

# **Freshwater Mussel Survey Report**

## **Triangle Expressway Southeast Extension (TIP No R-2721/R-2828/R-2829)**

Wake and Johnston Counties, North Carolina

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**February 2012**

## EXECUTIVE SUMMARY

The freshwater mussel fauna within the project study corridor for the proposed Triangle Expressway Southeast Extension project (TIP #s R-2721, R-2828, R-2829) was evaluated by The Catena Group Inc. (TCG) to establish a planning level baseline status of the freshwater mussel resources within the project study corridor, with particular emphasis on the federally protected Dwarf Wedgemussel and Tar River Spinymussel, and other mussel species with assigned conservation statuses in North Carolina of Endangered. Habitat evaluations and mussel surveys were performed in selected portions of perennial water bodies within the study corridor in an effort to identify particular streams that contain significant freshwater mussel populations, particularly those that support listed species.

A total of 110 separate stream reaches were evaluated for the presence of mussels (Figures 1 and 2, Appendix A), with 15 freshwater mussel species, as well as 2 freshwater clam species and 4 aquatic snail species found. For purposes of data analysis and discussion, the project study area was segmented into three sections based on general watersheds: Western Section (Middle Creek and tributaries), Central Section (Swift Creek and tributaries), and Eastern section (Neuse River and tributaries).

**Western Section:** Middle Creek drains the western section of the project corridor study area, and from a freshwater mussel standpoint, is the most significant water body in the Western section. Middle Creek was known to support several rare mussel species, including the Dwarf Wedgemussel; however, this species has not been detected during any survey effort since 1992, where it was found at the NC 50 crossing downstream of the study area in Johnston County. In addition, occurrences and numbers of other rare mussel species known from the stream have declined in recent years. The results of this survey effort further support this declining trend, as only very low numbers of four rare mussel species were found. Observations of habitat conditions also support the apparent decline.

The proposed project will cross Middle Creek in the upper limits of the watershed upstream of Sunset Lake. While it is possible that the Dwarf Wedgemussel still occurs in Middle Creek further downstream in Johnston County, the presence of Sunset Lake between the proposed crossing and potentially occupied habitat downstream makes the potential for any direct impacts very unlikely. No rare mussel species were found in any of the tributaries; however, some of these streams such as Basal Creek, Little Creek, and Guffy Branch support fairly high abundances of the Eastern Elliptio, and contain areas of “good” mussel habitat, which may be suitable for the Dwarf Wedgemussel.

**Central Section:** The Central section of the project study area drains to the Swift Creek Subbasin, which is considered an aquatic habitat of national significance, as it supports the Dwarf Wedgemussel. Historically, at least 18 species of freshwater mussels have been reported to occur in the Swift Creek subbasin. This study confirms the relatively high species diversity (for Atlantic Slope drainages) of this stream, as at least 14 species were collected. The study also confirms the persistence of the Dwarf Wedgemussel in Swift Creek below Lake Benson, as three individuals were found within the study corridor. In addition, two other individuals were found downstream of the project

corridor, as part of a concurrent study carried out by TCG for the City of Raleigh. Other targeted mussel species, including the Atlantic Pigtoe and Yellow Lance, were also located along with several other rare mussel species. Thus, direct impacts to these species are possible from project construction within this section of Swift Creek.

Because of the existence of the Dwarf Wedgemussel in Swift Creek, the study corridor for this project was expanded to include an avoidance alternative (Red Route), which would cross Swift Creek upstream of Lake Benson. This section of Swift Creek is not believed to support the Dwarf Wedgemussel, and the results of this study further support this assumption, as it was not found, nor were any of the associate rare mussel species. In addition, Lake Benson occurs between this section of the creek and occupied habitat downstream. As such, direct impacts to the Dwarf Wedgemussel are unlikely to occur if the Red Corridor is constructed; however, conclusions regarding Indirect and Cumulative Impacts to the population cannot be determined at this time, and will need to be addressed with all alternates within the study area.

No rare mussel species were found in any of the tributaries to Swift Creek within the study area; however, both White Oak Creek and Little Creek are known to support Dwarf Wedgemussel and other rare species farther downstream of the study area. In both instances, artificial impoundments are present between any of the proposed crossing locations and occupied habitat downstream; therefore direct impacts are unlikely.

**Eastern Section:** The Eastern section of the project corridor drains to the Neuse River from the US 64/264 Bypass crossing of the river downstream to the vicinity of the Wake/Johnston County line. Tributaries to the Neuse River within this section include Walnut Creek and Beddingfield Creek to the south; Mango Creek, Unnamed Tributary (UT) to Neuse River, Poplar Creek, and Mark's Creek to the north.

Historically, at least 18 species of freshwater mussels have been reported to occur in the mainstem of the Neuse River within the project study area. While this study indicates relatively high species diversity (for Atlantic Slope drainages) of this section of the river (10 species), including the targeted Green Floater, species like the Dwarf Wedgemussel, Atlantic Pigtoe, Yellow Lance and Notched Rainbow, which historically occurred in this area, were not found. The presence of the Green Floater is the first documented occurrence of this species in this section of the Neuse River since the early 1950's.

While the Dwarf Wedgemussel is unlikely to still occur in this section of the Neuse River, the re-discovery of the Green Floater, which was believed to have been extirpated from this area, may indicate that some of the other species formerly reported from this area may still exist in low numbers, as the Green Floater was obviously present, but in such low numbers that it was not found during surveys since that time. The presence of Green Floater at multiple sites (8) and the fact that the majority of individuals found were of the same size (age) class, suggest a recent population expansion. Additional surveys will need to be done once an alternate is chosen. No rare mussel species were found in any of the tributaries in this section. Habitat conditions are generally unsuitable for the Dwarf Wedgemussel; thus it is very unlikely to occur in any of the water bodies within this section of the study corridor.

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## 1.0 INTRODUCTION

The North Carolina Turnpike Authority (NCTA) a division of the North Carolina Department of Transportation (NCDOT), proposes the construction of a new road corridor from NC-55 near Apex south and east to US-64/264 Bypass near Knightdale within Wake and Johnston Counties, referred to as the Triangle Expressway Southeast Extension. The entire project area occurs within the Neuse River Basin.

Two freshwater mussel species federally designated and protected as Endangered under the Endangered Species Act of 1973 as amended are known to occur within the Neuse River Basin in Wake and Johnston Counties, the Dwarf Wedgemussel (*Alasmidonta heterodon*) and the Tar River Spiny mussel (*Elliptio steinstansana*). To assess the potential for these two species to occur within the project area, The Catena Group, Inc. (TCG) was retained by H.W. Lochner (Lochner), to gather updated mussel survey data for streams within the project corridor during the preliminary planning phase of the project in order to assist in selection of potential corridors and to initiate any potential consultation with the agencies as early as possible to avoid project delays.

In addition, four species listed as state Endangered and Federal Species of Concern (FSC),<sup>1</sup> the Atlantic Pigtoe (*Fusconaia masoni*), Green Floater (*Lasmigona subviridis*), Yellow Lampmussel (*Lampsillis cariosa*), and Yellow Lance (*Elliptio lanceolata*), have been previously documented in this portion of the Neuse River Basin, and were also targeted in this survey because the US Fish and Wildlife Service (USFWS) is in the process of putting together “Elevation to Candidate Species Status” packages for some of these species as they may be formally listed as Threatened, or Endangered in the near future (John Fridell, USFWS Recovery Biologist, personal communication). In addition, The Center for Biological Diversity (CBD), a nonprofit conservation organization dedicated to the protection of endangered species and wild places ([www.biologicaldiversity.org](http://www.biologicaldiversity.org)) recently petitioned the USFWS to list 404 aquatic species in the southeastern United States, including three of these four species as either Threatened or Endangered under the Endangered Species Act (CBD 2010). As such, it has been determined that it would be prudent to address these species during this phase of project planning in the event that they become federally listed as Threatened or Endangered. Several other mussel species that are considered to be rare in North Carolina and have assigned various conservation statuses are also known from this portion of the Neuse River Basin (Table 1).

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<sup>1</sup> **Federal Species of Concern (FSC)** are defined as species that are under consideration for listing for which there is insufficient information to support listing. FSCs are not afforded federal protection under the Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. However, the status of these species is subject to change, and so should be included for consideration.

**Table 1. Rare Aquatic Species Neuse River Basin in Wake/Johnston Counties**

Scientific Name	Common Name	Federal Status	NC Status
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	E	E
<i>Alasmidonta undulata</i>	Triangle Floater	~	T
<i>Elliptio congarea</i>	Carolina Slabshell	~	W3/W5
<i>Elliptio lanceolata</i>	Yellow Lance	FSC	E
<i>Elliptio producta</i>	Atlantic Spike	~	W3/W5
<i>Elliptio roanokensis</i>	Roanoke Slabshell	~	T
<i>Fusconaia masoni</i>	Atlantic Pigtoe	FSC	E
<i>Lampsilis cariosa</i>	Yellow Lampermussel	FSC	E
<i>Lampsilis radiata</i>	Eastern Lampermussel	~	T
<i>Lasmigona subviridis</i>	Green Floater	FSC	E
<i>Strophitus undulatus</i>	Creeper	~	T
<i>Villosa constricta</i>	Notched Rainbow	~	SC

See Appendix B for status designations

## 2.0 MUSSEL SURVEY EFFORTS

Portions of all perennial water bodies within the project study corridor were evaluated for the presence of freshwater mussels and other aquatic mussel species, with particular emphasis on the federally protected Dwarf Wedgemussel and Tar River Spiny mussel, as well as four state Endangered /FSC mussel species, three of which have been included in a petition for consideration for federal listing as Endangered or Threatened.

### 2.1. Mussel Survey Methodology

Survey locations were chosen based on mapping as provided by Lochner, pre-survey investigations, accessibility, and appropriate habitat for the target species as determined in the field. Surveys were conducted by TCG personnel on the following dates in 2010:

- Tim Savidge: April 28; June 11, 16, 18, 23, 24; July 2, 8, 13, 20, 26; October 7, 12, 13, 21, 26, 27; November 23, 24
- Tom Dickinson: April 28; May 7; June 11, 16, 23; July 8, 22, 26; October 7, 19, 21, 26, 27; November 23, 24
- Chris Sheats: June 16, 18, 23; July 8, 20, 26; October 7, 12, 13, 19; November 23, 24
- Jonathan Hartsell: July 8
- Kate Montieth: May 7
- David Zitlow: July 8
- Daniel Savidge: June 23, 24; July 2, 8, 13; October 7, 26
- Ivy Kimbrough: July 20; October 7, 12, 13, 19, 21, 26, 27; November 24
- Maggie Griffin: October 19, 21, 26, 27; November 23, 24

The following non-TCG personnel assisted with the surveys on the following dates:

- Sarah McRae-USFWS: October 7
- John Fridell-USFWS: October 21, 26, 27
- Karen Lynch-NCDOT: October 27
- Jason Mays-NCDOT: October 7, 21, 27



- Mike Sanderson-NCDOT: October 21, 27
- Logan Williams-NCDOT: October 27
- Hal Bain-RK&K: October 12, 13
- Matt Smith-ESI: November 24

In each stream segment, a habitat evaluation was first performed by accessing a specific stream or stream system downstream of the corridor and walking the drainage for at least 0.5 person-hour. If it was determined by professional judgment that further efforts were not warranted, then survey efforts were stopped. This decision by the respective investigator to discontinue survey effort on a particular stream was based on a lack of suitable habitat for freshwater mussels. Within the surveyed reaches, all habitat types (riffle, run, pool, slack-water, etc.) were sampled by a minimum of a two-person team. The survey team began at the downstream end of the survey reach and proceeded upstream with the team spread across the stream into survey lanes. A combination of visual using bathyscopes (glass-bottom view buckets) or mask and snorkel, and tactile methodologies were employed as appropriate. Upstream and downstream survey limits were recorded using a hand-held Garmin 12 or e-Trex Vista GPS unit. Timed searches were employed in each reach to provide a catch per unit effort (CPUE). Searches were also conducted for relict shells. Presence of fresh shell material was equated with species presence, but was not factored into CPUE.

Relative abundance for freshwater snails and the freshwater clam species were estimated using the following criteria:

- Very abundant > 30 observed at survey station
- Abundant 16-30 observed at survey station
- Common 6-15 observed at survey station
- Uncommon 3-5 observed at survey station
- Rare 1-2 observed at survey station
- Patchy indicates an uneven distribution of the species within the sampled site.

## **2.2. Mussel Survey Results**

A total of 111 separate stream reaches within the study corridor were evaluated for the presence of mussels (Figures 1 and 2, Appendix A), with 15 freshwater mussel species, as well as 2 freshwater clam species and 4 aquatic snail species being found (Table 2).

Stream survey segments are reported by USGS stream name, the date surveyed, and respective sequence within that date. Unnamed tributaries are noted as "UT" to the named receiving water body. Habitat descriptions and survey results are summarized below for each site in order from West to East. Site numbers (i.e., 101010.1) indicate the date in YYMMDD (year, month, day) format with survey sequence from that day of sampling listed after the decimal point. Survey segments are depicted in their respective figures in Appendix A.

**Table 2.** Study Corridor: Mollusk Species Found

Scientific Name	Common Name	# Sites Found	Conservation Status
<b>Freshwater Mussels</b>	~	~	~
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	3	Federally E
<i>Alasmidonta undulata</i>	Triangle Floater	28	State T
<i>Elliptio complanata</i>	Eastern Elliptio	100	None
<i>Elliptio congarea</i>	Carolina Slabshell	43	State W
<i>Elliptio icterina</i>	Variable Spike	81	None
<i>Elliptio lanceolata</i>	Yellow Lance	8	State E
<i>Elliptio mediocris</i>	No Common Name	17	None
<i>Elliptio producta</i>	Atlantic Spike	8	State W
<i>Elliptio roanokensis</i>	Roanoke Slabshell	34	State T
<i>Fusconaia masoni</i>	Atlantic Pigtoe	23	State E
<i>Lampsilis radiata</i>	Eastern Lampmussel	44	State T
<i>Lasmigona subviridis</i>	Green Floater	8	State E
<i>Pyganodon cataracta</i>	Eastern Floater	24	None
<i>Strophitus undulatus</i>	Creeper	32	State T
<i>Utterbackia imbecillis</i>	Paper Pondshell	14	None
<b>Freshwater Snails and Clams</b>	~	~	~
<i>Campeloma decisum</i>	Pointed Campeloma	40	None
<i>Corbicula fluminea</i>	Asian Clam	101	Exotic
<i>Helisoma anceps</i>	Two-ridge Ram's Horn	2	Common
<i>Physidae</i>	A Physid Snail	4	None
<i>Planorbella trivolvis</i>	Marsh Ram's Horn	1	None
<i>Sphaeriidae</i>	A Sphaeriid Clam	2	None

For purposes of data analysis and discussion, the project study area was segmented into three sections based on general watersheds: Western Section (Middle Creek and tributaries), Central Section (Swift Creek and tributaries), and Eastern section (Neuse River and tributaries).

### 2.2.1. Western Section

The western section of the project corridor occurs within the Middle Creek Subbasin between NC 55 and NC 50. Six reaches of Middle Creek, were evaluated, as were portions of all perennial tributaries to Middle Creek within the study corridor (15 sites).

