STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

December 4, 2007

Mr. John F. Sullivan, III
Division Administrator
Attention: Clarence Coleman, Engineer
Federal Highways Administration – NC Division
310 New Bern Avenue, Suite 410
Raleigh, NC 27601-1418

SUBJECT: Endangered Species Act Section 7 Biological Assessment for the James spinymussel for the proposed replacement of Bridge No. 60 on NC 89/8 over the Dan River, Stokes County, Federal Aid Project No. BRSTP-008 (4), WBS element 33621.1.1, T.I.P. No. B-4281.

Dear Mr. Coleman:

Enclosed are two copies of the final Biological Assessment for the subject project (one copy for FHWA, one for USFWS). This copy replaces the copy sent with the letter dated November 16, 2007. The North Carolina Department of Transportation staff has concluded the proposed action will incur a biological conclusion of "May Affect – Likely to Adversely Affect" for the species in question. We request that you initiate formal Endangered Species Act Section 7 consultation for James spinymussel (*Pleurobema collina*) under TIP No. B-4281. Schweinitz's sunflower (*Helianthus schweinitzii*), also listed for this county, received a biological conclusion of No Effect and small anthered bittercress (*Cardamine microanthera*) received a biological conclusion of May Affect-Not Likely to Adversely Affect.

If you need further information, or have any questions concerning the attached materials, please contact Sara Easterly at 919-715-5499 or Jared Gray at 919-715-1422.

Sincerely,

E. L. Fuller

for Gregory J. Thorpe, Ph.D.,
Environmental Management Director, PDEA

cc w/ attachments:

John Thomas, USACE
Wade Kirby, NCDOT-PDEA
Sara Easterly, NCDOT-NEU
Marella Buncick, USFWS
Felix Davila, FHWA
Jared Gray, NCDOT-NEU

Electronic Copy:

Mark Staley, NCDOT-REU
Malcolm C. Watson, NCDOT-RDU
Cathy Houser, NCDOT-RDU
Dewayne Sykes, NCDOT-RDU
Ron Allen, NCDOT-RDU
Scott Blevins, NCDOT-RDU
Marshall Clawson, Hydraulics Unit
David Chang, Hydraulics Unit
Ricky Keith, NCDOT-SDU
Allen Raynor, NCDOT-SDU
Laura Sutton, NCDOT-SDU
Keith E. Raulston , PE, P.E., Division 9
Billy Trivette, Jr. , P.E., Construction Unit
Michael Robinson , P.E., Construction Unit
Randy A. Garris, P.E., Project Services Unit
Art McMillan , PE Highway Design

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS
1598 MAIL SERVICE CENTER
RALEIGH NC 27699-1598

TELEPHONE: 919-715-1334
FAX: 919-715-5501

WEBSITE: WWW.DOH.DOT.STATE.NC.US

LOCATION:
2728 CAPITAL BLVD., SUITE 240
RALEIGH NC 27604

Biological Assessment

North Carolina Department of Transportation
Transportation Improvement Program No. B-4281
Bridge 60 over the Dan River on NC89/8
Federal Aid No. BRSTP-008 (4)
WBS Element No. 33621.1.1
Stokes County, North Carolina

Contact Person:
Jared Gray
Environmental Specialist
NC Dept. of Transportation
Biological Surveys Group
(919) 715-1422

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

INTRODUCTION **1**
TABLE 1. ENDANGERED SPECIES 1
CONSULTATION TO DATE 1
PROJECT DESCRIPTION **2**
PURPOSE AND NEED 2
NEW STRUCTURE 2
DEFINED ACTION AREA 2
DAN RIVER SUBBASIN **3**
OVERALL BASIN SUMMARY 3
UPPER DAN RIVER SUBBASIN 03-02-01 3
ECOLOGICAL SIGNIFICANCE OF ROANOKE RIVER BASIN 5
Environmental Baseline (Upper Dan River) *7*
SPECIES DESCRIPTION **9**
JAMES SPINYMUSSEL (PLEUROBEMA COLLINA) 9
SURVEY INFORMATION **13**
Avoidance and Minimization Measures *14*
STANDARD MEASURES 14
ADDITIONAL MEASURES 15
OTHER ALIGNMENTS CONSIDERED AND REJECTED TO AVOID IMPACTS 15
REMOVAL OF EXISTING STRUCTURE 16
EFFECTS ANALYSIS **17**
DIRECT EFFECTS 18
INDIRECT AND CUMULATIVE EFFECTS 18
BIOLOGICAL CONCLUSION: May Affect, Likely to Adversely Affect *19*
PROPOSED MEASURES TO OFFSET EFFECTS **19**
PRECONSTRUCTION SURVEY & MUSSEL RELOCATION 19
HABITAT/RIPARIAN BUFFER CONSERVATION 20
ADDITIONAL SPECIES **21**
SCHWEINITZ'S SUNFLOWER (HELIANTHUS SCHWEINITZII) 21
DESCRIPTION: 21
Biological Conclusion: No Effect *22*
SMALL-ANTHERED BITTERCRESS (CARDAMINE MICROANTHERA) 22
DESCRIPTION: 22
HABITAT AND DISTRIBUTION: 22
Biological Conclusion: May Affect, Not Likely to Adversely Affect *22*
The Migratory Bird Treaty Act *23*
LITERATURE CITED **24**

APPENDIX A Project Location
APPENDIX B Design Information
APPENDIX C Relocation Site
APPENDIX D Map of Division 9 Projects
APPENDIX E NCDOT Relocation Plan
APPENDIX F Clark Site Detailed Buffer Mitigation Plan
APPENDIX G Aerial Map Location of the Clark and Venable Sites
APPENDIX H Right of Entry Agreement for relocation Site

Introduction

The purpose of this biological assessment is to review the proposed project, Transportation Improvement Program (TIP) # B-4281, in sufficient detail to determine whether the proposed action may affect any of the endangered species listed below. This biological assessment is prepared in accordance with legal requirements set forth under Section 7 of the Endangered Species Act (16 U.S.C. 1536 (c)).

