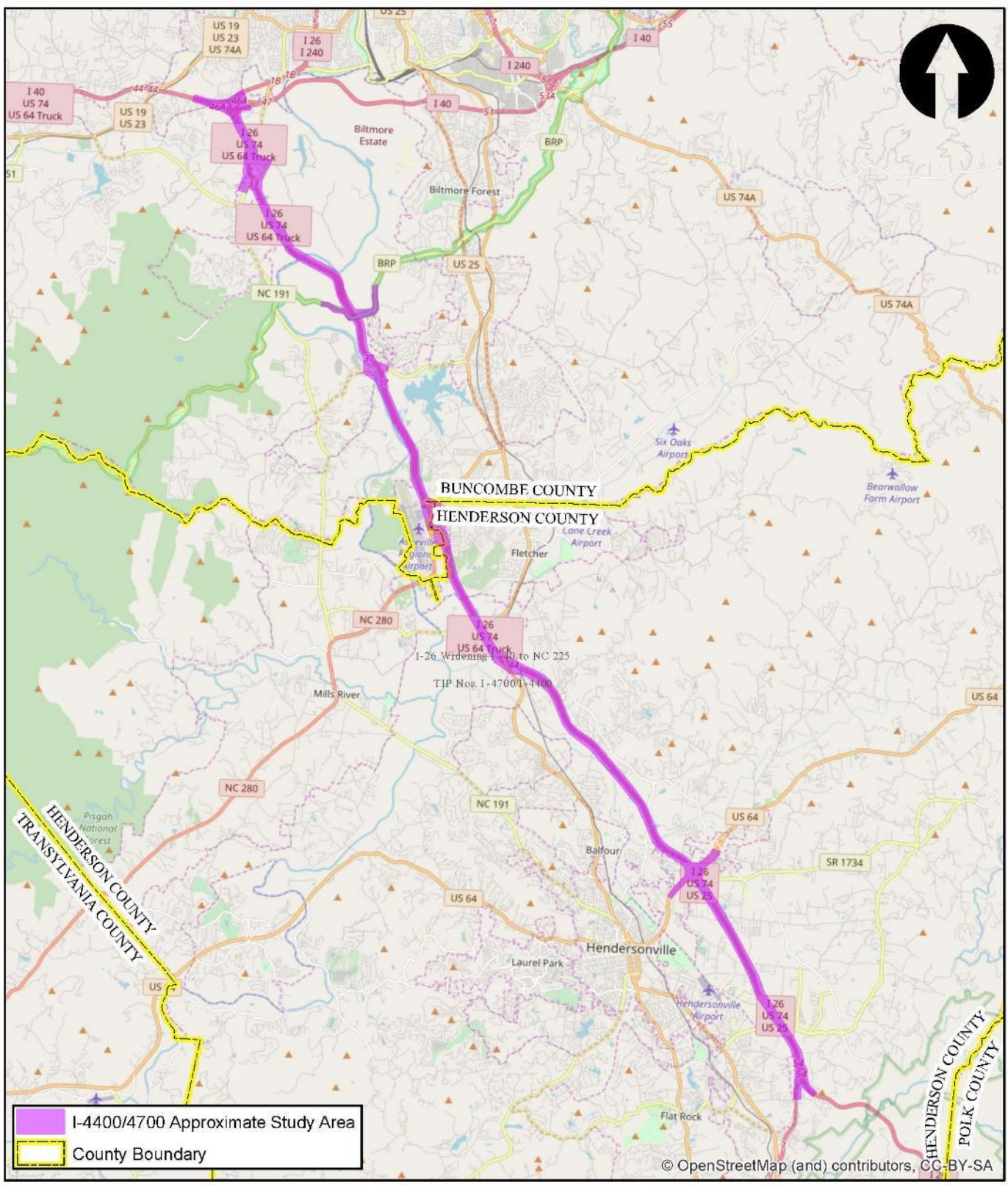
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Appendix A: Figures



Prepared For:

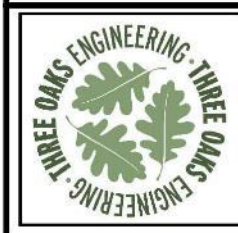
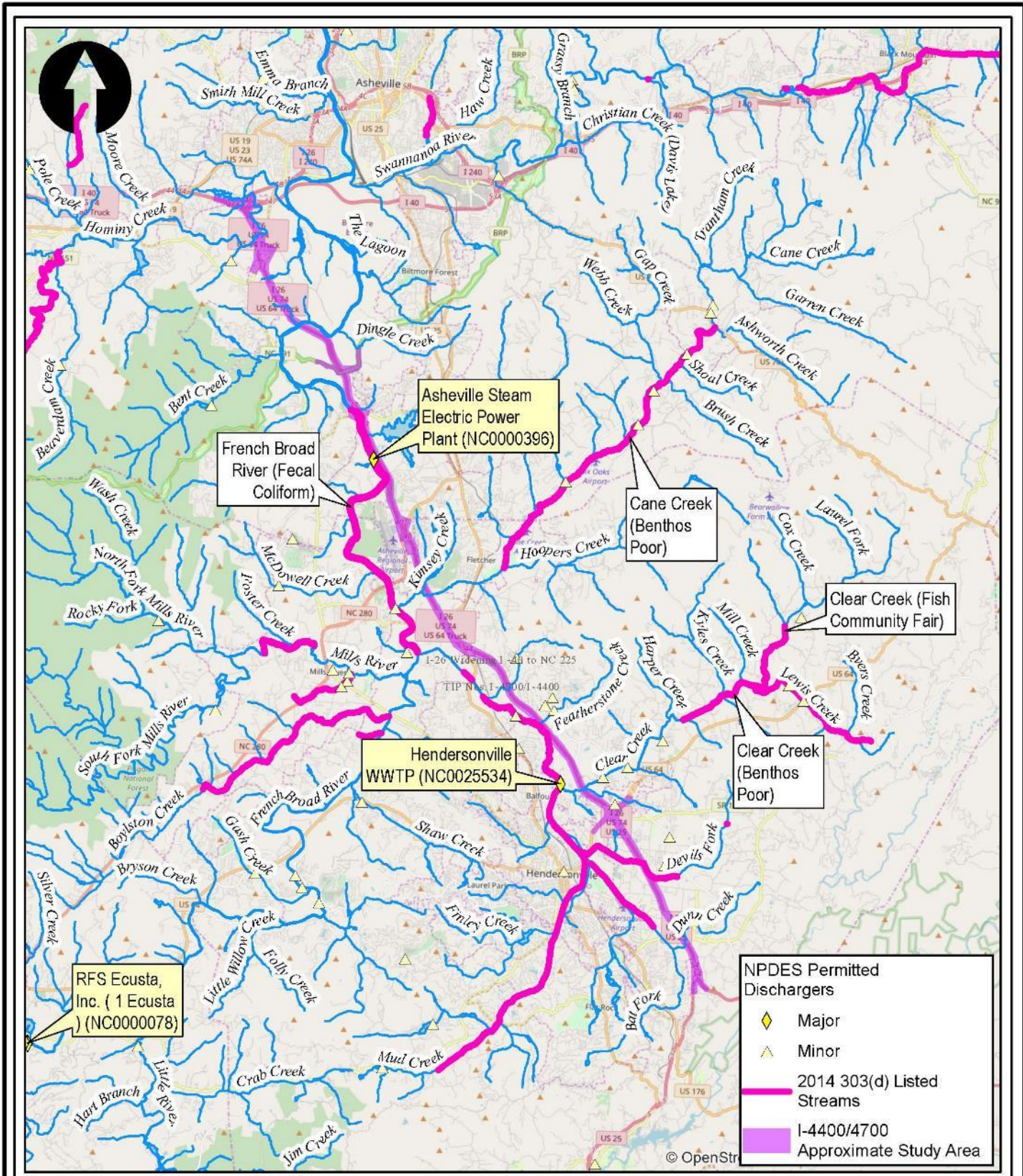
Freshwater Mussel Surveys

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)
 NPDES Discharges &
 303(d) Listed Streams
 Buncombe & Henderson Counties,
 North Carolina