#### Middle Creek Site-100428.1

This section of Middle Creek was accessed off the Holly Springs Road (SR 1152) crossing. Channel width ranges from 4 to 5 meters with relatively stable 1-meter high banks. In order of dominance, substrate consists of sand, gravel, silt, cobble, and mud. Water levels were normal and water visibility was clear. A wastewater treatment plant (wwtp) discharge was noted and the smell of effluent was present. An extensive natural buffer surrounds the reach. Mussel surveys were conducted for a total of 3.07 person hours.

**Table 3.** Middle Creek Site-100428.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	96	31.27/hr
<i>Elliptio icterina</i>	Variable Spike	2	0.65/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Middle Creek Site-100428.2**

This section of Middle Creek was accessed off Sunset Lake Road (SR 1301). Channel width ranges from 2 to 5 meters with 1-meter high banks showing some signs of erosion. In order of dominance, substrate consists of silt, sand, clay, gravel, and mud. The smell of wwtp effluent was noted. Surveys were conducted for a total of 1.40 person hours.

**Table 4.** Middle Creek Site-100428.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	8	5.71/hr
<i>Elliptio icterina</i>	Variable Spike	2	1.43/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant
<i>Physella</i> sp.	A Physid Snail	~	Patchy, Common

**Middle Creek Site-100428.3**

This section of Middle Creek was located within the tailrace of Sunset Lake. Channel width ranges from 6 to 10 meters with <1-meter high relatively stable banks. In order of dominance, substrate consists of boulder, gravel, sand, cobble, bedrock, and silt. Surveys were conducted for 1.00 person hour.

**Table 5.** Middle Creek Site-100428.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	6	6.00/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	2.00/hr
<i>Pyganodon cataracta</i>	Eastern Floater	0	Shell only
<i>Utterbackia imbecillis</i>	Paper Pondshell	0	Shell only
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant
<i>Sphaeriidae</i>	A Sphaeriid clam	~	Uncommon

**Middle Creek Site-100611.1**

This mid section of Middle Creek within the study area was accessed off the Lake Wheeler Road Crossing (SR 1371). Channel width ranges from 6 to 10 meters with 1- to 2-meter high moderately eroded banks. In order of dominance, substrate consists of sand, silt, gravel, clay, and cobble. Mussels were concentrated in small patches of suitable habitat. Surveys were conducted for 4.67 person hours.

**Table 6.** Middle Creek Site-100611.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.21/hr
<i>Elliptio complanata</i>	Eastern Elliptio	225	48.18/hr
<i>Elliptio icterina</i>	Variable Spike	154	32.98/hr
<i>Strophitus undulatus</i>	Creeper	2	0.43/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Middle Creek Site-100616.2**

This section of Middle Creek occurs off the Old Stage Road (SR 1006) crossing. Channel width ranges from 10 to 12 meters with 2-meter high banks that range from fairly stable to moderately eroded. In order of dominance, substrate consists of sand, silt, clay, cobble, and boulder. Surveys were conducted for 5.15 person hours.

**Table 7.** Middle Creek Site-100616.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	241	46.80/hr
<i>Elliptio icterina</i>	Variable Spike	121	23.50/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.19/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Very Abundant

**Middle Creek Site-100616.1**

This most downstream section of Middle Creek within the study area was accessed off the Barber Bridge Road (SR 2739) crossing. Channel width ranges from 10 to 15 meters with 2-meter high banks that ranged from stable to severely eroded. In order of dominance, substrate consists of sand, clay, gravel, silt, and cobble. Mussels were fairly common in areas associated with stable clay and rock outcrops, and uncommon to absent in the rest. Surveys were conducted for 6.25 person hours.

**Table 8.** Middle Creek Site-100616.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	393	62.88/hr
<i>Elliptio icterina</i>	Variable Spike	146	23.36/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.16/hr
<i>Strophitus undulatus</i>	Creeper	1	0.16/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Very Abundant

**Basal Creek Site-100623.3**

This section of Basal Creek upstream of Bass Lake was accessed off the NC 55 crossing. Channel width ranges from 3 to 6 meters with <1-meter high moderately eroded banks. In order of dominance, substrate consists of sand, gravel, silt, clay, cobble, and bedrock. There is an extensive wetland complex created by beaver (*Castor canadensis*) dams upstream of the reach. Surveys were conducted for 2.13 person hours.

**Table 9.** Basal Creek Site-100623.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	414	194.37/hr
<i>Elliptio icterina</i>	Variable Spike	139	65.26/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Basal Creek Site-100618.1**

This section of Basal Creek extends from the Basal Creek arm of Sunset Lake upstream to the SR 1393 crossing just below the tailrace of Bass Lake. The stream consists of a series of braided channels within a floodplain wetland created by beaver dams. There is a large amount of detritus and woody debris. The channels range from 2 to 4 meters wide with <1-meter high banks. In order of dominance, substrate consists of sand, clay and gravel. Surveys were conducted for 4.0 person hours.

**Table 10.** Basal Creek Site-100618.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	51	12.75/hr
<i>Pyganadon cataracta</i>	Eastern Floater	2	0.50/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	2	0.50/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Uncommon

**UT to Middle Creek Site-100507.2**

This section of a UT to Middle Creek was accessed from the Optimist Farm Road (SR 1390) crossing. Channel width ranges from 2 to 4 meters with 1-meter high banks that showed signs of erosion. In order of dominance, substrate consists of sand, gravel, and silt. A mixture of residential development and forested landscape occurs adjacent to this reach. Mussel surveys were conducted for 2.5 person hours.

**Table 11.** UT Middle Creek Site-100507.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	2	0.80/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Rare

**Rocky Branch Site-100507.1**

This section of Rocky Branch was accessed off the Optimist Farm Road (SR 1390) crossing. Channel width ranges from 2 to 4 meters with 1-meter high banks that showed signs of erosion. Surveys were conducted upstream of a section of the channel that was impounded by beavers. In order of dominance, substrate consists of gravel, sand, cobble, and boulder. Surveys were conducted for 2.17 person hours.

**Table 12.** Rocky Branch Site-100507.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	1	0.46/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Rare

**UT Middle Creek (Bell’s Lake Creek) Site-100618.3**

This stretch of UT to Middle Creek (Bell’s Lake Creek) which originates from Bell’s Lake extends from approximately 100 meters below the Optimist Farm Road (SR 1390) crossing to a point approximately 650 meters upstream. The channel ranges from 2 to 4 meters wide, with eroded banks 1 meter high. Substrate is dominated by sand, gravel and cobble. No mussels were located during the 1.5 person hours of search time.

**Table 13.** UT Middle Creek (Bell’s Lake Creek) Site-100618.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
None	~	~	~
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Uncommon

**Terrible Creek Site-100618.2**

This section of Terrible Creek extends from approximately 0.5 mile downstream of the Johnson Pond Road (SR 1404) crossing upstream to the bridge. The channel, which ranges from 2 to 4 meters with <1-meter high banks, flows through a floodplain marsh wetland system, that appears to be a relict bed of a former impoundment. Numerous small beaver dams are present throughout. In order of dominance, substrate consists of sand, gravel, and cobble. Surveys were conducted for 2.67 person hours.

**Table 14.** Terrible Creek Site-100618.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	5	1.87/hr
<i>Pyganodon cataracta</i>	Eastern floater	7	2.62/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Patchy, Common

**Terrible Creek Site-100624.2**

This section of Terrible Creek extends from the WWTP discharge in Terrible Creek above Hilltop Road (SR 2751) upstream to the US 401 crossing. The channel width ranges from 3 to 4 meters, and the fairly stable banks are between 1 and 1.5 meters high. The substrate is dominated by sand, cobble, and gravel. Fairly extensive woodland is present on both sides of the stream. Surveys were conducted for 2.73 person hours.

**Table 15.** Terrible Creek Site-100624.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	85	31.14/hr
<i>Elliptio icterina</i>	Variable Spike	8	2.93/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Terrible Creek Site-100624.1**

This section of Terrible Creek extends from the Hilltop Road (SR 2751) crossing upstream to the WWTP discharge point. The channel ranges from 3 to 4 meters wide, and the highly eroded banks are between 1 and 1.5 meters high. The substrate is dominated by sand, cobble, and silt. Fairly extensive woodland is present on both sides of the stream. Surveys were conducted for 0.8 person hour.



**Table 16.** Terrible Creek Site-100624.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	1	1.25/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**UT Middle Creek Site-100611.2**

This UT to Middle Creek was accessed from its confluence with Middle Creek near the Lake Wheeler Road (SR 1371) crossing of Middle Creek. Channel is approximately 2 meters wide before it broadens into a larger inundated wetland system with no defined channel. The wetland complex also encompasses another UT to Middle Creek that flows into Middle Creek, approximately 160 meters upstream of this UT confluence. Substrate is dominated by silt and mud. No mollusks were located during the 0.5 person hour of search time. The survey endpoint depicted on Figure 2, Sheet 4 occurs within this wetland complex, and not within a defined channel.

**Panther Branch Site-100611.3**

This section of Panther Branch was accessed off the Old Stage Road (SR 1006) crossing. The incised channel ranges from 3 to 4 meters wide with unstable 2-meter high banks. In order of dominance, substrate consists of sand, gravel, silt, cobble, and clay. Surveys were conducted for 1.5 person hours.

**Table 17.** Panther Branch Site-100611.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio icterina</i>	Variable Spike	38	25.33/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon

**Little Creek Site-100623.1**

This section of Little Creek was accessed off the NC 42 crossing. Channel width ranges from 3 to 5 meters with relatively stable 1- to 2-meter high banks. In order of dominance, substrate consists of sand, pebble, gravel, clay, silt, and cobble. Surveys were conducted for 4.33 person hours.

**Table 18.** Little Creek Site-100623.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	316	72.98/hr
<i>Elliptio icterina</i>	Variable Spike	173	39.95/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Little Creek Site-100623.2**

This section of Little Creek is located just upstream of Site-100623.1. Channel width ranges from 2 to 5 meters with 1-meter high moderately eroded banks. In order of dominance, substrate consists of sand, pebble, gravel, clay, silt, and cobble. Surveys were conducted for 1.5 person hours.

**Table 19.** Little Creek Site-100623.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	143	95.33/hr
<i>Elliptio icterina</i>	Variable Spike	25	16.67/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Guffy Branch Site-100623.4**

This section of Guffy Branch extends from the confluence with Little Creek upstream to the Saul's Road (SR 2727) crossing. The channel width ranges from 3 to 4 meters, and the slightly eroded banks are between 1 and 1.5 meters high. The substrate is dominated by sand, and cobble. A mixture of forest and pastureland occurs along the stream. Surveys were conducted for 3.0 person hours.

**Table 20.** Guffy Branch Site-100623.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	135	45.00/hr
<i>Elliptio icterina</i>	Variable Spike	14	4.67/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Patchy, Common

### Guffy Branch Site-100623.5

This section of Guffy Branch extends from the Saul's Road (SR 2727) crossing to a point approximately 600 meters upstream. The channel width ranges from 2 to 3 meters, and the fairly stable banks are 1 meter high. The substrate is dominated by sand, and cobble, with areas of bedrock interspersed. A mixture of forest and fallow agricultural land occurs along the stream. Surveys were conducted for 1.17 person hours.

**Table 21.** Guffy Branch Site-100623.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	95	81.20/hr
<i>Elliptio icterina</i>	Variable Spike	21	11.95/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Patchy, Common

### Buffalo Branch Site-100623.6

This section of Buffalo Branch extends from the NC 50 crossing to a point approximately 450 meters upstream, near the Johnston/Wake County line. The channel width ranges from 3 to 4 meters, and the fairly stable banks are 1 meter high. The substrate is dominated by sand, and cobble. The surrounding landscape is forested. Surveys were conducted for 2.00 person hours.

**Table 22.** Buffalo Branch Site-100623.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	92	46.00/hr
<i>Elliptio icterina</i>	Variable Spike	14	7.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

### 2.2.2. Central Section

The Central section of the project corridor occurs within the Swift Creek Subbasin between NC 50 and US 70. Two general areas of Swift Creek were evaluated: 1) Swift Creek between Lake Wheeler and Lake Benson (8 sites); and 2) Swift Creek between Lake Benson and the Cornwallis Road (SR 1525) crossing (55 Sites). Tributaries to Swift Creek that were evaluated include Mahler's Creek, UT to Swift Creek, White Oak Creek, and Little Creek (7 sites).

#### Swift Creek between Lake Wheeler and Lake Benson Site-101124.4

This section of Swift Creek extends from a point approximately 250 meters below the spillway of Lake Wheeler upstream to the spillway. The stream channel ranges from 8 to 10 meters wide, with relatively stable banks up to 2 meters high. The substrate is dominated by sand and gravel, with clay and silt along the banks. Surveys were conducted for 3.58 person hours.

**Table 23.** Swift Creek Site-101124.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	105	29.33/hr
<i>Elliptio icterina</i>	Variable Spike	9	2.51/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	5	1.40/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

#### Swift Creek between Lake Wheeler and Lake Benson Site-101124.3

This site occurs in an extensive riffle habitat in a bend of Swift Creek approximately halfway between the Lake Wheeler spillway and the US 401 crossing of the creek. The stream channel is 6 meters wide, with relatively stable banks 1 meter high. The substrate is dominated by cobble and gravel, with clay and silt along the banks. Surveys were conducted for 3.67 person hours.

**Table 24.** Swift Creek Site-101124.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	84	22.89/hr
<i>Elliptio icterina</i>	Variable Spike	33	8.99/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

#### Swift Creek between Lake Wheeler and Lake Benson Site-101124.2

This site occurs in a long run and pool habitat sequence approximately 600 meters above the US 401 crossing of the creek. The stream channel is 6 to 9 meters wide, with relatively stable banks 1.5 meters high. The substrate is dominated by sand and gravel, with clay and silt along the banks. Surveys were conducted for 3.5 person hours.

**Table 25.** Swift Creek Site-101124.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	82	23.43/hr
<i>Elliptio icterina</i>	Variable Spike	17	4.86/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Wheeler and Lake Benson Site-101124.1**

This site occurs in an extensive shallow run and riffle habitat approximately 400 meters above the US 401 crossing of the creek. The stream channel is 6 to 8 meters wide, with relatively stable banks 1.5 meters high. The substrate is dominated by sand and gravel, with clay and silt along the banks. Surveys were conducted for 3.08 person hours.

**Table 26.** Swift Creek Site-101124.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	54	17.53/hr
<i>Elliptio icterina</i>	Variable Spike	23	7.47/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Wheeler and Lake Benson Site-101123.6**

This site occurs in a long run, pool and slack-water habitat sequence, approximately 200 meters below the CSX crossing of the creek near US 401. The stream channel is 7 to 9 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by unconsolidated sand with clay and silt banks. Surveys were conducted for 1.33 person hours.

**Table 27.** Swift Creek Site-101123.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	27	20.30/hr
<i>Elliptio icterina</i>	Variable Spike	7	5.26/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

### Swift Creek between Lake Wheeler and Lake Benson Site-101123.5

This site occurs in a long pool and slack-water section with limited riffle and run habitat, approximately 1,050 meters above the Old Stage Road (SR 1006) crossing of the creek. The stream channel is 8 to 10 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by unconsolidated sand with clay and silt banks. Surveys were conducted for 2.13 person hours.