Table 1. Endangered Species

Common Name	Scientific Name	Federal Status
James spinymussel	(*Pleurobema collina*)	Endangered
Schweinitz's sunflower	(*Helianthus schweinitzii*)	Endangered
small-anthered bittercress	(*Cardamine microanthera*	Endangered

Consultation to Date

On October 2, 2006, an on-site field meeting, with Denise Moldenhauer of the United States Fish and Wildlife Service (USFWS) and NCDOT, was held to discuss the current plans for B-4281 and to talk about avoidance and minimization measures that could be used for James spinymussel (JSM) and small-anthered bittercress. A moratorium for the James spinymussel and relocation of the mussels was discussed as well. NCDOT was represented at the meeting with members from their Roadway Design Unit, Structures, Natural Environment, Hydraulics, Roadside Environmental, Right-of-Way, and Division Engineers.

In a letter dated April 9, 2007 NCDOT received concurrence from USFWS that the proposed B-4281 project may affect, but was not likely to adversely affect small-anthered bittercress as long as certain commitments were met by NCDOT.

On August 1, 2007 another on-site field meeting was held with Marella Buncick (USFWS) and NCDOT. NCDOT was represented at the meeting with members from their Roadway Design, Structures, Right-of-Way, Hydraulics, Natural Environment and Division Engineers. The purpose of the meeting was to discuss the updated design information and any outstanding issues that needed to be resolved in order to complete the proposed project. USFWS wanted to be sure that the agreed upon environmental commitments would be relayed to the contractor. For example, that clearing near the river would be allowed, but grubbing would be unacceptable.

August 15, 2007 USFWS biologist Marella Buncick met with staff from NCDOT'S Roadside Environmental Unit and the Natural Environment Unit to discuss sediment and erosion control concerns. Some concerns pertained to the JSM and the others had to do with Buck Island creek and small-anthered bittercress and the earlier commitments that the USFWS wanted in place in order for them to concur with the "may affect not likely to adversely affect" call.

Project Description

Purpose and Need

The purpose of this project is to replace a structurally deficient, functionally obsolete bridge with an adequate structure to provide safer and more efficient traffic operations. The existing Bridge No. 60 over the Dan River on NC 89/8 has an overall length of 315 feet and a deck width of 23.3 feet. Bridge 60 was built in 1932 with a superstructure composed of reinforced concrete deck on reinforced concrete girders. The substructure consists of reinforced concrete abutments and interior bents. The sufficiency rating for the bridge is 42.6 out of a possible 100 and is considered structurally deficient (NCDOT 2005).

New Structure

NCDOT proposes to replace Bridge No. 60 on NC 89/NC8 over the Dan River in Stokes County, approximately 2.0 miles (3.2 kilometers) northwest of the community of Danbury (See Map, Appendix A). TIP B-4281 is currently scheduled to be opened for construction bids (let date) on April 19, 2008. The existing bridge is proposed to be replaced with a 3-span (2 @ 120 feet and 1@ 160 feet), reinforced concrete deck slab on 54 inch steel plate girders with 9 feet, 6 inch centers. The substructure will consist of pile end bents and post and beam bents on a drilled pier foundation. The bridge will have an overall length of 400 feet and a clear roadway width of 32 feet. The bridge will be replaced on the northern side (Alternate A in the Categorical Exclusion) and traffic will be maintained on the existing structure as an on-site detour. New approaches to the bridge will provide 12-foot travel lanes with 8-foot shoulders including 2-foot paved shoulders. Approximately 1500 feet of new approaches will be required. There will be no bents required in the river. Anticipated traffic service is 4800 vehicles per day in the year 2025, a relatively low volume. No debris will enter the river during demolition of the existing structure, or construction of the new bridge. For detailed design information, see Appendix B.

Defined Action Area

The project action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. [50 CFR §402.02]. For this type of bridge replacement, the limits of the effects are generally considered to include the limits of construction of the approach on both sides of the structure and any area receiving the runoff from the construction activity including the receiving stream extending 400 meters downstream of the structure. Mussel relocation for this project will require moving mussels upstream to appropriate habitat. Therefore, the action area should extend 2.0 miles upstream to the relocation site off of SR 1456 (Dan River Shores Road). For a map of the relocation site see Appendix C. Also, to be included in the action area is the Clark and Venable sites, which were purchased as conservation measures for JSM. This will extend the action area 8.6 miles downstream to

the Clark and Venable sites off of Dodgetown Road and Pitzer Road. For a map of the Clark and Venable sites see Appendix G

Dan River Subbasin

Overall Basin Summary

The Dan River subbasin occurs within the Roanoke River (RR) basin, which begins in the Blue Ridge Mountains of northwestern Virginia and flows in a generally southeastern direction for 400 miles before emptying into the Albemarle Sound in eastern North Carolina. The Roanoke River, by the time it reaches the fall line near Roanoke Rapids, it has captured water from nearly 8,000 square miles of land. Then from Roanoke Rapids to the coast, the Roanoke River drains another 2,000 square miles, carrying more water than any other river in North Carolina (NCDENR 2006). The North Carolina portion of the RR Basin is composed of two major parts: The Dan River and its tributaries in the western section, upstream of Kerr Lake, and the RR as it enters North Carolina in the eastern section. The RR mainstem enters Kerr and Gaston Lakes and then flows into Roanoke Rapids Lake before regaining its riverine form and flowing to the Albemarle Sound. The North Carolina portion of the basin contains twelve monitored lakes, all of which are man-made reservoirs. Flow in the Roanoke River in North Carolina is highly regulated by Kerr Reservoir and Lake Gaston (NCDENR-DWQ 2001).

There are 15 counties and 42 municipalities located either in whole or in part in the basin. Based on 2000 census data, the NC population of the basin is 344,638 people. The most populated areas are located northeast of the Greensboro/Winston-Salem/High Point area, and around the larger municipalities in the basin such as Roanoke Rapids, Eden, Williamston, and Plymouth (NCDENR 2006). The overall population in the basin is 98 persons per square mile. Based on the most current land cover information provided by the National Resources Inventory (NCDENR 2006), there was a 136 percent increase in urban and built-up areas adding 74,700 acres to this land cover category in the Roanoke Basin from 1982 to 1997. Uncultivated croplands also increased by 22,200 (89.5 percent), while cultivated croplands (20.4 percent), forest (0.5 percent) and pastureland (21.5 percent) all decreased respectively (NCDENR 2006).