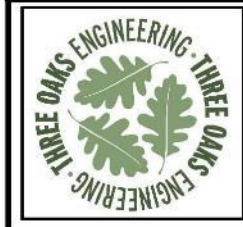
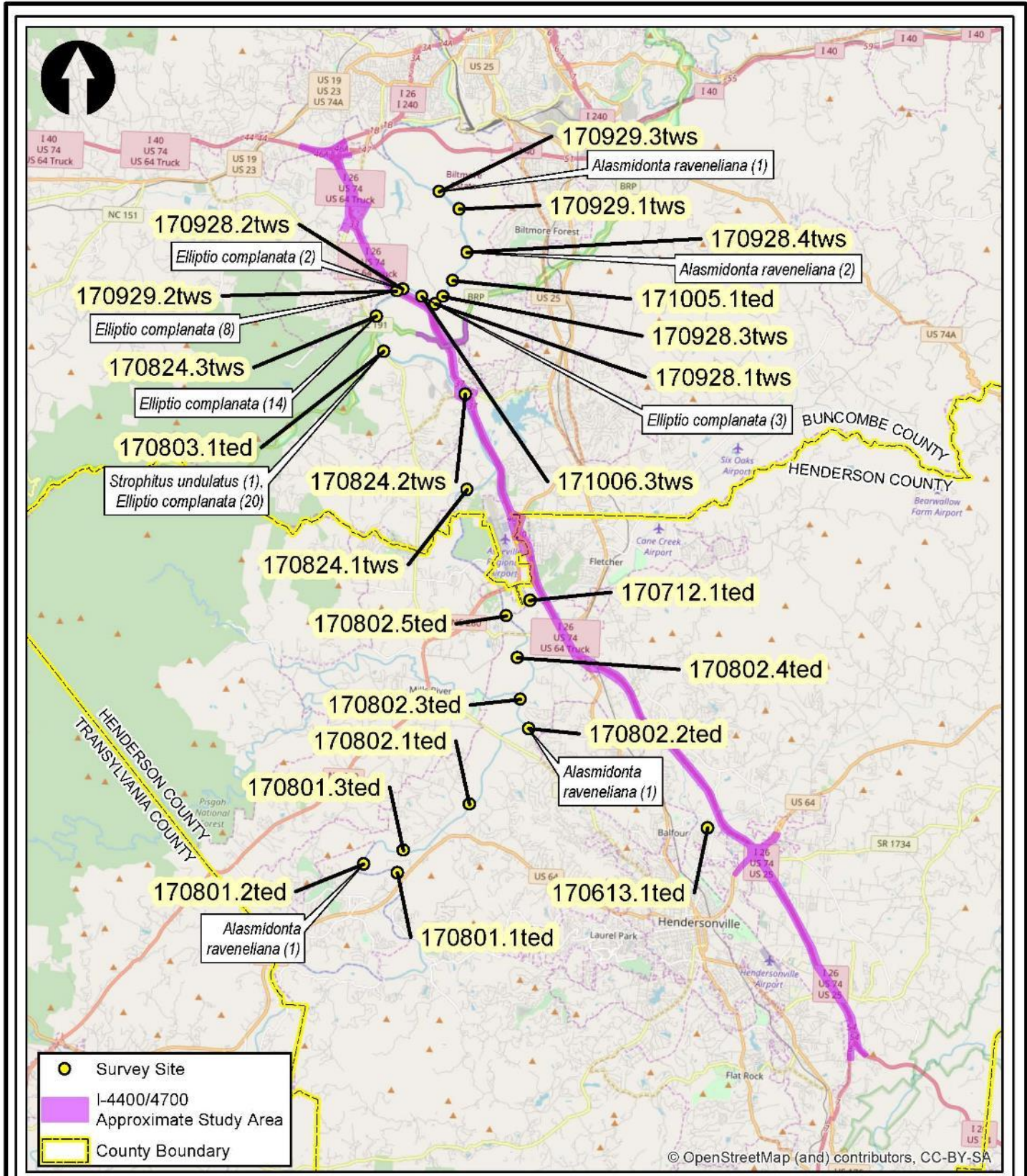
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Scale: 0 1 2 Miles

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