**Table 28.** Swift Creek Site-101123.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	21	9.86/hr
<i>Elliptio icterina</i>	Variable Spike	11	5.16/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.47/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

### Swift Creek between Lake Wheeler and Lake Benson Site-101123.4

This site occurs in a long (60 meter) extensive riffle and run habitat sequence approximately 650 meters above the Old Stage Road (SR 1006) crossing of the creek. The stream channel is 6 to 8 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by gravel and sand with clay banks. Surveys were conducted for 2.20 person hours.

**Table 29.** Swift Creek Site-101123.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	75	34.09/hr
<i>Elliptio icterina</i>	Variable Spike	96	43.64/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.45/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

### Swift Creek between Lake Wheeler and Lake Benson Site-101123.3

This site occurs in a long run, pool, and slack-water habitat sequence approximately 400 meters above the Old Stage Road (SR 1006) crossing of the creek. The stream channel is 8 to 10 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by unconsolidated sand, gravel, and cobble with clay banks. Surveys were conducted for 1.80 person hours.

**Table 30.** Swift Creek Site-101123.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	4	2.22/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Mahler's Creek Site-101124.5**

This section of Mahler's Creek occurs in the vicinity of the New Bethel Church Road (SR 2708) crossing. The channel ranges from 2 to 4 meters wide with 1- to 2-meter high moderately eroded banks. The substrate is dominated by shifting sand and silt. Surveys were conducted for 1.5 person hours.

**Table 31.** Mahlers Creek Site-101124.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	2	1.33/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam		Uncommon

**Mahler's Creek Site-101124.8**

This section of Mahler's Creek extends from the confluence with Swift Creek to a point approximately 370 meters upstream. The channel ranges from 2 to 3 meters wide with 1- to 2-meter high severely eroded banks. The substrate is dominated by shifting sand and silt. Surveys were conducted for 1.5 person hours.

**Table 32.** Mahlers Creek Site-101124.8: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	6	4.0/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam		Patchy, Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101124.6**

This site extends from the Mahler's Creek confluence upstream to a point approximately 250 meters below the NC 50 crossing of Swift Creek. The stream channel is 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. A small beaver dam occurs within this reach, creating slack-water pool habitat. The substrate is dominated by sand and silt, with large amounts of detritus and woody debris. Surveys were conducted for 1.25 person hours.

**Table 33.** Swift Creek Site-101124.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	5	4.00/hr
<i>Elliptio icterina</i>	Variable Spike	1	0.80/hr
<i>Elliptio mediocris</i>	No Common Name	1	0.80/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101124.7**

This site occurs in a shallow riffle habitat within an island channel on the left descending side of Swift Creek, approximately 50 meters in length just below the Mahler's Creek confluence. The island stream channel is 5 meters wide, with severely eroded banks 2.5 meters high. The substrate is dominated by shifting sand and pebble. Surveys were conducted for 1.0 person hour.

**Table 34.** Swift Creek Site-101124.7: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	6	6.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-100708.5**

This site occurs in a riffle/run/pool habitat sequence approximately 500 meters downstream of the Mahler's Creek confluence. The stream channel is 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. The substrate is dominated by sand and gravel. Surveys were conducted for 2.08 person hours.



**Table 35.** Swift Creek Site-100708.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	110	52.88/hr
<i>Elliptio icterina</i>	Variable Spike	6	2.88/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.48/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.48/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	13	6.25/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-100708.4**

This site occurs in wide bend of Swift Creek, approximately 750 meters downstream of the Mahler's Creek confluence. The habitat consists of shallow sandbar/riffles grading to a deep scoured run. The stream channel is 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. The substrate is dominated by sand and gravel, with clay banks. Surveys were conducted for 4.17 person hours.

**Table 36.** Swift Creek Site-100708.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	238	57.07/hr
<i>Elliptio icterina</i>	Variable Spike	4	0.96/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.24/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	16	3.84/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-100708.3**

This site occurs in a shallow sandbar/riffle and run habitat, approximately 920 meters downstream of the Mahler's Creek confluence. The stream channel is 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. The substrate is dominated by sand and pebble, with clay banks. Surveys were conducted for 4.17 person hours.

**Table 37.** Swift Creek Site-100708.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	575	137.89/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.24/hr
<i>Elliptio icterina</i>	Variable Spike	30	7.19/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.24/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	3	0.72/hr
<i>Pyganodon cataracta</i>	Eastern Floater	11	2.64/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	20	4.80/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Patchy, Common
<i>Physella</i> sp.	A Physid Snail	~	Patchy, Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-100708.2**

This site occurs in a narrow riffle and run habitat, approximately 1,020 meters downstream of the Mahler's Creek confluence. The stream channel is 6 meters wide, with moderately eroded banks 2.5 meters high. The substrate is dominated by sand and pebble, with clay banks. Surveys were conducted for 3.0 person hours.

**Table 38.** Swift Creek Site-100708.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	250	83.33/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.33/hr
<i>Elliptio icterina</i>	Variable Spike	11	3.67/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	5	1.67/hr
<i>Strophitus undulatus</i>	Creeper	1	0.33/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	5	1.67/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-100708.1**

This site occurs in a narrowly meandering section of the creek, approximately 1,350 meters downstream of the Mahler's Creek confluence. The stream channel is 6 to 10 meters wide, with moderately eroded banks 2.5 meters high. The habitat consists of a series of short riffle run sequences dominated by cobble, sand, and gravel substrate, with clay banks. Surveys were conducted for 2.92 person hours.

**Table 39.** Swift Creek Site-100708.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	307	105.14/hr
<i>Elliptio congarea</i>	Carolina Slabshell	3	1.03/hr
<i>Elliptio icterina</i>	Variable Spike	28	9.59/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.34/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	0.68/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.34/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101123.2**

This site occurs in a long straight section of Swift Creek, approximately 1,800 meters downstream of the Mahler's Creek confluence. The stream channel is 10 to 12 meters wide, with moderately eroded banks 2 meters high. Habitat consists of a shallow run grading to a slackwater pool created by a small beaver dam. Substrate is dominated by sand, with clay along the banks. Surveys were conducted for 2.13 person hours.

**Table 40.** Swift Creek Site-101123.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	144	67.60/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	0.94/hr
<i>Elliptio icterina</i>	Variable Spike	20	9.39/hr
<i>Elliptio mediocris</i>	No Common Name	3	1.41/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.47/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.47/hr
<i>Pyganodon cataracta</i>	Eastern Floater	9	4.22/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	4	1.88/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101123.1**

This site occurs adjacent to the Indian Overlook Residential Community and extends from the WWTP discharge point upstream for 167 meters. Habitat consists of a straight relatively shallow pool habitat, with small sandbar and log jam created riffles interspersed. The stream channel is 10 meters wide, with moderately eroded banks 2 meters high. Substrate is dominated by sand and gravel, with clay along the banks. Surveys were conducted for 8.53 person hours.

**Table 41.** Swift Creek Site-101123.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	578	67.76/hr
<i>Elliptio congarea</i>	Carolina Slabshell	6	0.70/hr
<i>Elliptio icterina</i>	Variable Spike	51	5.98/hr
<i>Elliptio producta</i>	Atlantic Spike	3	0.35/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.12/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	3	0.35/hr
<i>Pyganodon cataracta</i>	Eastern Floater	47	5.51/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	2	0.23/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.1**

This site occurs adjacent to the Indian Overlook Residential Community and extends from a point approximately 167 meters downstream of the WWTP discharge point up to the discharge point. The site occurs in a broad bend of the creek, and contains shallow riffle and run habitats dominated by gravel, sand, and cobble substrate. The stream channel is 10 to 12 meters wide, with moderately eroded banks 2 meters high. Surveys were conducted for 10.58 person hours.

**Table 42.** Swift Creek Site-101027.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	185	17.48/hr
<i>Elliptio icterina</i>	Variable Spike	17	1.61/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.19/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.09/hr
<i>Pyganodon cataracta</i>	Eastern Floater	83	7.84/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.4**

This site occurs in short, cobble and gravel dominated, riffle habitat, in a narrow bend of the creek, approximately 180 meters below the Indian Overlook WWTP discharge. The stream channel is 8 meters wide, with moderately eroded banks 2 meters high. Surveys were conducted for 0.53 person hours.

**Table 43.** Swift Creek Site-101027.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	5	9.43/hr
<i>Elliptio icterina</i>	Variable Spike	1	1.89/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.3**

This site occurs in wide straight section of the creek approximately 240 meters below the Indian Overlook WWTP discharge. The stream channel is 15 meters wide, with moderately eroded banks 2 meters high. Habitat consists of a series of small riffle, run, and pool habitats. Surveys were conducted for 1.0 person hour.

**Table 44.** Swift Creek Site-101027.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	61	61.00/hr
<i>Elliptio icterina</i>	Variable Spike	7	7.00/hr
<i>Pyganodon cataracta</i>	Eastern Floater	3	3.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.2**

This site occurs in wide straight section of the creek approximately 470 meters below the Indian Overlook WWTP discharge. The stream channel is 15 meters wide, with severely eroded banks 2 meters high. Large sandbars and log jams occur throughout this reach, and the habitat consists of shallow runs dominated by shifting sand, and deep pools above the log jams with clay banks. Surveys were conducted for 1.47 person hours.

**Table 45.** Swift Creek Site-101027.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	29	19.73/hr
<i>Elliptio icterina</i>	Variable Spike	Shell	0.0/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	Shell	0.0/hr
<i>Pyganodon cataracta</i>	Eastern Floater	4	2.72/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101007.6**

This site was accessed from the Garner WWTP Spray Field facility off Wrenn Road, and occurs in a narrow bend of the creek approximately 1,300 meters below the Indian Overlook WWTP discharge. The stream channel is 15 meters wide, with moderately eroded banks 1.5 meters high. Habitat consists of shallow riffles and runs dominated by sand with clay banks. Surveys were conducted for 2.67 person hours.

**Table 46.** Swift Creek Site-101007.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	3	1.12/hr
<i>Elliptio complanata</i>	Eastern Elliptio	219	82.02/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.37/hr
<i>Elliptio icterina</i>	Variable Spike	30	11.24/hr
<i>Elliptio mediocris</i>	No Common Name	1	0.37/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.37/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.37/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101007.5**

This 30 meter long site was accessed from the Garner WWTP Spray Field facility off Wrenn Road, and occurs in a narrow, straight run habitat approximately 1,370 meters below the Indian Overlook WWTP discharge. The stream channel is 15 meters wide, with moderately eroded banks 1.5 meters high. Substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 1.92 person hours.

**Table 47.** Swift Creek Site-101007.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	154	80.21/hr
<i>Elliptio icterina</i>	Variable Spike	40	20.83/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	1.04/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101007.1**

This 30-meter long site was accessed from the Garner WWTP Spray Field facility off Wrenn Road, and occurs in a bend with shallow riffle/run habitat approximately 1,630 meters below the Indian Overlook WWTP discharge. The stream channel is 15 meters wide, with moderately eroded banks 1.5 meters high. Substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 3.13 person hours.

**Table 48.** Swift Creek Site-101007.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	211	67.41/hr
<i>Elliptio icterina</i>	Variable Spike	36	11.50/hr
<i>Elliptio mediocris</i>	No Common Name	1	0.32/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.32/hr
<i>Strophitus undulatus</i>	Creeper	1	0.32/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101007.4**

This site was accessed from the Garner WWTP Spray Field facility off Wrenn Road, and occurs in a wide, straight section of the creek approximately 1,830 meters below the Indian Overlook WWTP discharge. The stream channel is 18 meters wide, with severely eroded banks 2 meters high. Habitat is classified as a shallow run dominated by sand and pebble with clay banks. A large amount of woody debris is present. Surveys were conducted for 2.06 person hours.

**Table 49.** Swift Creek Site-101007.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	113	54.85/hr
<i>Elliptio icterina</i>	Variable Spike	18	8.74/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.48/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.48/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.48/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101007.3**

This site was accessed from the Garner WWTP Spray Field facility off Wrenn Road, and occurs in a narrow bend at the confluence with an intermittent tributary from the north, approximately 1,930 meters below the Indian Overlook WWTP discharge. The stream channel is 12 meters wide, with severely eroded banks 1.5 meters high. Habitat is classified as a shallow riffle/run dominated by sand and pebble with clay banks. A large amount of woody debris is present. Surveys were conducted for 2.75 person hours.

**Table 50.** Swift Creek Site-101007.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	280	101.82/hr
<i>Elliptio congarea</i>	Carolina Slabshell	3	1.09/hr
<i>Elliptio icterina</i>	Variable Spike	48	17.45/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.36/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.36/hr
<i>Strophitus undulatus</i>	Creeper	1	0.36/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101007.2**

This site was accessed from the Garner WWTP Spray Field facility off Wrenn Road, and occurs in a long, straight section of the stream approximately 1,100 meters above the Wake/Johnston County line. The stream channel is 15 meters wide, with severely eroded banks 1.5 meters high. Habitat consists primarily of deep runs and pools with a few small riffle areas that have formed below fallen trees. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 4.0 person hours.

**Table 51.** Swift Creek Site-101007.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	347	86.75/hr
<i>Elliptio icterina</i>	Variable Spike	14	3.50/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.25/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.10**

This site was accessed from the I-40 crossing of the creek, and occurs in a wide section of the stream approximately 100 meters above the Wake/Johnston County line. The stream channel is 12 meters wide, with moderately eroded banks 2 meters high. Habitat consists primarily of deep runs and pools with a few small riffle areas that have formed below fallen trees. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 2.33 person hours.



**Table 52.** Swift Creek Site-101027.10: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	0.86/hr
<i>Elliptio complanata</i>	Eastern Elliptio	221	94.85/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.43/hr
<i>Elliptio icterina</i>	Variable Spike	35	15.02/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.43/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.43/hr
<i>Strophitus undulatus</i>	Creeper	1	0.43/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.9**

This site was accessed from the I-40 crossing of the creek, and occurs in a narrow straight section of the stream in the vicinity of the Wake/Johnston County line. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2 meters high. The site consists of a sequence of shallow glide, riffle, and run habitat sequences. The substrate is dominated by sand and gravel with clay banks. Surveys were conducted for 3.73 person hours.

**Table 53.** Swift Creek Site-101027.9: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.27/hr
<i>Elliptio complanata</i>	Eastern Elliptio	336	90.08/hr
<i>Elliptio congarea</i>	Carolina Slabshell	3	0.80/hr
<i>Elliptio icterina</i>	Variable Spike	50	13.40/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	Shell	0.0/hr
<i>Pyganodon cataracta</i>	Eastern Floater	2	0.54/hr
<i>Strophitus undulatus</i>	Creeper	2	0.54/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.8**

This 30-meter long site was accessed from the I-40 crossing of the creek, and occurs in a broad bend of the stream approximately 280 meters downstream of the Wake/Johnston County line. The stream channel ranges from 6 to 10 meters wide, with moderately eroded banks 2 to 3-meters high. The site consists of a sequence of shallow, glide, riffle and run habitat sequences. The substrate is dominated by bedrock overlain with sand, gravel and cobble with clay banks. Surveys were conducted for 3.67 person hours.