Upper Dan River Subbasin 03-02-01

This bridge project lies in the subbasin 03-02-01 of the RR basin. These subbasin classifications are assigned by the North Carolina Department of Environment and Natural Resources (DENR), Division of Water Quality (DWQ) section, formerly known as the Division of Environmental Management (DEM). More than seventy percent of this subbasin is forested and less than three percent is cultivated cropland and the highest percentage of pasture. The estimated subbasin population, based on the 2000 census, is 108,615. Stokes County is projected to receive the largest population increase of the sixteen counties in the RR basin (NC portion). By the year 2020, estimated population growth for Stokes County is 24% (NCDENR 2006).

The Dan River watershed is divided into four physiographic subdivisions: Uplands (river mile 199-194: river kilometer 320-312), Blue Ridge Escarpment (river mile 194-165: river kilometer 312-266), Inner Piedmont (river mile 165-122: river kilometer 265-197), and Fault Basin (river mile 122-0: river kilometer 196-0) (Rhode et al. 2001). The proposed B-4281 project addressed in this Biological Assessment occurs within the Inner Piedmont subdivision of the Dan River.

Rock formations along the Dan River are primarily metamorphic and metavolcanic in origin, dating from the late Proterozoic and early Paleozoic periods (NC Department of Natural Resources and Community Development 1985). Underlying rocks include granite, granite gneiss, schist, slate and phyllite. The noted exception is a remnant of a large trench created in the Triassic Period known as the Dan River Triassic Basin, which is a trough of sediments 0-6-miles wide extending from Germantown near the Stokes/Forsyth County line northeast into Rockingham County (Pickett 1962, and NRCS 1995). It is approximately 40 miles long and includes 128 square miles (Pickett 1962). This area corresponds to the Fault Basin (river mile 122-0, river kilometer 196-0) subdivision of the Dan River (Rhode et al. 2001). Basalt and sedimentary rocks underlie the Dan River Triassic Basin. Sediments here range from sandstones to mudstones and include shale, arkose and in a few areas, conglomerate. Thin coal beds and petrified wood have been deposited in this trough (NRCS 1995). In Rockingham County, the alluvial soils along the Dan, Smith and Mayo rivers came from material weathered from sedimentary rocks of the Dan River Triassic Basin and weathered igneous and metamorphic rocks of the surrounding uplands.

These soils are in the montmorillontic mineralogy class. Montmorillontic clays have expanding properties and result in a high to very high shrink-swell potential when found in some soil types (NRCS 1995).

The primary soil types, which run the length of the Dan River in Stokes County, are Riverview and Toccoa soils (RtA) 0-4% slopes, occasionally flooded; and Rion, Pacolet and Wateree (RpE) 25-60% slopes. Both are deep and well, or moderately well drained. Neither is generally recommended for building sites, RtA due to its high erodability and RpE due to its propensity for seasonal flooding. These soils are rated good for sustaining a variety of flora and fauna, but both rank poor and very poor for supporting wetland plants and wetland wildlife (NRCS 1995).

Most of the land in this portion of the basin is forested (73 percent), but a significant portion is also in use as cultivated cropland and pasture (25 percent). A large number of tributaries and major sections of the Dan River are deeply entrenched, possibly suggesting the effects of long-term erosion. Soil erosion rates as great as 21 tons/acre/year have been documented for cultivated cropland in the Upper Dan River (NCDOT 2002). This compared to 7.3 tons/acre/year from cultivated cropland for the nearby Upper Tar River Basin. The upper Dan River is classified as trout waters, and part of the area is also designated a State Water Trail by the NC Division of Parks and Recreation. Characteristics of this subbasin are transitory between mountain and piedmont ecoregions. As a result of fairly steep to moderate topography, headwater

reaches of most tributaries are forested, while many downstream sections are intensively farmed.

Historically, the economy of the areas within the Dan River subbasin depended on natural resources. Farming of tobacco, corn, wheat, rye and other crops was the main source of income for the area. Forest products were also important to the economy of the area, especially in the late 1700s (NRCS 1995). Land use in the area has seen both a decrease (57% in Stokes and 60% in Rockingham counties) in farm and forested farm acreage in the last century (NCDOT 2002). Currently, there are 62,520 acres in Rockingham County of privately owned woodland and 45,641 acres in Stokes County. There has been a slight increase or steadying within the last 20 years, as compared to the overall variable decline borne over the 20th century. Since the 1980s, these counties have given increasing acreage to conservation. Rockingham and Stokes Counties now have 1,051 and 1,201 acres in conservation, respectively (NCDOT 2002).

Tobacco was once the predominate crop in both counties. At its peak in the 1950s, 166,262 acres in Rockingham County and 137,034 acres in Stokes County were in Tobacco production. Currently, less than ten thousand acres in each county are being farmed for tobacco.

Ecological Significance of Roanoke River Basin

The Roanoke River basin is ecologically significant and diverse in numerous ways, and contains habitat for over 140 rare plants and animal species. The character of the basin as it enters North Carolina, contains some natural communities often associated with mountains. The Piedmont provides habitat for a number of rare fish and mussels, as well as small-anthered bittercress, a species only known to Stokes County and adjacent Henry County, Virginia. This endemic plant requires small or intermittent streams and seepage areas, and is found in the wet soil and rocks along small stream banks in hardwood forest with intact forest cover. This species was presumed extinct, however it was rediscovered in 1985, nearly 30 years after it had last been seen. The coastal plain section of the Roanoke contains high quality examples of wetland communities such as Coastal Plain Bottomland Hardwoods and Cypress-Gum Swamps. Finally, the Roanoke River is the major contributor of freshwater to Abermarle Sound (NCDENR 2006).

The Natural Heritage Program has identified over 145 natural areas in the Roanoke River basin. There are 11 rare mollusks, five rare insects, one rare crustacean, and nine rare fish in the basin. The JSM is found in the Roanoke River subbasins 03-02-01 and 03-02-02 (NCDENR 2006).

The Dan River subbasin is known to support several rare fish and freshwater mussel species, including the federally protected JSM (Table 2). The federally endangered Roanoke logperch (Percina rex) has been found in a few isolated areas in the Dan River drainage in Virginia. Table 2 presents a list of State and Federally listed rare aquatic species in Dan River.

Table 2 Rare Aquatic Species in the Dan River

Scientific Name	Common Name	NC Status	Federal Status
Mussels			
Alasmidonta undulata*	Triangle floater	T	~
Alasmidonta varicosa*	Brook floater	E	FSC
Fusconaia masoni*	Atlantic pigtoe	E	FSC
Lasmigona subviridis	Green floater	T	~
Pleurobema collina	James River spinymussel	E	E
Strophitus undulatus*	Squawfoot	T	~
Villosa constricta	Notched rainbow	SC	~
Fish			
Ambloplites cavifrons	Roanoke bass	SR	~
Etheostoma podostemone	Riverweed darter	SC	~
Exoglossum maxillingua	Cutlips minnow	E	~
Hypentelium roanokense	Roanoke hogsucker	SC	~
Noturus gilberti	Orangefin madtom	E	FSC
Noturus insignis ssp 1	Spotted margined madtom	SR	FSC
Percina rex^	Roanoke logperch	~	E
Scartomyzon ariommus	Bigeye jumprock	SC (PT)	~
Thoburnia hamiltoni	Rustyside sucker	E	~

* known only from tributaries in the Dan River Basin
^ known from the subbasin in Virginia
E, T, SC, SR and FSC denote Endangered, Threatened, Special Concern (NC), Significantly Rare (NC) and Federal Species of Concern, receptively

The North Carolina Natural Heritage Program (NHP) maintains a database of rare plant and animal species, as well as significant natural areas, for the state of North Carolina. The NHP compiles the DENR priority list of "Natural Heritage Areas" as required by the Nature Preserves Act (NCGS 113A-164 of Article 9). 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. These sites are rated with regard to national, state and regional significance. This list contains those areas, which should be given priority for protection; however, it does not imply that all of the areas currently receive protection (NCDENR 1995). The Dan River aquatic habitat in Stokes County is considered to be of "National Significance". The significance of this site was assigned to the Dan River prior to the knowledge of rare freshwater mussel species, including the JSM.

Environmental Baseline (Upper Dan River)

Since the discovery of the JSM in the Dan River in October 2000, NCDOT has embarked on an extensive survey of the Dan River subbasin. Personnel from the USFWS, North Carolina Wildlife Resource Commission (NCWRC), NC State University School of Veterinary Medicine, North Carolina National Heritage Program (NCNHP) and Virginia Polytechnical Institute (VPI) assisted at various times during these surveys. Most of the survey efforts have been concentrated in Stokes, Rockingham and Caswell counties. Greater than 380 person-hours of survey time have been expended by NCDOT (and volunteers from other agencies) during this endeavor. This does not include survey efforts conducted by the WRC and other agencies independent of NCDOT's efforts. In addition to the mainstem of the Dan River, the JSM was also discovered in the Mayo River (a tributary to the Dan River at approximately river mile 109 (river kilometer 175) in northwest Rockingham County). The JSM has not been found in any other tributaries to the river. In fact, the majority of tributaries in the Dan River drainage appear to be devoid of a mussel fauna (NCDOT 2002).

Although surveys in the Dan River watershed are not totally complete, a range for the JSM has been established. This range is approximately 36 river-miles and lies entirely within Stokes County, North Carolina. The upstream limit lies near the Flippin Road (SR 1416) crossing, extending to at least Dodgetown Road (SR 1695) south of Danbury. The JSM was not located in the reach above the established range between the VA 103 crossing in Patrick County, VA, and Flippin Rd. This reach should be resurveyed however, because the JSM was not found in the reach below Danbury from SR 1652 (Moir Farm Rd.) down to SR 1695 (Dodgetown Rd.) until the third time it was surveyed. JSM has not been found at various survey points further down river in Rockingham and Caswell Counties, but surveys in this part of the river have been limited. Continued survey work in the river above and below the apparent range will need to be done to more accurately determine the distribution of this species in the river (NCDOT 2002).

In the upper part of the established range, reach between SR 1416 (Flippin Rd.) and SR 1432 (Collinstown Rd. the JSM is extremely rare and is represented by only one individual. A small impoundment at Jessups Mill, located on the river just above SR 1432, may be restricting the distribution of this species in the river. Because of its fairly small size (31.9 mm), the one individual found above the dam cannot be considered a relict adult. However, the fact that the catch per unit effort (CPUE) is very low (0.08/hr) in this reach compared to the reach immediately below the dam (0.43/hr), it is very likely that the dam may be influencing the distribution of this species in this section of the river. Below Jessups Mill the JSM appears to be fairly evenly distributed in the river until its distribution becomes patchy below Danbury. It appears to be most abundant (based on CPUE) in the stretch between NC 704 and NC 89 (Table 3). However, time of year, survey conditions, and experience of survey personnel can influence the CPUE (NCDOT 2002).