**Table 54.** Swift Creek Site-101027.8: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	1	0.27/hr
<i>Alasmidonta undulata</i>	Triangle Floater	4	1.09/hr
<i>Elliptio complanata</i>	Eastern Elliptio	915	249.32/hr
<i>Elliptio congarea</i>	Carolina Slabshell	14	3.81/hr
<i>Elliptio icterina</i>	Variable Spike	133	36.24/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.27/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	5	1.36/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.54/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.27/hr
<i>Strophitus undulatus</i>	Creeper	2	0.54/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.7**

This site was accessed from the I-40 crossing of the creek, and occurs in a narrow straight section between two bends of the stream in approximately 320 meters downstream of the Wake/Johnston County line. The stream channel ranges from 6 to 8 meters wide, with moderately eroded banks 2 meters high. The site contains a sequence of shallow, glide, riffle and run habitat sequences. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 3.0 person hours.

**Table 55.** Swift Creek Site-101027.7: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	0.67/hr
<i>Elliptio complanata</i>	Eastern Elliptio	190	63.33/hr
<i>Elliptio congarea</i>	Carolina Slabshell	5	1.67/hr
<i>Elliptio icterina</i>	Variable Spike	17	5.67/hr
<i>Elliptio mediocris</i>	No Common Name	2	0.67/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	3	1.00/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.33hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.33/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.6**

This site was accessed from the I-40 crossing of the creek, and occurs between two narrow bends approximately 300 meters upstream of I-40. The stream channel ranges from 6 to 8 meters wide, with moderately eroded banks 2 meters high. Habitat consists

primarily of runs and pools, with limited riffles. The substrate is dominated by sand and pebble with clay banks and scattered boulders. Surveys were conducted for 3.67 person hours.

**Table 56.** Swift Creek Site-101027.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	0.54/hr
<i>Elliptio complanata</i>	Eastern Elliptio	284	77.38/hr
<i>Elliptio congarea</i>	Carolina Slabshell	11	3.00/hr
<i>Elliptio icterina</i>	Variable Spike	29	7.90/hr
<i>Elliptio mediocris</i>	No Common Name	2	0.54/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.27/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101027.5**

This site was accessed from the I-40 crossing of the creek, and occurs in a long, straight, narrow section of the stream approximately 200 meters upstream of I-40. The stream channel ranges from 5 to 8 meters wide, with moderately eroded banks 2 meters high. Habitat consists primarily of runs and pools, with limited riffles. The substrate is dominated by sand and pebble with clay banks and scattered boulders. Surveys were conducted for 2.87 person hours.

**Table 57.** Swift Creek Site-101027.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	63	21.95/hr
<i>Elliptio congarea</i>	Carolina Slabshell	3	1.04/hr
<i>Elliptio icterina</i>	Variable Spike	13	4.53/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	0.70/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	0.70/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.7**

This site occurs just below the I-40 crossing of the creek. The stream channel ranges from 8 to 10 meters wide, with severely eroded banks 2.5 meters high. Habitat consists primarily of runs and pools, with limited riffles created by sandbars and log jams. The substrate is dominated by shifting sand. Surveys were conducted for 2.92 person hours.

**Table 58.** Swift Creek Site-101021.7: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.34/hr
<i>Elliptio complanata</i>	Eastern Elliptio	55	18.84/hr
<i>Elliptio congarea</i>	Carolina Slabshell	5	1.71/hr
<i>Elliptio icterina</i>	Variable Spike	8	2.74/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.34/hr
<i>Strophitus undulatus</i>	Creeper	1	0.34/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.6**

This site occurs approximately 380 meters below the I-40 crossing of the creek in a long straight section. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. The site contains a sequence of shallow, glide, riffle and run habitat sequences. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 6.42 person hours.

**Table 59.** Swift Creek Site-101021.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	0.31/hr
<i>Elliptio complanata</i>	Eastern Elliptio	200	31.15/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.16/hr
<i>Elliptio icterina</i>	Variable Spike	39	6.07/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.16/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	3	0.47/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	3	0.47/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	0.31/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.16/hr
<i>Strophitus undulatus</i>	Creeper	1	0.16/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.5**

This site occurs approximately 480 meters below the I-40 crossing of the creek in a long straight run habitat. The stream channel ranges from 7 to 9 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by sand and gravel, with clay banks and occasional cobble and boulder. Surveys were conducted for 3.85 person hours.

**Table 60.** Swift Creek Site-101021.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	62	16.10/hr
<i>Elliptio congarea</i>	Carolina Slabshell	9	2.34/hr
<i>Elliptio icterina</i>	Variable Spike	16	4.16/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	0.52/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.52/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.26/hr
<i>Strophitus undulatus</i>	Creeper	1	0.26/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.4**

This site occurs approximately 580 meters below the I-40 crossing of the creek in a long, straight section. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. The site contains a sequence of shallow glide, riffle, and run habitat sequences. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 3.25 person hours.

**Table 61.** Swift Creek Site-101021.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.31/hr
<i>Elliptio complanata</i>	Eastern Elliptio	231	71.08/hr
<i>Elliptio congarea</i>	Carolina Slabshell	10	3.08/hr
<i>Elliptio icterina</i>	Variable Spike	28	8.62/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	0.62/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.62/hr
<i>Strophitus undulatus</i>	Creeper	1	0.31/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Patchy, Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.3**

This 30 meter long site occurs approximately 620 meters below the I-40 crossing of the creek in a long, straight section. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2.5 meters high. Habitat consists of a shallow riffle transitioning to a deep run. The substrate is dominated by sand and gravel with clay banks. Surveys were conducted for 2.83 person hours.

**Table 62.** Swift Creek Site-101021.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	126	44.52/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	0.71/hr
<i>Elliptio icterina</i>	Variable Spike	16	5.65/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.35/hr
<i>Strophitus undulatus</i>	Creeper	1	0.35/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Patchy, Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.2**

This site occurs approximately 700 meters below the I-40 crossing of the creek in a long, straight, narrow section. The stream channel ranges from 6 to 8 meters wide, with fairly stable banks 2 meters high. The site contains a braided channel of shallow glide, riffle, and run habitat sequences created by sandbars. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 4.67 person hours.

**Table 63.** Swift Creek Site-101021.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.21/hr
<i>Elliptio complanata</i>	Eastern Elliptio	234	50.11/hr
<i>Elliptio congarea</i>	Carolina Slabshell	4	0.86/hr
<i>Elliptio icterina</i>	Variable Spike	62	13.28/hr
<i>Elliptio mediocris</i>	No Common Name	1	0.21/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	0.43/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.43/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	4	0.86/hr
<i>Strophitus undulatus</i>	Creeper	8	1.71/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101021.1**

This site occurs approximately 800 meters below the I-40 crossing of the creek in a long, straight section. The stream channel ranges from 8 to 10 meters wide, with fairly stable banks 2 meters high. The site contains riffle and run habitats. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 3.5 person hours.

**Table 64.** Swift Creek Site-101021.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	0.57/hr
<i>Elliptio complanata</i>	Eastern Elliptio	147	42.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	4	1.14/hr
<i>Elliptio icterina</i>	Variable Spike	23	6.57/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.28/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.28/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.28/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.28/hr
<i>Strophitus undulatus</i>	Creeper	1	0.28/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.8**

This site occurs approximately 1,000 meters below the I-40 crossing of the creek in a long straight run. The stream channel ranges from 6 to 8 meters wide, with moderately eroded banks 1.5 meters high. The substrate is dominated by sand and gravel with clay banks. Surveys were conducted for 1.33 person hours.

**Table 65.** Swift Creek Site-101012.8: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	3	2.26/hr
<i>Elliptio complanata</i>	Eastern Elliptio	140	105.26/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.75/hr
<i>Elliptio icterina</i>	Variable Spike	28	21.05/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.75/hr
<i>Strophitus undulatus</i>	Creeper	1	0.75/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.7**

This site occurs approximately 1,100 meters below the I-40 crossing of the creek in a broad bend. The stream channel ranges from 6 to 8 meters wide, with eroded banks 2 meters high. Habitat consists of a shallow riffle grading into a deep run. The substrate is dominated by sand and gravel with clay banks. Surveys were conducted for 2.67 person hours.

**Table 66.** Swift Creek Site-101012.7: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	0.75/hr
<i>Elliptio complanata</i>	Eastern Elliptio	243	91.01/hr
<i>Elliptio congarea</i>	Carolina Slabshell	4	1.50/hr
<i>Elliptio icterina</i>	Variable Spike	21	7.86/hr
<i>Elliptio mediocris</i>	No Common Name	4	1.50/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.37/hr
<i>Strophitus undulatus</i>	Creeper	1	0.37/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.6**

This site occurs approximately 800 meters above the NC 42 crossing of the creek in long straight pool and glide habitat. The stream channel ranges from 6 to 8 meters wide, with eroded banks 3 meters high. The substrate is dominated by sand and silt with clay banks and occasional boulders. Surveys were conducted for 1.62 person hours.

**Table 67.** Swift Creek Site-101012.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	112	69.14/hr
<i>Elliptio icterina</i>	Variable Spike	7	4.32/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.62/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.62/hr
<i>Strophitus undulatus</i>	Creeper	2	1.23/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.5**

This site occurs approximately 700 meters above the NC 42 crossing of the creek in broad bend with glide, riffle, and run habitat sequences. The stream channel ranges from 6 to 8 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by sand with clay banks. Surveys were conducted for 1.67 person hours.



**Table 68.** Swift Creek Site-101012.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	91	54.49/hr
<i>Elliptio icterina</i>	Variable Spike	7	4.19/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.60/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.60/hr
<i>Strophitus undulatus</i>	Creeper	1	0.60/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.4**

This site occurs approximately 600 meters above the NC 42 crossing of the creek in straight section between two bends with riffle and run habitats. The stream channel ranges from 6 to 8 meters wide, with moderately eroded banks 2 meters high. The substrate is dominated by sand with clay banks. Surveys were conducted for 2.0 person hours.

**Table 69.** Swift Creek Site-101012.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance /CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	88	44.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	3	1.50/hr
<i>Elliptio icterina</i>	Variable Spike	16	8.00/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	1.00/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.50/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	1.00/hr
<i>Strophitus undulatus</i>	Creeper	1	0.50/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.3**

This site occurs approximately 400 meters above the NC 42 crossing of the creek in straight section just below the confluence of an unnamed tributary to the north. The stream channel ranges from 6 to 8 meters wide, with severely eroded banks 2 meters high. Habitat consists of deep pool grading into a swift run. The substrate is dominated by shifting sand with clay banks. Surveys were conducted for 1.0 person hour.

**Table 70.** Swift Creek Site-101012.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	60	60.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	1.00/hr
<i>Elliptio icterina</i>	Variable Spike	6	6.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.2**

This site occurs approximately 300 meters above the NC 42 crossing of the creek just above a narrow bend of the creek. The stream channel ranges from 6 to 8 meters wide, with severely eroded banks 2 meters high. Habitat consists of a shallow riffle grading into a swift run. The substrate is dominated by shifting sand with clay banks. Surveys were conducted for 1.0 person hour.

**Table 71.** Swift Creek Site-101012.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	64	64.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	1.00/hr
<i>Elliptio icterina</i>	Variable Spike	12	12.00/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	1.00/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	Shell	0.0/hr
<i>Strophitus undulatus</i>	Creeper	1	1.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101012.1**

This site occurs approximately 200 meters above the NC 42 crossing of the creek in a narrow bend of the creek. The stream channel ranges from 5 to 6 meters wide, with severely eroded banks 2 meters high. Habitat consists of a shallow riffle grading into a swift run. The substrate is dominated by shifting sand with clay banks. Surveys were conducted for 1.5 person hours.

**Table 72.** Swift Creek Site-101012.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.67/hr
<i>Elliptio complanata</i>	Eastern Elliptio	116	77.33/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.67/hr
<i>Elliptio icterina</i>	Variable Spike	20	13.33/hr
<i>Lampsilis radiata</i>	Eastern Lamppussel	Shell	0.0/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**UT Swift Creek Site-100713.4**

This UT to Swift Creek, which flows into Swift Creek approximately 400 meters upstream of NC 42, extends from the SR 1548 crossing of the stream to a point approximately 260 meters upstream. Numerous beaver dams within the stream and adjacent floodplain have created a braided channel wetland system. Substrate consists of sand and mud, with large amounts of detritus and aquatic vegetation. Surveys were conducted for a total of 1.00 person hour. No freshwater mussels were found; however, three aquatic snail species were common, and the Asian clam was also present.

**Table 73.** Swift Creek Site-100713.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
None	~	~	~
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Uncommon
<i>Helisoma anceps</i>	Two-ridge Ram's Horn	~	Common
<i>Physidae</i>	A Physid Snail		Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.9**

This site occurs approximately 100 meters below the NC 42 crossing of the creek in a narrow bend. The stream channel ranges from 5 to 6 meters wide, with relatively stable banks 2 meters high. Habitat consists of a shallow glide grading into a swift run. The substrate is dominated by gravel and sand with clay banks. Surveys were conducted for 2.0 person hours.

**Table 74.** Swift Creek Site-101013.9: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.50/hr
<i>Elliptio complanata</i>	Eastern Elliptio	251	125.50/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	1.00/hr
<i>Elliptio icterina</i>	Variable Spike	54	27.00/hr
<i>Elliptio mediocris</i>	No Common Name	2	1.00/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	1.00/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	1.00/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.50/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.50/hr
<i>Strophitus undulatus</i>	Creeper	5	2.50/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.8**

This site occurs in a long straight section of the stream below a broad bend approximately 170 meters below the NC 42 crossing of the creek. The stream channel ranges from 5 to 6 meters wide, with moderately eroded banks 2 meters high. Habitat consists of a long pool grading into a short riffle. The substrate is dominated by gravel and sand with clay banks. Surveys were conducted for 0.67 person hour.

**Table 75.** Swift Creek Site-101013.8: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	33	49.25/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	1.49/hr
<i>Elliptio icterina</i>	Variable Spike	5	7.46/hr
<i>Elliptio mediocris</i>	No Common Name	1	1.49/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.7**

This site occurs in a long straight section of the stream below a broad bend approximately 200 meters below the NC 42 crossing of the creek. The stream channel ranges from 5 to 6 meters wide, with severely eroded banks 2 meters high. Habitat consists of a long pool grading into a short run. Large amounts of woody debris are present. The substrate is dominated by gravel and sand with clay banks. Surveys were conducted for 0.67 person hour.

**Table 76.** Swift Creek Site-101013.7: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	12	17.91/hr
<i>Elliptio icterina</i>	Variable Spike	2	2.98/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.6**

This site occurs in a long, straight, constricted section of the stream approximately 230 meters below the NC 42 crossing of the creek. The stream channel ranges from 5 to 6 meters wide, with moderately eroded banks 2 meters high. Habitat consists of a riffle and run series. The substrate is dominated by gravel and sand with clay banks. Surveys were conducted for 1.33 person hours.