Table 3 Catch Per Unit Effort for the JSM in the Dan River

Reach	River Miles	Survey Sites	Man hours	#JSM	CPUE
VA 103 to SR 1416	6.0	13	24.6	0	0/hr
SR 1416 to SR 1432	6.5	8	12.33	1	0.08/hr
SR 1432 to NC 704	6.3	11	32.7	14	0.43/hr
NC 704 to NC 89	7.12	7	12.86	19	1.48/hr
NC 89 to NC 8/89	6.82	8	22.33	10	0.45/hr
NC 8/89 to SR 1652	4.73	10	27.32	15	0.55/hr
SR 1652 to SR 1695	4.6	15	34.9	4	0.11/hr
Total	36.3*	72	167.04	59	0.41/hr*

*River Miles and CPUE calculated for combined occupied reaches. Unoccupied reaches are not factored into total

The species has also been found in an approximate 7.5-mile stretch of the Mayo River from the NC/VA border down to approximately 1.5-miles downstream of NC 770 in northwest Rockingham County, NC. Below this point in the Mayo River there are approximately 3 miles of the river that are not occupied by the JSM, due to point source discharge (Stoneville WWTP), sand/gravel mine (Stoneville Sand Mine), and an impoundment (Avalon Dam). The JSM has been found in a short reach (~0.5 mile) of the Mayo River between Avalon Dam and the Mayo Dam. Further surveys are needed below the Mayo Dam to determine its presence in this reach of the river. The James spinymussel is now found in a 22 miles stretch of the South Fork Mayo River in Virginia during recent surveys VDOT and VPI (Melissa Petty). These survey efforts will continue in the Dan River subbasin in Virginia through VPI (Melissa Petty, Personal Communication).

The JSM, like all mussels, are sensitive to changes within their watershed, particularly deforestation, urbanization and construction activities. The Dan River watershed population growth between 1980 and 1990 was 15% versus a statewide average increase of 12.7%. The estimated subbasin population, based on the 1990 census, was 45,777 and in 2000 it is estimated at 108,615 (NCDENR 2001). At present the subbasin is dominantly rural and does appear to be experiencing urbanization. Currently there are four TIP projects planned that affect the upper Dan River watershed and one recently built project (B-3045 on NC 89), which went to let in 2004 (Table 4) (see Appendix D for Map).

Table 4. TIP projects in the Upper Dan River Watershed

TIP #	Road	Waterway	Let
B-3045	NC 89	Dan River	Spring 2004
B-4281	NC 89/8	Dan River	April 2008
B-2639	SR1688	Dan River	July 2004
B-4280	SR 1307	Town Fork Creek	August 2008
B-4282	NC 66	Pinch Gut Creek	February 2008

The North Carolina Ecosystem Enhancement Program (NCEEP) has six projects going on in the 8 digit HUC 03010103 of the Dan River Basin. Four projects are preservation projects on the Mayo River and or one of its tributaries. The total linear feet of stream that has been preserved through the four projects is 11495. NCEEP has a 10,000 linear feet restoration project on Pinch Gut Creek and another 3,850 linear feet project on Snow Creek. Also, on Snow Creek NCEEP is doing 855 feet of stream enhancement. These projects once finished should provide some streambank stability, habitat, and hopefully help with the longevity of the JSM.

Species Description

James spinymussel *(Pleurobema collina)*

Status: Endangered
Family: Unionidae
Listed: July 22, 1988

Description and Distribution: The JSM is a small freshwater mussel slightly less than three inches in length. Adults have a dark brown shell with prominent growth rings and occasionally, short spines on each valve. Young mussels have a shiny yellow shell with or without one to three short spines. Prior to its decline, this freshwater mussel was found throughout the James River upstream of Richmond and in all of its major upstream tributaries. The species has declined rapidly during the past two decades and now exists only in small, headwater tributaries of the upper James River basin in Virginia and West Virginia and the upper Roanoke River drainage of Virginia and North Carolina (USFWS 2003a).

Life History: Suitable habitat for this species includes free-flowing streams with a variety of flow regimes. The James spinymussel is found in a variety of substrates that are free from silt. Like other freshwater mussels, this species is a filter feeder. It feeds on plankton collected from water that is passed over its gills. Reproduction occurs sexually. Females carry eggs in their gills. During spawning, the male release sperm into the water column and the sperm are taken into the female through the gills. The resulting larvae (known as glochidia) are released from the female into the water column and must attach to a fish host to survive. While attached to the fish host, development of the glochidia continues. Once metamorphosis is complete, the juvenile mussel drops off the fish host and continues to develop on the stream bottom. Known fish hosts for this species include the bluehead chub (*Nocomis leptocephalus*), rosyside dace (*Clinostomus funduloides*), blacknose dace (*Rhinichthys atratulus*), mountain redbelly dace (Phoxinus oreas), rosefin shiner (*Lythrurus ardens*), satinfin shiner (*Cyprinella analostana*), central stoneroller (*Campostoma anomalum*), and swallowtail shiner (*Notropis procne*) (USFWS 2003a).

Threats to Species (Particularly the Dan River Population)

The cumulative effects of several factors, including sedimentation, point and non-point discharge, stream modification (e.g., impoundment, channelization), coupled with the apparent restricted range, are believed to have contributed to the decline of this species throughout its range (USFWS 1990). When mussel populations are reduced to a small number of individuals and are restricted to short reaches of isolated streams, they are 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 or railroads.

Siltation resulting from improper erosion control of various land usage, including agricultural, silviculture, and development activities, 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 directly smothering mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than 1 inch have been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of the endangered dwarf-wedge mussel (*Alasmidonta heterodon*), because of accelerated sedimentation and erosion (Smith 1981).

As previously described above the soils in the Dan River Basin are subject to high erosion rates. Big Creek which enters the Dan River just below NC 89 and Seven Island Creek which enters the river just above SR 1668 carry heavy sediment loads to the river. Excessive sediment and poor quality habitat have been observed in the Dan River below the confluences with these creeks.

The impacts from in-stream sand and gravel-mining operations on aquatic environments and riparian habitats are well-documented (Meador and Layher 1998, Kondolf 1997, Starnes and Gasper 1996). These physical and biotic effects can extend far upstream and downstream from the site of extraction (Brown et al. 1998). The recovery time of the stream ecosystem from mining operations can be very extensive (>20 years) and total restoration in some cases has been considered improbable (Kanehl and Lyons 1992, Brown et al. 1998).

There are a number of active and inactive mining operations in the Dan River subbasin (including the main-stem of the Dan and Mayo rivers) in Stokes and Rockingham counties. None of the instream mines occur within or upstream of habitat that is currently occupied by the JSM. Without historic distribution data of the JSM in the Dan River subbasin, it is difficult to determine the effects, if any, these in-stream mine operations have had on the current distribution of this species in the drainage. It is however, apparent that habitat in the extraction sites is of poor quality for mussels and it is highly unlikely that recruitment of the JSM into these areas could ever be successful. "Poor quality habitat" occurs for considerable distances upstream and downstream (including tributaries) of these extraction sites.

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992b, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes to the aquatic community composition. These changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for glochidia (Fuller 1974). As mentioned earlier, a small impoundment called Jessups Mill, which is located on the river just above SR 1432 may be restricting the downstream range of the JSM in the river. It is also apparent that the two small hydroelectric dams on the Mayo River (Mayo Dam and Avalon Dam) have negatively affected distribution of the JSM spinymussel in the Mayo River. Numerous small impoundments also occur on the Dan River downstream of the JSM range. Again, without historic data on the distribution of the JSM in the Dan River, it is difficult to determine if these structures had any impact on the species.

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 JSM. Concern has been raised over competitive interactions for space, food and oxygen with this species and native mussels, possibly during the juvenile stages (Neves and Widlak 1987, Alderman 1997). The Asian clam is common to abundant within the Dan and Mayo rivers.

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). This species has not been recorded in the Roanoke River basin.

Wide forested buffers have been identified as critical in maintaining stream type (Llhardt et al. 2000), water temperature control (Lynch and Corbett 1990), food resources (Palik, et al. 2000) and instream habitat (Semlitsch 1998) for aquatic resources. Deforestation of large magnitude in the Dan and Mayo River watersheds is expected to have significant effects on the JSM.

Point Source Pollution

Point source discharge is defined as discharges that enter surface waters through a pipe, ditch, or other well-defined point of discharge. These include municipal (city and county) and industrial wastewater treatment facilities, small domestic discharging treatment systems (i.e., schools, commercial offices, subdivisions and individual residents), and stormwater systems from large urban areas and industrial sites. The primary substances and compounds associated with point source discharge include

nutrients, oxygen demanding wastes, and toxic substances such as chlorine, ammonia and metals.

Under Section 301 of the Clean Water Act of 1977 (CWA) discharge of pollutants into surface waters is regulated by the Environmental Protection Agency (EPA). Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permitting program, which delegates permitting authority to qualifying states. In North Carolina, the Division of Water Quality (DWQ) of The Department of Environment and Natural Resources is responsible for permitting and enforcement of the NPDES program. There are 21 NPDES permitted dischargers in the subbasin 03-02-01 (Table 5), most of which are small wastewater treatment plants serving schools or subdivisions. Four of these small wastewater treatment plants had problems with elevated biochemical oxygen demand (BOD) and ammonia in their discharges. The largest discharge is from the Town of Walnut Cove's Wastewater Treatment Plant (WWTP) to Town Fork Creek. Duke Power Company's Belews Creek Steam Station discharges cooling water to Belews Lake and ash pond basin effluent to the Dan River. Five dischargers, including the steam station, are required to monitor their effluent's toxicity: Kobe Copper Products, two Stokes County high schools, and Rayco Utilities. There were no indications of toxicity problems in 1999, and substantial improvements in effluent toxicity were observed relative to earlier data (NCDOT 2002).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations might not occur for up to two miles below points of chlorinated sewage effluent. Clarke and Neves (1984) suggested that sewage and industrial pollution might have contributed to the extirpation of the JSM from the North River in Virginia. Based on field observations, the municipal wastewater treatment plant, NPDES permit # NC0082384) located in Danbury appears to contribute to a reduction of mussel fauna, including the JSM in the river. However, this discharge is not the limiting factor in the downstream distribution of the JSM in the Dan River. In numerous other streams in North Carolina immediately below the point of effluent discharge, mussel populations have been observed to disappear entirely. The very low volume of discharge (0.1 mgd) at this site and the large size of the Dan River may be the reason that the discharge does not totally eliminate the mussel fauna below the treatment facility.

Table 5. NPDES Permits in the Roanoke River subbasin 03-02-01

Permit #	Facility	Type	Flow (MGD)	Stream
NC0025526	Walnut Cove, Town—WWTP	Minor	0.5	Town Fork Creek
NC0057720	Twin Lakes MHP/SSB, Inc.	Minor	0.04	Timmons Creek
NC0082384	Stokes Co./Danbury WWTP	Minor	0.1	Dan River
NC0044954	South Stokes High School	Minor	0.0173	Little Neatman Creek
NC0044962	North Stokes High School	Minor	0.0115	Dan River
NC0067091	Mikkola Downs Subdivision WWTP	Minor	0.072	East Belews Creek
NC0078115	Greystone Subdivision WWTP	Minor	0.032	Belews Creek

Cont. Table 5. NPDES Permits in the Roanoke River subbasin 03-02-01

NC0028746	Briarwood Subdivision WWTP	Minor	0.05	Brushy Fork Creek
NC0003492	RJ Reynolds Brook Cove site	Minor	0.02	Voss Creek (Sandy Branch)
NC0079049	RH Johnson Construction WWTP	Minor	0.06	Rough Fork
NC0035173	Kobewireland Copper Products Inc.	Minor	0.025	Dan River
NC0003441	JPS Elastomerics Corp	Minor	0.015	Little Dan River
NC0056791	Horizons Residential Care Center	Minor	0.015	Buffalo Creek
NC0083933	Heater Utilities/Salem Quarters WWTP	Minor	0.06	Belews Creek
NC0087980	Pine Hall Elementary School WWTP	Minor	0.004	Eurins Creek
NC0024406	Duke Energy Corporation/ Belews Creek Steam Station	Major	Not limited	West Belews Creek
NC0029777	Stokes Correctional Center	Minor	0.0132	Flat Shoals Creek
NC0043290	Danbury, Town—WTP	Minor	Not limited	Scott Creek (Steadmans Creek)
NC0037311	Creekside Manor Rest Home	Minor	0.01	Belews Creek
NC0060461	Carolina Water Service—Abington WWTP	Minor	0.2	Belews Creek
NC0075027	Cains Way Mobile Home Park	Minor	0.0432	Ader Creek

Non-point Source Pollution

Non-point source (NPS) refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities which are sources of non-point source pollution, including land development, construction activity, animal waste disposal, mining, agriculture and forestry operations as well as impervious surfaces such as roadways and parking lots. Various non-point source management programs, have been developed by a number of agencies to control specific types of non-point source pollution (e.g., forestry, pesticide, urban and construction related pollution). Each of these management plans develops BMPs to control the specific type of non-point

Survey Information

Full surveys for this project were conducted on October 3, 2006 and May 29, 2007. An additional abbreviated search of the project footprint was conducted on July 2, 2007. An earlier survey in June 2001 was completed as part of a larger effort to determine the range of the JSM. All of these survey efforts detected JSM at the project site. JSM has been detected in the area upstream and downstream of the project.