**Table 77.** Swift Creek Site-101013.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	3	2.26/hr
<i>Elliptio complanata</i>	Eastern Elliptio	137	103.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.75/hr
<i>Elliptio icterina</i>	Variable Spike	17	12.78/hr
<i>Elliptio mediocris</i>	No Common Name	1	0.75/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.75/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.75/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.5**

This site occurs in a long pool above a broad bend approximately 260 meters below the NC 42 crossing of the creek. The stream channel ranges from 5 to 6 meters wide, with severely eroded banks 2 meters high. The substrate is dominated by sand and silt with clay banks. A large amount of woody debris and detritus is present. Surveys were conducted for 1.0 person hour.

**Table 78.** Swift Creek Site-101013.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	96	96.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	4	4.00/hr
<i>Elliptio icterina</i>	Variable Spike	11	11.00/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	1.00/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	1	1.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.3**

This site occurs in a broad bend approximately 660 meters below the NC 42 crossing of the creek. The stream channel ranges 6 to 7 meters wide, with relatively stable banks 2 meters high. Habitat consists of a shallow glide transitioning to a run. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 2.88 person hours.

**Table 79.** Swift Creek Site-101013.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	4	1.39/hr
<i>Elliptio complanata</i>	Eastern Elliptio	425	147.57/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.35/hr
<i>Elliptio icterina</i>	Variable Spike	38	13.19/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	3	1.04/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	6	2.08/hr
<i>Strophitus undulatus</i>	Creper	4	1.39/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	1	0.35/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.2**

This site occurs in straight wide section approximately 700 meters below the NC 42 crossing of the creek. The stream channel ranges 8 to 9 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a glide to riffle to run sequence, with sand and gravel substrate. Surveys were conducted for 1.33 person hours.

**Table 80.** Swift Creek Site-101013.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	3	2.26/hr
<i>Elliptio complanata</i>	Eastern Elliptio	121	90.98/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	0.75/hr
<i>Elliptio icterina</i>	Variable Spike	11	8.27/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.75/hr
<i>Elliptio mediocris</i>	No Common Name	3	2.26/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	6	4.51/hr
<i>Strophitus undulatus</i>	Creeper	2	1.50/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Common
<i>Physidae</i>	A Physid Snail	~	Uncommon

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.4**

This site occurs in small riffle section at the confluence of an intermittent channel from the south, approximately 730 meters below the NC 42 crossing of the creek. The stream channel ranges from 7 to 8 meters wide, with relatively stable banks 2 meters high. The substrate is dominated by sand and pebble with clay banks. Surveys were conducted for 0.58 person hour.

**Table 81.** Swift Creek Site-101013.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	1.72/hr
<i>Elliptio complanata</i>	Eastern Elliptio	25	43.10/hr
<i>Elliptio icterina</i>	Variable Spike	14	24.14/hr
<i>Elliptio mediocris</i>	No Common Name	1	1.72/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	1.72/hr
<i>Strophitus undulatus</i>	Creeper	2	3.45/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Swift Creek between Lake Benson and Cornwallis Road Site-101013.1**

This site occurs in straight wide section approximately 750 meters below the NC 42 crossing of the creek. The stream channel ranges from 8 to 9 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a glide to riffle to run sequence, with sand and gravel substrate. Surveys were conducted for 2.33 person hours.

**Table 82.** Swift Creek Site-101013.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	1	0.43/hr
<i>Alasmidonta undulata</i>	Triangle Floater	7	3.00/hr
<i>Elliptio complanata</i>	Eastern Elliptio	180	77.25/hr
<i>Elliptio icterina</i>	Variable Spike	28	12.02/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.43/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.43/hr
<i>Strophitus undulatus</i>	Creeper	2	0.86/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Common
<i>Planorbella trivolvis</i>	Marsh Ram's Horn	~	Rare

**Swift Creek between Lake Benson and Cornwallis Road Site-101026.4**

This site occurs in straight wide section approximately 770 meters below the NC 42 crossing of the creek. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a series of glide to riffle to run sequences, with sand and gravel substrate. Surveys were conducted for 6.50 person hours.

**Table 83.** Swift Creek Site-101026.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	1	0.15/hr
<i>Alasmidonta undulata</i>	Triangle Floater	11	1.69/hr
<i>Elliptio complanata</i>	Eastern Elliptio	489	75.23/hr
<i>Elliptio congarea</i>	Carolina Slabshell	8	1.23/hr
<i>Elliptio icterina</i>	Variable Spike	89	13.69/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.15/hr
<i>Elliptio mediocris</i>	No Common Name	9	1.38/hr
<i>Elliptio producta</i>	Atlantic Spike	1	0.15/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	0.31/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.15/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.15/hr
<i>Pyganodon cataracta</i>	Eastern Floater	2	0.31/hr
<i>Strophitus undulatus</i>	Creeper	5	0.77/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant



### Swift Creek between Lake Benson and Cornwallis Road Site-101026.3

This site occurs in narrow bend approximately 950 meters below the NC 42 crossing of the creek. The stream channel ranges from 6 to 8 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a riffle to run sequence, with sand and gravel substrate. Surveys were conducted for 5.58 person hours.

**Table 84.** Swift Creek Site-101026.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	8	1.43/hr
<i>Elliptio complanata</i>	Eastern Elliptio	515	92.29/hr
<i>Elliptio congarea</i>	Carolina Slabshell	7	1.25/hr
<i>Elliptio icterina</i>	Variable Spike	173	31.00/hr
<i>Elliptio mediocris</i>	No Common Name	10	1.79/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.18/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	6	1.08/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.18/hr
<i>Strophitus undulatus</i>	Creeper	6	1.08/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

### Swift Creek between Lake Benson and Cornwallis Road Site-101026.2

This site occurs in a short run between two narrow bends approximately 980 meters below the NC 42 crossing of the creek. The stream channel ranges from 7 to 9 meters wide, with moderately eroded banks 2 meters high. Habitat consists of sand and pebble with clay banks. Surveys were conducted for 1.17 person hours.

**Table 85.** Swift Creek Site-101026.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.85/hr
<i>Elliptio complanata</i>	Eastern Elliptio	130	111.11/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	1.71/hr
<i>Elliptio icterina</i>	Variable Spike	23	19.66/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	1	0.85/hr
<i>Lampsilis radiata</i>	Eastern Lampermussel	2	1.71/hr
<i>Strophitus undulatus</i>	Creeper	2	1.71/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101026.1**

This site occurs in straight section approximately 1,010 meters below the NC 42 crossing of the creek. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a glide to riffle to run sequence, with sand and pebble substrate. Surveys were conducted for 3.75 person hours.

**Table 86.** Swift Creek Site-101026.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.27/hr
<i>Elliptio complanata</i>	Eastern Elliptio	257	68.53/hr
<i>Elliptio congarea</i>	Carolina Slabshell	5	1.33/hr
<i>Elliptio icterina</i>	Variable Spike	86	22.93/hr
<i>Elliptio lanceolata</i>	Yellow Lance	1	0.27/hr
<i>Elliptio mediocris</i>	No Common Name	4	1.07/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.27/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.53/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.27/hr
<i>Strophitus undulatus</i>	Creper	3	0.80/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Rare
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Swift Creek between Lake Benson and Cornwallis Road Site-101019.4**

This site occurs in narrow, straight section approximately 1,000 meters above the Cornwallis Road (SR 1525) crossing of the creek. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a scoured run, with sand and pebble substrate with occasional cobble. Surveys were conducted for 3.73 person hours.

**Table 87.** Swift Creek Site-101019.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	246	65.95/hr
<i>Elliptio icterina</i>	Variable Spike	23	6.17/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	1	0.27/hr
<i>Fusconaia masoni</i>	Atlantic Pigtoe	2	0.54/hr
<i>Strophitus undulatus</i>	Creper	2	0.54/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Rare
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

### Swift Creek between Lake Benson and Cornwallis Road Site-101019.3

This site occurs in broad bend approximately 600 meters above the Cornwallis Road (SR 1525) crossing of the creek. The stream channel ranges from 8 to 10 meters wide, with moderately eroded banks 2 meters high. Habitat is characterized as a scoured run, with sand and pebble substrate with occasional cobble. Surveys were conducted for 4.0 person hours.

**Table 88.** Swift Creek Site-101019.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.25/hr
<i>Elliptio complanata</i>	Eastern Elliptio	291	72.75/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	0.50/hr
<i>Elliptio icterina</i>	Variable Spike	32	8.00/hr
<i>Elliptio mediocris</i>	No Common Name	1	0.25/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	0.50/hr
<i>Strophitus undulatus</i>	Creeper	3	0.75/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

### White Oak Creek Site-100722.1

This section of White Oak Creek was accessed off the Raynor Road (SR 2555) crossing. Channel width ranged from 2 to 4 meters with relatively stable 1-meter high banks. In order of dominance, substrate consisted of sand, clay, silt, and pebble. Water levels were normal and water visibility was clear. Mussel surveys were conducted for a total of 1.83 person hours.

**Table 89.** White Oak Creek Site-100722.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	34	18.58/hr
<i>Elliptio icterina</i>	Variable Spike	2	1.09/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Uncommon

### White Oak Creek Site-100713.1

This section of White Oak Creek extends from the SR 1550 (Winston Road) crossing of the creek to a point approximately 300 meters upstream. The poorly defined channel is approximately 1.5 meters wide and meanders through a marsh wetland system. The substrate consists of firm clay and sand. Surveys were conducted for a total of 2.00 person hours.

**Table 90.** White Oak Creek Site-100713.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
None	~	~	~
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Patchy Common
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Little Creek Site-100720.4**

This section of Little Creek occurs between a point approximately 200 meters upstream of the Amelia Church Road (SR 1553) crossing to a point approximately 600 meters upstream and was accessed off the Raynor Road (SR 2555) crossing. Channel width ranged from 3 to 4 meters with relatively stable 1-meter high banks. Habitat consists of shallow pool to riffle to run sequences, with sand and cobble dominated substrate.

Surveys were conducted for a total of 3.0 person hours.

**Table 91.** Little Creek Site-100720.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance /CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	262	87.33/hr
<i>Elliptio icterina</i>	Variable Spike	10	3.33/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Patchy, Common
<i>Corbicula fluminea</i>	Asian Clam	~	Rare

**Little Creek Site-100713.3**

This section of Little Creek extends from the Amelia Church Road (SR 1553) crossing to a point approximately 200 meters upstream. Channel width ranged from 3 to 4 meters with relatively stable 1-meter high banks. Habitat consists of shallow pool to riffle to run sequences, with sand and cobble dominated substrate. Surveys were conducted for a total of 1.0 person hour.

**Table 92.** Little Creek Site-100713.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	78	78.00/hr
<i>Elliptio icterina</i>	Variable Spike	5	5.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Patchy, Common
<i>Corbicula fluminea</i>	Asian Clam	~	Rare

**2.2.3. Eastern Section**

The Eastern section of the project corridor occurs between Business 70 north to the US 64/US 264 Bypass, and drains to the Neuse River from the US 64/264 Bypass crossing of the river downstream to the vicinity of the Wake/Johnston County line. Tributaries to the Neuse River within this section include: Walnut Creek and Beddingfield Creek to the south; Mango Creek, Unnamed Tributary (UT) to Neuse River, Poplar Creek, and Mark's Creek to the north.

**Big Branch Site-100722.2**

This section of Big Branch, a tributary to Walnut Creek, was accessed off the Auburn Church Road (SR 2548) crossing. Channel width ranged from 3 to 5 meters with 1-meter high banks that showed signs of erosion. Substrate was dominated by a heavy load of unconsolidated sand. Water levels were normal and water visibility was clear. A few shells of Asian clam were the only evidence of mollusks found in 1.0 person hour.

**Table 93.** Big Branch Site-100722.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
None	~	~	~
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Rare

**Walnut Creek Site-100623.4**

This section of Walnut Creek extends from the Barwell Road (SR 2551) crossing to a point approximately 700 meters upstream. Channel width ranges from 10 to 12 meters with moderately eroded banks 2 to 3 meters high. Substrate consists of shifting sand with numerous boulders. No mussels were found in 2.5 person hours of survey time.

**Table 94.** Walnut Creek Site-100623.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
None	~	~	~
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Beddingfield Creek Site-100713.2**

This section of Beddingfield Creek extends from approximately 30 meters below the Shotwell Road (SR 1553) crossing to a point approximately 400 meters upstream of the crossing. The channel width ranges from 3 to 4 meters with severely eroded banks 2 to 4 meters high. Substrate consists of shifting sand. No mollusk species were found in 1.5 person hours.

**Neuse River Site-100726.1**

This site occurs in a slack-water section of Neuse River approximately 50 meters upstream of the Poole Road (SR 1007) crossing at a canoe access. The river is approximately 40 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of bedrock overlain with silt and sand. Surveys were conducted for 0.41 person hour.

**Table 95.** Neuse River Site-100726.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	25	60.98/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	2	4.88/hr
<i>Lasmigona subviridis</i>	Green Floater	1 shell	0.0/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.2**

This site occurs at the Poole Road (SR 1007) crossing of the Neuse River in a deep run habitat. The river is approximately 40 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand and gravel with clay banks, and occasional boulders. Surveys were conducted for 1.05 person hours.

**Table 96.** Neuse River Site-100726.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	41	39.05/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	1.90/hr
<i>Elliptio icterina</i>	Variable Spike	2	1.90/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	59	56.19/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.95/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.3**

This site occurs approximately 300 meters below the Poole Road (SR 1007) crossing of the Neuse River in a riffle to run habitat sequence. The river is approximately 40 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand and gravel with clay banks. Surveys were conducted for 2.25 person hours.

**Table 97.** Neuse River Site-100726.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	214	95.11/hr
<i>Elliptio congarea</i>	Carolina Slabshell	8	3.56/hr
<i>Elliptio icterina</i>	Variable Spike	16	7.11/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	426	189.33/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	4	1.78/hr
<i>Lasmigona subviridis</i>	Green Floater	23	10.22/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.4**

This site occurs approximately 200 meters below the Walnut Creek confluence with the river. The river is approximately 40 meters wide with moderately eroded banks 2 to 3 meters high. The habitat consists of a bedrock cascade and plunge pool. Mussels were mostly found within bedrock crevices and pockets of accumulated sand. Surveys were conducted for 1.0 person hour.

**Table 98.** Neuse River Site-100726.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	37	37.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1 shell	0.0/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	19	19.00/hr
<i>Lasmigona subviridis</i>	Green Floater	1	1.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.5**

This site occurs approximately 600 meters below the Walnut Creek confluence with Neuse River in a run habitat. The river is approximately 26 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand and gravel with clay banks. Surveys were conducted for 1.0 person hour.

**Table 99.** Neuse River Site-100726.5: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	66	66.00/hr
<i>Elliptio congarea</i>	Carolina Slabshell	1	1.00/hr
<i>Elliptio icterina</i>	Variable Spike	1	1.00/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	26	26.00/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	1.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.6**

This site occurs approximately 1,100 meters below the Walnut Creek confluence with the Neuse River in a riffle to run habitat sequence. The river is approximately 28 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists mostly of unconsolidated sand with clay banks, and occasional pockets of gravel in the thalweg. Surveys were conducted for 1.75 person hours.