Survey records contained within the NCWRC Aquatic Database indicate that JSM has commonly been found at NC89/8 crossing and at numerous other crossings in Stokes County. Table 6. provides all known survey data from the project site.

Table 6. Survey information from NC89/8

Survey Date	Species Present	JSM Live (L) Shells (S)
June 19, 2001	JSM, E. spp, E a, V.c,	5L, 3S
October 3, 2006	JSM, E.spp, V. c	2S
May 29, 2007	JSM, E.spp, V. c	5L, 1S
July2, 2007	JSM, E.spp, V. c	3L

Species Present: E.spp (Elliptio species)*, E a (Elliptio angustata), V.c (Villosa constricta), JSM (Pleurobema collina)

* Taxanomic uncertainty of the Elliptio genus has resulted in several morphological forms of Elliptio being lumped into E. complanata and E. icterina groups. Elliptio individuals are commonly identified as E.spp.

Avoidance and Minimization Measures

Standard Measures

North Carolina Department of Transportation's Guidelines for Best Management Practices for the Protection of Surface Waters, Erosion and Sediment Control Guidelines for Contract Construction, and Best Management Practices for Bridge Demolition and Removal, are incorporated into NCDOT projects that occur within, or upstream of, water bodies that contain federally protected aquatic species. These are considered Environmentally Sensitive Areas. Some specific items from the above referenced guidelines within the Environmentally Sensitive Areas shall apply:

- The Contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations.
- Once grading operations begin in identified Environmentally Sensitive Areas, work shall progress in a continuous manner until complete.
- Erosion control devices shall be installed immediately following the clearing operation.
- Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment.
- Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 feet in height measured along the slope, or greater than 2 acres in area, whichever is less.

Additionally, NCDOT will invite representatives from the USFWS and the NCWRC to the pre-construction meeting for these projects, along with all subsequent field inspections prior to construction, to insure compliance with all special project commitments.

Additional Measures

The following are additional measures intended to further reduce deleterious construction related impacts to the waterway:

- Best Management Practices for Bridge Demolition and Removal will be implemented during the removal of the existing bridge.

- Removal of the existing bents will take place when water flow level is at a minimum point allowable within the project schedule and will be done in such a manner to minimize disturbance to the streambed.

- Final design has been done which proposes to place new bents approximately 10 feet from normal water edge, on stream bank, allowing for the water area to be completely spanned.

- Design standards in sensitive watersheds will apply.
- All sedimentation and erosion control devices, throughout the project limits, must be cleaned out when ½ full with sediment, to ensure proper function of the devices.
- Install Class II rip rap slope protection simultaneously with the embankment construction.
- A temporary access road for conveying construction equipment in the floodplain/buffer will be stabilized with rock or timber matting. A rock workpad or timber matting will also be utilized between the streambank and the interior bent in the river for removal of the interior bent. The contractor may use a tarp placed around the interior bent to further minimize debris in the water.
- Deck drains will not be allowed to discharge directly into stream.
- Embankment construction and grading shall be managed in such a manner to prevent surface runoff/drainage from discharging in the riparian buffer at all times. All interim surfaces will be graded to drain to temporary erosion control devices. Temporary berms, ditches, etc. will be incorporated as necessary to prevent temporary runoff from discharging into the riparian buffer.
- The use of temporary work bridges in lieu of causeways to construct proposed bridge.
- Locate temporary work bridges to eliminate impacts to tributary of Dan River.

Other alignments considered and rejected to avoid impacts

- An alternative which would replace Bridge No. 60 along a new alignment to the south while maintaining traffic on the existing bridge was considered and eliminated due cost and impacts to Dry-Mesic Oak Hickory Forest and Piedmont/Mountain Alluvial Forest.

- A no-build alternative was considered, but was unfeasible, because it would cause closure of the bridge and that the bridge provided too much traffic service for this to occur.

- NCDOT also considered bridge rehabilitation and deemed not feasible due to the age and deteriorated condition of Bridge No. 60.

Removal of Existing Structure

NCDOT has developed a set of Best Management Practices for Bridge demolition and removal in order to protect the water quality and aquatic life of the affected environment in the vicinity of a project. These guidelines are currently being revised. The proposed projects fall into the "Case 1" category of projects, which applies to Endangered Species and Outstanding Resource Waters (ORWs). The Contractor will be required to submit for approval a proposed demolition plan. Demolition techniques will follow NCDOT's Best Management Practices for Bridge Demolition and Removal (BMPs). The demolition description below is provided to give an example of what the Department considers practical at this site. The actual approved plan may not be similar to this method. Our focus will be on minimization and the contractor will be encouraged to develop techniques that provide equal or fewer impacts than described see direct effects section of this assessment. The demolition of this structure will not involve the use of explosives or shattering methods. Every precaution will be taken to ensure that debris from the bridge does not enter the river.

The Contractor will be required to create a proposed demolition plan sealed by a Professional Engineer registered in NC. Demolition techniques that do not allow debris to enter the river must be used. The plan shall incorporate the following:

- Prior to bridge demolition, remove all asphalt-wearing surface from the concrete deck. This will be accomplished in a manner that doesn't allow asphalt to enter the river. Examples of approved techniques include milling or "scrapping" with a backhoe bucket. Depending on the technique used, containment headers may be required. Typically this consists of vertical boards attached to the bottom of concrete barrier rail to prevent material from spilling into the river during removal.