**Table 100.** Neuse River Site-100726.6: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	2	1.14/hr
<i>Elliptio complanata</i>	Eastern Elliptio	197	112.57/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	1.14/hr
<i>Elliptio icterina</i>	Variable Spike	2	1.14/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	211	120.57/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.57/hr
<i>Lasmigona subviridis</i>	Green Floater	5	2.86/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.7**

This site occurs approximately in the middle of a large broad bend of the river, approximately 1,900 meters above the Auburn-Knightdale Road (SR 2555) crossing in a riffle to run habitat sequence. The river is approximately 28 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand, gravel, and cobble with clay banks, and occasional boulders. A large sandbar occurs along the left descending bank, extending into the river for one-third the width. Surveys were conducted for 1.75 person hours.

**Table 101.** Neuse River Site-100726.7: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	107	61.14/hr
<i>Elliptio congarea</i>	Carolina Slabshell	2	1.14/hr
<i>Elliptio icterina</i>	Variable Spike	2	1.14/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	57	32.57/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	1.14/hr
<i>Lasmigona subviridis</i>	Green Floater	5	2.86/hr
<i>Strophitus undulatus</i>	Creper	1 shell	0.0/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.8**

This site occurs in a straight section between two broad bends of the river, approximately 1,000 meters above the Auburn-Knightdale Road (SR 2555) crossing. The habitat consists of a riffle to run habitat sequence. The river is approximately 28 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand, gravel, and cobble with clay banks and occasional boulders. Surveys were conducted for 1.75 person hours.

**Table 102.** Neuse River Site-100726.8: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	104	59.43/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	219	125.14/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.57/hr
<i>Lasmigona subviridis</i>	Green Floater	1	0.57/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100726.9**

This site occurs in a relatively narrow straight section of the river, approximately 300 meters above the Auburn-Knightdale Road (SR 2555) crossing. The river is approximately 24 meters wide with moderately eroded banks 2 to 3 meters high. The habitat consists of a bedrock cascade and plunge pool. Mussels were mostly found within bedrock crevices and pockets of accumulated sand. Surveys were conducted for 1.25 person hours.

**Table 103.** Neuse River Site-100726.9: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	18	14.40/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	52	41.60/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.80/hr
<i>Lasmigona subviridis</i>	Green Floater	1	0.80/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100720.2**

This site occurs in the vicinity of the Auburn-Knightdale Road (SR 2555) crossing, in a run and pool habitat sequence. The river is approximately 32 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand and cobble with clay banks. The right descending bank has been stabilized with rip rap that extends into the channel. Surveys were conducted for 1.16 person hours.

**Table 104.** Neuse River Site-100720.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	55	47.41/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	25	21.55/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	1.72/hr
<i>Lasmigona subviridis</i>	Green Floater	3	2.59/hr
<i>Pyganodon cataracta</i>	Eastern Floater	1	0.86/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100720.1**

This site occurs approximately 220 meters below the Auburn-Knightdale Road (SR 2555) crossing in a deep run. A large sandbar extends from the left descending bank to the center of the channel. The river is approximately 30 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand and gravel with some areas of exposed bedrock. Surveys were conducted for 2.83 person hours.

**Table 105.** Neuse River Site-100720.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	8	2.82/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	188	66.43/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	1	0.35/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	1	0.35/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Neuse River Site-100720.3**

This site occurs in the vicinity of the Mail Plantation Road (SR 2509) crossing in a small riffle to long, deep run habitat sequence. The river is approximately 34 meters wide with moderately eroded banks 2 to 3 meters high. Substrate consists of sand, gravel and cobble with clay banks. A large sandbar occurs along the left descending bank, extending into the river for one-quarter the width. Surveys were conducted for 2.5 person hours.

**Table 106.** Neuse River Site-100720.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Alasmidonta undulata</i>	Triangle Floater	1	0.40/hr
<i>Elliptio complanata</i>	Eastern Elliptio	45	18.0/hr
<i>Elliptio congarea</i>	Carolina Slabshell	3	1.20/hr
<i>Elliptio roanokensis</i>	Roanoke Slabshell	18	7.20/hr
<i>Lampsilis radiata</i>	Eastern Lampmussel	2	0.80/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Mango Creek Site-100702.2**

This site occurs approximately 100 meters downstream of the Hodge Road (SR 2516) crossing in a side channel 2 to 3 meters wide of Mango Creek created by a beaver dam across the main channel. Habitat is characterized as a shallow run with a sand and clay substrate. Surveys were conducted for 1.5 person hours.

**Table 107.** Mango Creek Site-100702.2: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Pyganodon cataracta</i>	Eastern Floater	6	4.00/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	4	2.67/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant

**Mango Creek Site-100702.1**

This site extends from the Hodge Road (SR 2516) crossing to a point approximately 600 meters upstream. Habitat consists of a large, braided channel, beaver created, wetland complex. Substrate consists of sand, clay, mud, and detritus. Surveys were conducted for 3.0 person hours.

**Table 108.** Mango Creek Site-100702.1: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Pyganodon cataracta</i>	Eastern Flaoater	12	4.0/hr
<i>Utterbackia imbecillis</i>	Paper Pondshell	4	1.33/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant
<i>Helisoma anceps</i>	Two-ridge Ram's Horn	~	Patchy, Common
<i>Physidae</i>	A Physid Snail	~	Patchy, Uncommon
<i>Sphaeriidae</i>	A Sphaeriid Clam	~	Uncommon

**UT Neuse River Site-100722.3**

This UT to the Neuse River was accessed off the Poole Road crossing. Channel width ranges from 1 to 2 meters with relatively unstable 1- to 2-meter high banks. In order of dominance, substrate consists of sand, clay, gravel, silt, and pebble. Mussel surveys were conducted for a total of 1.33 person hours.

**Table 109.** UT Neuse River Site-100722.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	6	4.51/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common
<i>Corbicula fluminea</i>	Asian Clam	~	Abundant
<i>Helisoma anceps</i>	Two-ridge Ram's Horn	~	Patchy, Common
<i>Physidae</i>	A Physid Snail	~	Patchy, Uncommon
<i>Sphaeriidae</i>	A Sphaeriid Clam	~	Uncommon

**Poplar Creek Site-100702.3**

This site extends from the Grasshopper Road (SR 2511) crossing upstream to the Poole Road (SR 1007) crossing. The channel ranges from 3 to 4 meters wide, with severely eroded banks 3 meters high. The substrate consists of unconsolidated sand with scattered cobble. A WWTP discharge is located near the Poole Road crossing. Surveys were conducted for 2.33 person hours.

**Table 110.** Poplar Creek Site-100702.3: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
None	~	~	~
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Corbicula fluminea</i>	Asian Clam	~	Common

**Marks Creek 100722.4**

This section of Marks Creek was accessed off Marks Creek Road (SR 2234). Channel width ranges from 3 to 6 meters with 2-meter high banks that showed signs of erosion. In order of dominance, substrate consists of sand, silt, granitic bedrock, clay, and gravel. Surveys were conducted for a total of 1.0 person hour.

**Table 111.** Marks Creek Site 100722.4: Mollusk Species Found

Scientific Name	Common Name	#	Abundance/ CPUE
<b>Freshwater Mussels</b>	~	~	<b>CPUE</b>
<i>Elliptio complanata</i>	Eastern Elliptio	12	12.00/hr
<b>Freshwater Snails and Clams</b>	~	~	<b>Relative Abundance</b>
<i>Campeloma decisum</i>	Pointed Campeloma	~	Common

**3.0 MUSSEL SPECIES DESCRIPTIONS**

Brief descriptions of the six targeted mussel species, four of which were found during this survey effort, are provided below as are descriptions of the 11 other mussel species found.

**3.1. Federally Protected Species**

The two federally endangered freshwater mussel species known to occur within the Neuse River Basin in Wake and Johnston Counties were the main focus of this study. Prior to these surveys, the Dwarf Wedgemussel had been found in Swift Creek and Middle Creek, and was historically known from the Neuse River in Wake County. The only known occurrence of the Tar River Spiny mussel in the Neuse River Basin is from the Little River in Johnston County. This species has never been found in Swift Creek, and was not found during this study.

**3.1.1. *Alasmidonta heterodon* (Dwarf Wedgemussel)*****Characteristics***

The Dwarf Wedgemussel was originally described as *Unio heterodon* (Lea 1829). Simpson (1914) subsequently placed it in the genus *Alasmidonta*. Ortmann (1914) placed it in a monotypic subgenus *Prolasmidonta*, based on the unique soft-tissue anatomy and conchology. Fuller (1977) believed the characteristics of *Prolasmidonta* warranted elevation to full generic rank and renamed the species *Prolasmidonta*

*heterodon*. Clarke (1981) retained the genus name *Alasmidonta* and considered *Prolasmidonta* to be a subjective synonym of the subgenus *Pressodonta* (Simpson 1900).

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

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

#### ***Distribution and Habitat Requirements***

The historic range of the Dwarf Wedgemussel was confined to Atlantic slope drainages from the Peticodiac River in New Brunswick, Canada, south to the Neuse River, North Carolina. Occurrence records exist from at least 70 locations, encompassing 15 major drainages, in 11 states and 1 Canadian Province (USFWS 1993). When the recovery plan for this species was written, the Dwarf Wedgemussel was believed to have been extirpated from all but 36 localities, 14 of them in North Carolina (USFWS 1993). The most recent assessment (2007 5-Year Review) indicates that the Dwarf Wedgemussel is currently found in 15 major drainages, comprising approximately 70 "sites" (one site may have multiple occurrences). At least 45 of these sites are based on less than five individuals or solely on relict shells. It appears that the populations in North Carolina, Virginia, and Maryland are declining as evidenced by low densities, lack of reproduction, or inability to relocate any individuals in follow-up surveys. Populations in New Hampshire, Massachusetts, and Connecticut appear to be stable, while the status of populations in the Delaware River watershed affected by the recent floods of 2005 is uncertain (USFWS 2007).

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

believed to have been extirpated from the main-stem of the Neuse River. It was found at 3 sites within the study area, all in Swift Creek.

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

### ***Threats to Species***

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

Siltation resulting from substandard land-use practices associated with activities such as agricultural, 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, Markings and Bills 1979). Sediment accumulations of less than 25 mm have been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of the Dwarf Wedgemussel because of accelerated sedimentation and erosion (Smith 1981).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations may not occur for up to 3,218 meters (two miles) below points of chlorinated sewage effluent.

The impact of impoundments on freshwater mussels has been well documented (USFWS 1992a, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes in aquatic community composition. The changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for upstream transport of glochidia. Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for naiads (mussels) in the world, is now at the bottom of Wilson Reservoir and covered with 5.79 meters (19 feet) of muck (USFWS 1992b). Large portions of all of the river basins within the Dwarf Wedgemussel's range have been impounded and this is



believed to be a major factor contributing to the decline of the species (Master 1986, USFWS 1993).

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

### **3.1.2. *Elliptio steinstansana* (Tar River Spiny mussel)**

#### ***Characteristics***

The Tar River Spiny mussel grows to a maximum length of 60 millimeters. Short spines are arranged in a radial row anterior to the posterior ridge on one valve and symmetrical to the other valve. The shell is generally smooth in texture with as many as 12 spines that project perpendicularly from the surface and curve slightly ventrally. However, adult specimens tend to lose their spines as they mature (USFWS 1992a). The Tar River Spiny mussel is distinguished by its shiny periostracum, parallel pseudocardinal teeth, and the linear ridges on the inside surface of the shell.

Little is known about the reproductive biology of the Tar River Spiny mussel (USFWS 1992c), however, nearly all freshwater mussel species have similar reproductive strategies, which involves a larval stage (glochidium), that becomes a temporary obligatory parasite on a fish. Many mussel species have specific fish hosts, which must be present to complete their life cycle. McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

#### ***Distribution and Habitat Requirements***

Previously this mussel was believed to be endemic to the Tar River system, currently occurring in relatively short stretches of the Tar River and three creeks (Shocco, Sandy/Swift and Fishing/Little Fishing) in the Tar drainage. Historically, the Tar River Spiny mussel was collected in the Tar River from near Louisburg in Franklin County to Falkland in Pitt County, a range of approximately 125.5 kilometers (78 river miles). Clarke (1983) located Tar River Spiny mussel in only a 19.31 km (12-mile) stretch of the Tar River in Edgecombe County. Since 1998, five individuals of this species have been found in the Little River of the Neuse River Basin in Johnston (NCWRC unpublished data). This species is also listed as being found in the Little River in site records of Clarke (1983), but was not mentioned in the report. The Tar River Spiny mussel has never

been found in any of the water bodies in the project area, nor was it found during this study.

The preferred habitat of the Tar River Spiny mussel in Swift Creek of the Tar River Basin was described as relatively fast flowing, well oxygenated, circumneutral pH water in sites prone to significant swings in water velocity, with a substrate comprised of relatively silt-free loose gravel and/or coarse sand.

### ***Threats to Species***

The cumulative effects of several factors, including sedimentation, point and non-point discharge, and stream modifications (impoundments, channelization, etc.), have contributed to the decline of this species throughout its range. The remaining populations of Tar River Spiny mussel are generally small in numbers. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity (Strayer et al. 1996). Catastrophic events may consist of natural events such as flooding or drought, as well as human influenced events such as toxic spills associated with highways, railroads or industrial-municipal discharges. Other threats are similar to those described above for Dwarf Wedgemussel.

### ***3.2. Target Federal Species of Concern (FSC)***

The four FSC species targeted have been previously reported in the study area; however, prior to this survey, no recent records of the Green Floater, or Yellow Lamp mussel were known.

#### ***3.2.1. *Elliptio lanceolata* (Yellow Lance)***

##### ***Characteristics***

The yellow lance was described from the Tar River at Tarboro, North Carolina by I. Lea in 1828. This species differs from other lance-shaped elliptios by having a “waxy” bright yellow periostracum that lacks rays. The posterior ridge is distinctly rounded and curves dorsally towards the posterior end.

##### ***Distribution and Habitat Requirements***

This species is distributed from the Neuse River Basin north to the Rappahannock, but is not believed to occur in the Roanoke or James River Basin. It is in considerable decline throughout its range. Extant populations occur in the Neuse, Tar/Pamlico, Chowan and York River basins. This species is found in small streams to large rivers in substrates primarily consisting of clean sand, and occasionally gravel. It was found at 8 sites within Swift Creek during this study.

### ***Threats to Species***

Threats to this and many other freshwater mussel species are similar to those described above for the Dwarf Wedgemussel. This species is a FSC and is listed as Endangered in North Carolina. Williams et al. (1993) list this species as Endangered. There appears to be sufficient data to warrant elevation of the yellow lance to Candidate status in the very near future (John Fridell, Recovery Biologist USFWS, Personal Communication).

### **3.2.2. *Fusconaia masoni* (Atlantic Pigtoe)**

#### ***Characteristics***

The Atlantic Pigtoe was described by Conrad (1834) from the Savannah River in Augusta, Georgia. Shells of the Atlantic pigtoe are subrhomboidal in outline, with a parchment-like yellow to dark brown periostracum. The posterior ridge is very distinct, and the umbos extend well above the dorsal margin.

The Atlantic pigtoe is a tachytictic (short-term) breeder, brooding young and releasing glochidia in early summer. The bluegill (*Lepomis macrochirus*) and shield darter (*Percina peltata*) have been identified as potential fish hosts for this species (O'Dee and Waters 2000).

#### ***Distribution and Habitat Requirements***

The Atlantic Pigtoe ranges from the Ogeechee River Basin in Georgia north to the James River Basin in Virginia. It occurs in medium size streams to large rivers, but has experienced major declines throughout its entire range. The preferred habitat for this species is a substrate composed of gravel and coarse sand, usually at the base of riffles, however, it can be found in a variety of other substrates and habitat conditions (personal observations). It was found at 23 sites within Swift Creek during this study effort.

#### ***Threats to Species***

Threats to this and many other freshwater mussel species are similar to those described above for the Dwarf Wedgemussel. This species is a FSC and is listed as Endangered in North Carolina. Williams et al. (1993) list this species as Endangered. There appears to be sufficient data to warrant elevation of the Atlantic pigtoe to Candidate status in the very near future (John Fridell, Recovery Biologist USFWS, Personal Communication).

### **3.2.3. *Lasmigona subviridis* (Green Floater)**

#### ***Characteristics***

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

#### ***Distribution and Habitat Requirements***

The Green Floater occurs along the Atlantic slope from the Savannah River in Georgia north to the Hudson River in New York, as well as in the "interior" basins (New, Kanawah, and Watauga Rivers) of the Tennessee River basin. It occurs in small size streams to large rivers, in quiet waters such as pools, or eddies, with gravel and sand substrates. It has experienced major declines throughout its entire range. It was found at 8 sites within the Neuse River during this study.

#### ***Threats to Species***

Threats to this and many other freshwater mussel species are similar to those described above for the Dwarf Wedgemussel. This species is a FSC and is listed as Endangered in North Carolina. Williams et al. (1993) list this species as Threatened. Based on preliminary genetics research, the southern populations of the Green Floater (Tar

Pamlico, Neuse, and Yadkin/Pee Dee River Basins) appear to be genetically distinct from populations from the Roanoke River to the north and west (Morgan Railey and Arthur Bogan, North Carolina Museum of Natural Sciences, 2007 personal communication). Further research is needed to determine if these differences warrant classification of the southern populations as a distinct species.

#### **3.2.4. *Lampsilis cariosa* (Yellow Lampmussel)**

##### ***Characteristics***

This species was described from the Schuylkill River near Philadelphia (Say 1817). The waxy-yellow shell is obovate in outline, with a rounded anterior margin and slightly curved posterior margin, and is rarely rayed. The shell thickness begins as thin in juveniles becoming thicker with age. The moderately inflated shell attains a length of 120 mm (Bogan 2002). Male shells are elliptical and somewhat elongate in outline with the ventral margin evenly convex. Female shells are subovate to obovate in outline with the ventral margin expanded near the posterior margin, sloping up to a very bluntly rounded posterior margin. Posterior ridge is poorly developed and rounded, posterior slope slightly convex to flat. Beaks moderately swollen but not elevated much above the hinge line, located anterior of the middle of the shell, beak sculpture consist of about five poorly defined bars, the first ridge concentric with the remainder slightly double-looped. The left valve has two compressed pseudocardinal teeth, the posterior tooth low and immediately under the umbo, and two delicate lateral teeth. The right valve has a single compressed pseudocardinal tooth, and a single lamellar lateral tooth. The pseudocardinal teeth tend to become more stumpy and ragged with age. The interdentum is practically absent, and the beak cavity is open and moderately deep. Older specimens become brownish and lose much of the luster. Nacre color is bluish-white, often tinged with cream or salmon.

##### ***Distribution and Habitat Requirements***

The yellow lampmussel is found from the lower Ottawa River, Canada eastward to the Sydney River, Nova Scotia then south to the Ogeechee River Drainage Basin in Georgia (Johnson 1970). At one time this species probably ranged throughout most of the Atlantic drainages in North Carolina; however, historical records provided by Johnson (1970) and recent records (Bogan 2002, NCWRC Unpublished data) indicate the species occurs in the Catawba, Pee Dee, Waccamaw, Cape Fear, Neuse, Tar/Pamlico, and Chowan drainages.

##### ***Threats to Species***

Threats to this and many other freshwater mussel species are similar to those described above for the Dwarf Wedgemussel. This species is a FSC and is listed as Endangered in North Carolina. Williams et al. (1993) also list this species as Endangered.

### **3.3. Other Mussel Species Located**

#### **3.3.1 *Alasmidonta undulata* (Triangle Floater)**

This species was described from the Schuylkill River near Philadelphia (Say 1817). Its range extends from the Catawba River in North Carolina north to the lower St. Lawrence River. The shell shape is subtriangular to ovate and inflated. The anterior and ventral shell margins are rounded. The periostracum is yellowish green with broad green or black rays. This species is considered Special Concern throughout its range (Williams et

al. 1993). It is considered Threatened in North Carolina. This species was found at 1 site in Middle Creek, 28 sites in Swift Creek, and 2 sites in the Neuse River.

### **3.3.2 *Elliptio complanata* (Eastern Elliptio)**

This species was described as *Mya complanata* from the Potomac River in Maryland (Lightfoot 1786). Shell characteristics are highly variable. Shell shape is typically trapezoidal to rhomboid and compressed to inflated. The usually straight ventral margin is mostly parallel with the dorsal margin and the posterior margin is broadly rounded. Shell thickness varies from thin to solid. This species is widely distributed along the Atlantic Slope from Altamaha River Basin in Georgia north to the St. Lawrence River Basin, and west to Lake Superior and parts of the Hudson Bay Basin. It can be found in a variety of habitats from large rivers and, lakes to small headwater streams. The species is widespread and common throughout its range and considered stable (Williams et al. 1993). It was found at 100 sites in all three watershed sections of the study area.

### **3.3.3 *Elliptio congarea* (Carolina Slabshell)**

This species was described from the Congaree River, South Carolina by Lea (1831). The range of this species extends from the Ogeechee River, Georgia north to the Chowan River, North Carolina and Virginia. The shell is rhomboid and subcompressed with moderately full beaks. The front of the shell is wedge-shaped, with the posterior end obliquely truncate above and biangulate below. The posterior slope usually has numerous cross corrugations or wrinkles. The periostracum is greenish-yellow or tawny. (Williams et al. 1993) list this species as Special Concern. It is considered a Watch 2/Watch 5 species, which indicates that the species is rare to uncommon, but probably not in trouble (W2), but has known increasing threats to its habitat, whether populations are known to be declining or not (W5) (LeGrand et al. 2010). This species was found at 43 sites within Swift Creek and the Neuse River.

### **3.3.4 *Elliptio icterina* (Variable Spike)**

Described from the Savannah River near Augusta, Georgia (Conrad 1834), this highly variable species represents a complex of nearly 50 named species (Johnson 1970). The shell shape is oblong, subelliptical, or subrhomboid, with a prominent posterior ridge, and moderately elevated beaks. The periostracum is usually smooth and greenish yellow to tawny-brown. This species is considered common and currently stable throughout its range (Williams et al. 1993). It was found at 81 sites in all three watershed sections of the study area.

### **3.3.5 *Elliptio mediocris* (No Common Name)**

This species was described from the Neuse River 6 miles east of Raleigh (Lea 1863). Although Johnson (1970) synonymized this into the *E. complanata* complex and even though there has been no subsequent publication recognizing it as a distinct species, most aquatic biologists working with freshwater mussels on the Atlantic slope recognize it as such. Shell shape is typically rhomboid, and inflated. The usually straight ventral margin is mostly parallel with the dorsal margin and the posterior margin is broadly rounded. Unlike most forms of *E. complanata*, the beaks are moderately full, and the periostracum is covered with dark green rays of varying width that remain conspicuous even with older individuals. The posterior slope is high, but more rounded than *E. congarea*. This species was found at 17 sites only within Swift Creek.

### 3.3.6. *Elliptio producta* (Atlantic Spike)

This species was described from the Savannah River, Georgia by Conrad (1836). The range of this species extends from the Savannah River, Georgia north to the Potomac River Basin in Maryland and Virginia. The Atlantic spike was once synonymized with *Elliptio lanceolata* (Johnson 1970), but is now considered a separate species. The anterior shell margin is rounded and the posterior margin roundly pointed with the most posterior point slightly above the midline of the shell. The periostracum is often shiny, dark reddish brown to greenish brown, generally with out rays. Shell nacre is variable shades of purple. Williams et al. (1993) list this species as Special Concern. The Atlantic spike was found at two sites in Middle Creek and six sites in Swift Creek.

### 3.3.7. *Elliptio roanokensis* (Roanoke Slabshell)

The Roanoke slabshell was described from the Roanoke River (exact location unknown) by I. Lea (1838). The reported range of this species extends from the Connecticut River in Massachusetts south to the Savannah River in Georgia (Walter 1954). Based on shell morphologies, Johnson (1970) synonymized this and 100 other species into the *Elliptio complanata* complex, however it is now widely recognized as being a valid species. The periostracum is generally very smooth, often with placations (furrows) and reddish yellow in color. Shells of this species reach lengths exceeding 150 mm. This species is listed as Threatened in North Carolina. Williams et al. (1993) list this species as Special Concern. This species was found at 22 sites in Swift Creek, and all 12 sites in the Neuse River sites in Swift Creek and the Neuse River

### 3.3.8. *Lampsilis radiata* (Eastern Lampmussel)

*Lampsilis radiata radiata* (eastern lampmussel) and *Lampsilis radiata conspicua* (Carolina fatmucket). Gmelin (1791) described *Mya radiata* and used Malabar, a region of southern India as the type locality. Ortmann (1919) reported this locality as incorrect and noted Lamarck (1819) had listed it from Saratoga Lake in New York and recommended “if there should not be any other earlier record, we might select this as the type locality.” Simpson (1914) had earlier listed Virginia as the type locality, thus Johnson (1970) restricted the type locality to Potomac River, District of Columbia (approximately opposite, Fairfax Co., Virginia). Lea (1872) described *Unio conspicuus* from the Yadkin River in Rowan County, North Carolina, which Simpson (1914) treated as a variety of *Lampsilis radiata radiata*, which Johnson (1970) agreed with.

This large mussel is subelliptical to subovate in outline. Shells are generally thick and solid, with rounded anterior and posterior margins and vary from hardly inflated to very inflated. The periostracum is usually yellowish or brownish green with dark green rays over the entire surface. Like other members of this genus, this species is sexually dimorphic, with the shells of the male being more elongate, and the females more rounded and swollen, particularly in the posterior margin. Left valve has two pseudocardinal teeth, the posterior one located under the umbo, and two straight lateral teeth. The right valve has two separate pseudocardinal teeth, the upper is smaller and compressed, and has a single straight lateral tooth. Interdentum is lacking, umbo cavity is shallow, compressed. Nacre color is white, may be tinged with pink or salmon or may be completely pink or salmon. Shells of the Carolina fatmucket are much larger and heavier than the shells of the Eastern lampmussel (Adams et al. 1990) and tend to be more shiny

and smooth than the Eastern lampmussel, which is usually rough with close concentric wrinkles (Johnson, 1970, Timothy W. Savidge, personal observations). Also, the posterior ridge is much more broadly rounded in the Carolina fatmucket and, in general, the umbos are not as inflated. Adams et al. (1990) suggested that “because of these differences and because *L. r. radiata* is thought to parasitize an anadromous fish host and *L. r. conspicua* is found in areas without such fish species being present, it is possible that *L. r. radiata* and *L. r. conspicua* are separate species”.

The taxonomic status of the *Lampsilis radiata* complex is still uncertain. Both the eastern lampmussel and the Carolina fatmucket forms are known to occur in the Neuse River basin. This large mussel is subelliptical to subovate in outline. Shells are generally thick and solid, with rounded anterior and posterior margins. The periostracum is usually yellowish or brownish green with dark green rays over the entire surface. Like other members of this genus, this species is sexually dimorphic, with the shells of the male being more elongate, and the females more rounded and swollen, particularly in the posterior margin. Williams et al. (1993) consider this species to be Stable; however, both the eastern lampmussel and the Carolina fatmucket are considered Threatened in North Carolina. This species was found at 44 sites, two within Middle Creek, 32 within Swift Creek, and 10 within the Neuse River.

### **3.3.9. *Pyganodon cataracta* (Eastern Floater)**

Described by Say (1817) in the deep part of a milldam presumably near Philadelphia, this species is wide ranging in the Atlantic drainages from the lower St. Lawrence River Basin south to the Altamaha River Basin, Georgia, and in the Alabama-Coosa River drainage, and the Apalachicola and Coctawhatchee River Basins, Florida. The shells of this species are uniformly thin, and lack hinge teeth. The shell shape is ovate, subelliptical and elongate, with an evenly rounded anterior margin and a broadly rounded ventral margin. The periostracum is light to dark green with broad green rays on the posterior slope. Ortman (1919) recognized three generalized shell forms, the pond form, the creek/small river form and the big river form, that were related to environmental conditions. The pond form occurs in small ponds with muddy substrates, and is characterized by very thin elongate inflated shells. The creek form occurs in riffle-pool habitats in gravel substrates, and is much thicker and more compressed. The big river form is generally short and inflated and occurs in soft substrates. This species is considered common and currently stable throughout its range (Williams et al. 1993). It was found at 24 sites in all three watershed sections of the study area.

### **3.3.10. *Strophitus undulatus* (Creeper)**

This mussel was described from the Schuylkill River near Philadelphia (Say 1817). Its range extends from throughout much of the Interior River Basin and Atlantic Slope regions. The shell is elliptical to rhomboid in outline and somewhat inflated. The anterior end is rounded, and the posterior end is bluntly pointed. The periostracum is yellowish green to brown, with dark green rays. Williams et al. (1993) consider this species to be Stable; however it is considered Threatened in North Carolina. It was found at two sites within Middle Creek, 29 sites in Swift Creek, and one site in the Neuse River.

### 3.3.11. *Utterbackia imbecillis* (Paper Pondshell)

Described from the Wabash River in Indiana (Say 1829), this mussel occurs throughout the Mississippi River and Great Lakes drainages, south to northeastern Mexico and east along the Gulf Coast to Florida, as well as along the Atlantic Slope. It has an extremely thin shell that is oblong and inflated. The dorsal and ventral margins are nearly straight and parallel. The periostracum is greenish yellow with fine green rays. This species is considered common throughout its range (Williams et al. 1993). It was found at 14 sites in all three watershed sections of the study area, although mostly within Swift Creek.

## 4.0 DISCUSSION

These survey efforts provide a comprehensive updated evaluation of freshwater mussel species occurring within the project study area. This information helps to identify which water bodies within the study area contain significant mussel faunas, and can then be used to minimize impacts to these resources. At least one freshwater mussel species was found in 102 of the 110 stream sites sampled. Four of the six targeted mussel species were found during this study, including: the federally Endangered Dwarf Wedgemussel, which was found only within Swift Creek; the FSC and North Carolina listed Endangered Atlantic Pigtoe (Swift Creek), Yellow Lance which were found only within Swift Creek; and the FSC and North Carolina listed Endangered Green Floater which was found only within the Neuse River. Neither the Tar River Spinemussel, nor the Yellow Lampmussel was found during this study, although habitat that could potentially support both species is present in much of the study area. The Tar River Spinemussel has only ever been found in the Little River in the Neuse River Basin. There are historic records of the Yellow Lampmussel from the Neuse River and an unnamed tributary to Swift Creek in Wake County (Johnson 1970); however, this species has not been found in these areas in recent years (NCWRC Unpublished Data).

Although significant freshwater mussel resources occur within all three sections of the study area, habitat degradation and low relative abundances and species diversity is evident in some areas, particularly in the Western Section. As depicted in Table 111, the highest species diversity and number of rare species (as identified in Table 1) occur in the Central Section (Swift Creek and tributaries), followed by the Eastern Section (Neuse River and tributaries) and then Western Section (Middle Creek and tributaries).

**Table 112. Mussel Species by Study Corridor Section**

Section	# Species	# Rare Species	# FSC Species	# Federal Species
Western	8	4	0	0
Central	14	9	2	1
Eastern	10	6	1	0

### 4.1. Western Section

Middle Creek drains the western section of the project corridor study area, and from a freshwater mussel standpoint, is the most significant water body in the Western section. Like Swift Creek, Middle Creek was known to support several rare mussel species, including the Dwarf Wedgemussel; however, this species has not been detected during



any survey effort since 1992 (NCWRC unpublished data), where it was found at the NC 50 crossing downstream of the study area in Johnston County. In addition, occurrences and numbers of other rare mussel species known from the stream have declined in recent years (NCWRC Unpublished Database of Aquatic Species 2010). The results of this survey effort further support this declining trend, as only four rare mussel species were found in very low numbers (three Eastern Lampmussel, three Creeper, one Triangle Floater, and one Atlantic Spike). Observations of habitat conditions also support the apparent decline, as heavy sediment loads, stream-bed scour and stream-bank instability were evident at all sites sampled in Middle Creek. In addition, numerous WWTP discharges are located within the subbasin. The proposed project will cross Middle Creek in the upper limits of the watershed upstream of Sunset Lake. While it is possible that Dwarf Wedgemussel still occurs in Middle Creek further downstream in Johnston County, the presence of Sunset Lake between the proposed crossing and potentially occupied habitat downstream would eliminate the potential for any direct impacts to occur. Given the fact that the Tar River Spiny mussel has never been found in Middle Creek and Swift Creek, despite multiple surveys throughout both stream systems, it is unlikely to occur in this section of the project.

No rare mussel species were found in any of the tributaries; however, some of these streams such as Basal Creek, Little Creek, and Guffy Branch support fairly high abundances of the Eastern Elliptio, and contain areas of “good” mussel habitat, which may be suitable for the Dwarf Wedgemussel. However, given the results of this study, and other survey efforts in these tributaries, its presence is unlikely.

#### **4.2. Central Section**

The Central section of the project study area drains to the Swift Creek Subbasin. The NCWRC identified the Swift Creek watershed as one of 25 areas in North Carolina considered essential for the continued survival of endangered or threatened aquatic wildlife species (Alderman et al. 1993). As required by the Nature Preserves Act (NCGS 113A-164 of Article 9), the North Carolina Natural Heritage Program (NHP) compiles the North Carolina Department of Environment and Natural Resources (DENR) priority list of “Natural Heritage Areas” in which natural areas (sites) are inventoried and evaluated on the basis of rare plant and animal species, rare or high quality natural communities, and geologic features occurring in the particular site. The sites are rated with regard to national, state and regional significance, and Swift Creek is rated as having “National Significance”, due to the presence of the Dwarf Wedgemussel. It is noted that sites on the list should be given priority for protection; however, it does not imply that all of the areas currently receive protection (NCDENR 2005).

Historically, at least 18 species of freshwater mussels have been reported to occur in the Swift Creek subbasin. This study confirms the relatively high species diversity (for Atlantic Slope drainages) of this stream, as at least 14 species were collected, including the Dwarf Wedgemussel. It is very possible that the *E. complanata* and *E. icterina* complexes are represented by several species, which would further raise the number of species in the subbasin. The only three species reported to occur in Swift Creek that were not found in this study are the Green Floater, Carolina lance (*Elliptio angustata*) and Notched Rainbow. The green floater was reported as occurring in Swift Creek by Walter

(1956) and one specimen was found by Alderman (1991); however, it has not been found in Swift Creek in subsequent surveys. Taxonomic uncertainties with lanceolate elliptios exist; thus, specimens reported as the Carolina lance in previous surveys may in fact be the same species as what is reported in this study as the Atlantic spike, or the northern lance, two other lanceolate elliptio species. The Notched Rainbow was found in the study area in 2007 (TCG 2008).

The results of this study confirm the persistence of the Dwarf Wedgemussel in Swift Creek below Lake Benson, as three individuals were found within the study corridor. In addition, two other individuals were found downstream of the project corridor, as part of a concurrent study carried out by TCG for the City of Raleigh. The targeted FSC Atlantic Pigtoe and Yellow Lance and several other rare mussel species were also confirmed to persist in this section of Swift Creek. Thus, direct impacts to these species are possible from project construction within this section of Swift Creek.

Because of the existence of the Dwarf Wedgemussel in Swift Creek, the study corridor for this project was expanded to include an avoidance alternative (Red Route), which would cross Swift Creek upstream of Lake Benson. This section of Swift Creek is not believed to support the Dwarf Wedgemussel, and the results of this study further support this assumption, as it was not found, nor were any of the associate rare mussel species. In addition, Lake Benson occurs between this section of the creek and occupied habitat located downstream. As such, direct impacts to the Dwarf Wedgemussel are unlikely to occur if the Red Corridor is constructed; however, conclusions regarding Indirect and Cumulative Impacts to the population cannot be determined at this time, and will need to be addressed with all alternates within the study area.

The Tar River Spiny mussel was not found in Swift Creek during this study, and it has never been found in this subbasin, despite the presence of apparently suitable habitat. Given this, it is very unlikely to occur in this section of the project.

No rare mussel species were found in any of the tributaries to Swift Creek within the study area; however, both White Oak Creek and Little Creek are known to support Dwarf Wedgemussel and other rare species further downstream of the study area. In both instances artificial impoundments are present between any of the proposed crossing locations and occupied habitat downstream; therefore direct impacts are unlikely.

### **4.3. Eastern Section**

The Eastern section of the project corridor drains to the Neuse River from the US 64/264 Bypass crossing of the river downstream to the vicinity of the Wake/Johnston County line. Tributaries to the Neuse River within this section include: Walnut Creek and Beddingfield Creek to the south; Mango Creek, Unnamed Tributary (UT) to Neuse River, Poplar Creek, and Mark's Creek to the north.

Historically, at least 18 species of freshwater mussels have been reported to occur in the mainstem of the Neuse River within the project study area (Walter 1956, Johnson 1970), including the Dwarf Wedgemussel. While this study indicates relatively high species

diversity (for Atlantic Slope drainages) of this section of the river (10 species), species like the Dwarf Wedgemussel, Atlantic Pigtoe, Yellow Lance and Notched Rainbow, which historically occurred in this area, were not found. The presence of the Green Floater is the first documented occurrence of this species in this section of the Neuse River since the early 1950's (Walter 1956).

The population of the Dwarf Wedgemussel in the main-stem of the Neuse River has long been considered extirpated (USFWS 1993). This section of the Neuse River is drained by an extensive urban area (City of Raleigh). Given this, and the fact that it has not been found in the Neuse River in recent years, including during this study, it is unlikely to still occur in this section of the Neuse River. However, the re-discovery of the targeted FSC Green Floater, which was also believed to have been extirpated from this area, casts some uncertainty on this conclusion. Some of the other species formerly reported from this area like the Dwarf Wedgemussel and Atlantic Pigtoe (Johnson 1970) may still exist in low numbers, as the Green Floater was obviously present, but in such low numbers that it was not detected during surveys in recent years (NCWRC Unpublished Data). The presence of the Green Floater at multiple sites (8) and the fact that the majority of individuals found were of the same size (age) class, suggest a recent population expansion. Unless future surveys detect the Dwarf Wedgemussel in the Neuse River, it should still be considered a "Historic" population. However, intensive surveys will need to be conducted at the proposed Neuse River crossing once an alternate is chosen.

The Tar River Spinemussel was not found in the Neuse River during this study, nor has it ever been found in the Neuse River. As mentioned previously, the only population of this species in the Neuse River Basin is the Little River. As such, it is very unlikely that the Tar River Spinemussel occurs within the main-stem of the Neuse River in the study area.

No rare mussel species were found in any of the tributaries in this section. Habitat conditions in these tributaries are generally unsuitable for the Dwarf Wedgemussel, and Tar River Spinemussel, in that they are either highly degraded (Beddingfield Branch, Poplar Creek, Walnut Creek etc.), or they are more lentic (still water) in nature (Mango Creek) than lotic habitats (flowing water) where these species occur. Therefore, it is very unlikely that the Dwarf Wedgemussel, or Tar River Spinemussel occur in any of the Neuse River tributaries within this section of the study corridor.

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**APPENDIX A**  
**PROJECT FIGURES/SURVEY LOCATION SHEETS**



**APPENDIX B**  
**DEFINITIONS OF FEDERAL AND STATE LISTING CATEGORIES**  
**(FROM LEGRAND ET AL. 2010)**

United States Status. This status is designated by the U.S. Fish and Wildlife Service.

Federally listed Endangered and Threatened species are protected under the provisions of the Endangered Species Act of 1973, as amended through the 100th Congress. Unless otherwise noted, definitions are taken from the Federal Register, Vol. 56, No. 225, November 21, 1991 (50 CFR Part 17).

<b>STATUS CODE</b>	<b>STATUS</b>	<b>STATUS DEFINITION</b>
E	Endangered	A taxon "which is in danger of extinction throughout all or a significant portion of its range" (Endangered Species Act, Section 3).
T	Threatened	A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (Endangered Species Act, Section 3).
FSC	(Federal) Species of Concern [also known as Species at Risk]	"... the Service is discontinuing the designation of Category 2 species as candidates in this notice. The Service remains concerned about these species, but further biological research and field study are needed to resolve the conservation status of these taxa. Many species of concern will be found not to warrant listing, either because they are not threatened or endangered or because they do not qualify as species under the definition in the [Endangered Species] Act. Others may be found to be in greater danger of extinction than some present candidate taxa. The Service is working with the States and other private and public interests to assess their need for protection under the Act. Such species are the pool from which future candidates for listing will be drawn." (Federal Register, February 28, 1996). The Service suggests that such taxa be considered as "Species of Concern" or "Species at Risk", neither of which has official status. The N.C. Natural Heritage Program uses "(Federal) Species of Concern" in this document for those taxa formerly considered as Category 2.
P	Proposed	Species proposed in the Federal Register as a status different from its current Federal status.

<b>STATUS CODE</b>	<b>STATUS</b>	<b>STATUS DEFINITION</b>
T (S/A)	Threatened due to Similarity of Appearance	“Section 4 (e) of the [Endangered Species] Act authorizes the treatment of a species (subspecies or population segment) as endangered or threatened even though it is not otherwise listed as endangered or threatened if -- (a) the species so closely resembles in appearance an endangered or threatened species that enforcement personnel would have substantial difficulty in differentiating between the listed and unlisted species; (b) the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and (c) such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of the Act.” (Federal Register, November 4, 1997). [The American Alligator is listed as T (S/A) due to Similarity of Appearance with other rare crocodilians, and the southern population of the Bog Turtle is listed as T (S/A) due to Similarity of Appearance with the northern population of the Bog Turtle (which is federally listed as Threatened and which does not occur in North Carolina).]
XN	Nonessential Experimental Population	“Section 10 (j) of the Endangered Species Act of 1973, as amended, provides for the designation of introduced populations of federally listed species as nonessential experimental. This designation allows for greater flexibility in the management of these populations by local, state, and Federal agencies. Specifically, the requirement for Federal agencies to avoid jeopardizing these populations by their actions is eliminated and allowances for taking the species are broadened.” (U.S. Fish and Wildlife Service, 1995).
D	De-listed	Species has been proposed by the U.S. Fish and Wildlife Service for de-listing from the List of Endangered and Threatened Wildlife. However, at the present time, the species is still on the List of Endangered and Threatened Wildlife and is thus protected under the Endangered Species Act. Because such species still have legal Federal protection, the NHP will maintain existing records on the species, though new records might not necessarily be added. If the status becomes law prior to the next publication of the NHP Rare Animal List, the Program will remove the Federal designation from its database (and thus the species will no longer appear on printouts of Federally listed species). NHP may or may not continue to track the species, depending on its legal State status and other factors such as overall abundance and range in the state.

North Carolina Status. Endangered, Threatened, and Special Concern species of mammals, birds, reptiles, amphibians, freshwater fishes, freshwater and terrestrial mollusks, and crustaceans have legal protection status in North Carolina (Wildlife Resources Commission). In addition to the above categories, the Natural Heritage Program maintains computer and map files on Significantly Rare species, as well as species considered Extirpated. Paper files only are maintained for a few of the above species; these species are indicated by the phrase "not tracking."

<b>STATUS CODE</b>	<b>STATUS</b>	<b>STATUS DEFINITION</b>
E	Endangered	"Any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the Wildlife Resources Commission to be in jeopardy or any species of wild animal determined to be an 'endangered species' pursuant to the Endangered Species Act." (Article 25 of Chapter 113 of the General Statutes; 1987).
T	Threatened	"Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the Endangered Species Act." (Article 25 of Chapter 113 of the General Statutes; 1987).
SC	Special Concern	"Any species of wild animal native or once-native to North Carolina which is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulations adopted under the provisions of this Article." (Article 25 of Chapter 113 of the General Statutes; 1987).
P	Proposed	Species has been proposed by a Scientific Council as a status (Endangered, Threatened, Special Concern, Watch List, or for Delisting) that is different from the current status, but the status has not yet been adopted by the General Assembly as law. In the lists of rare species in this book, these proposed statuses are listed in parentheses below the current status. Only those proposed statuses that are different from the current statuses are listed.

<b>STATUS CODE</b>	<b>STATUS</b>	<b>STATUS DEFINITION</b>
SR	Significantly Rare	Any species which has not been listed by the N.C. Wildlife Resources Commission as an Endangered, Threatened, or Special Concern species, but which exists in the state in small numbers and has been determined by the N.C. Natural Heritage Program to need monitoring. (This is a N.C. Natural Heritage Program designation.) Significantly Rare species include "peripheral" species, whereby North Carolina lies at the periphery of the species' range (such as Hermit Thrush).
EX	Extirpated	A species which is no longer believed to occur in the state. (This is a N.C. Natural Heritage Program designation, though WRC also uses this status; the NHP list includes those on the WRC list.)
W	Watch List	Any other species believed to be of conservation concern in the state because of scarcity, declining populations, threats to populations, or inadequacy of information to assess its rarity (see page 59 for a more complete discussion). (This is a N.C. Natural Heritage Program designation.)
G		Species is a game animal, and therefore (by law) cannot be listed for State protection as E, T, or SC.