- Remove all concrete deck, rail, diaphragms, and girders by saw cutting or non-shattering methods. Due to the severely deteriorated condition of the bridge deck, a containment system must be installed prior to deck removal. This system may be supported from the existing girders or substructure or could be independent of the

existing bridge such as floating devices that catch any debris that may fall during deck removal. The containment system will only be used to catch debris that inadvertently falls due to the condition of the deck.

- Cranes positioned on the proposed work bridge will lift sections of deck, rail, diaphragms, and girders out. .

- The proposed work bridge fingers will be used as access for bent removal. Construct sandbag cofferdam around bent for demolition. During the demolition process water in the cofferdam shall be continuously pumped to cause negative head pressure relative to the Dan River to prevent saw water from entering the river. Equipment will need to be staged adjacent to the bent to facilitate sawing the bent into manageable sections above water elevation. Cranes positioned on the main Work Bridge will lift the sections out. Once the bents have been removed to water elevation, the remaining mass of concrete will be removed to stream bed elevation by underwater sawing or use of hoe ram to break the bent at stream bed interface to allow lifting out as a unit. The existing footing below the streambed will be left in place to avoid additional streambed disturbance.

It is NCDOT intent not to deposit any debris from the existing bridge into the Dan River. If debris does enter the river, the contractor will be required to submit a proposed removal method for review and approval prior to conducting this work. The use of a clam bucket or raking of the streambed will not be allowed. Debris will be lifted out with a crane where possible and may require manual installation of lifting devices to avoid further streambed disturbance.

Effects Analysis

Project-related threats to the JSM can be separated into direct, indirect, and cumulative effects. Direct impacts refer to consequences that are directly attributed to the construction of the project, such as land clearing, stream rechannelization, and erosion. Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur. Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR §402.02]. Potential direct, indirect, and cumulative effect on the JSM population in Dan River/Subbasin 03-02-01, which may result from project construction, are discussed below.

Direct Effects

Potential direct effects to aquatic species associated with transportation projects include substrate disturbance, siltation, alteration of hydrologic regime, and introduction of toxic compounds.

Substrate disturbance (habitat loss)

The construction of this bridge will not result in the placement of bents into the river. There will be 125 ft^2 of permanent effects due to the armoring the bank where the bent will be closest to the river, in order to prevent scouring. Approximately 800 ft^2 of the steambed that will be temporarily effected by the construction of a temporary work bridge. There will also be 1300 ft^2 of temporary effects associated with removal of bents.

It is estimated that a total of 2,225 ft^2 (125 ft^2 permanent and 2,100 ft^2 temporary) of streambed habitat will be effected by the construction of this bridge. NCDOT is proposing to remove individuals from the effected sites and relocate to other locations (see Proposed Measure to Offset Effects).

JSM individuals were observed in the vicinity of the proposed bridge replacement and both upstream and downstream of the project area in 2001, 2006 and 2007. A pre-construction survey and relocation of mussels in the project footprint will reduce the possibility of direct mortality of JSM. Construction activities do invariably have some adverse effect on the aquatic habitat by increasing the amount of erosion, siltation, and chemical pollution to the impacted waters; however, the above-mentioned measures will be incorporated by NCDOT to avoid/minimize effects to the Dan River and potential habitat for the JSM. Strict implementation of these measures will ensure that the effects will be minimal and temporary wherever possible.

The unavoidable effects of bridge construction are expected to adversely affect existing JSM in the Dan River immediately downstream of the project area, but these effects are anticipated to be temporary and sublethal. Effects caused by bridge construction are not likely to prevent the re-colonization of JSM into the action area in the future.

Indirect and Cumulative Effects

Economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990).

One unintended consequence of roadway improvements can be encouragement of additional development and sprawl depending upon local land development regulations, development demand, water/sewer availability, and other factors. Improvements to levels of service, better accommodation of merging and exiting traffic, and reductions in travel times can have land development impacts outside of the project area. New growth and development within mountain and piedmont areas always has the potential to degrade water quality, scenic values and recreational opportunities unless proper planning and development regulations are utilized. This potential increases when it occurs in an area with minimal or new planning programs and virtually non-existent development controls. Local development controls along the Dan River corridor should be encouraged.

The proposed project involves replacement of the existing structure in slightly to the north, but using some of the old approach on the western side. The new structure is not intended, or expected to increase accessibility to the adjacent lands, nor is it expected to result in changes in the type, or volume of traffic using the structure. The amount of indirect and cumulative effect to the JSM habitat and the individual mussels at this site is fairly small compared to the extensive amount of occupied habitat in the Dan River (approximately 36 miles). According to the Stokes County website, there are no new projects planned within the action area (http://www.co.stokes.nc.us/). According to NCDOT's Division 9 TIP planning there are no new projects schedule in the proposed action area (http://www.ncdot.org/planning/development/TIP/TIP/Trans/division9map). Based upon above listed data no new projects are located within the proposed action area. Because this project involves the replacement of an existing structure with a spanning structure on just slightly different alignment there will be minimal land use changes, if any, associated with this project. The indirect and cumulative effects of this bridge replacement project would be small as it merely replaces the original structure.

BIOLOGICAL CONCLUSION: May Affect, Likely to Adversely Affect

The replacement of Bridge No. 60 discussed in this Biological Assessment will result in impacts to the JSM and its habitat in the Dan River. As mentioned above, the proposed project may result in 125 ft^2 permanent and 2,100 ft^2 temporary to streambed habitat. A number of measures have been made to reduce these effects. Further measures can be incorporated to help offset these effects to the Dan River JSM population.

Proposed Measures to Offset Effects

Preconstruction Survey & Mussel Relocation

NCDOT personnel will perform a preconstruction survey within the project footprint and adjacent areas prior to the let date. The let date for this project is currently April 15, 2008. The proposed relocation area is an area the width of the river, extending from an area approximately 150 feet (47 meters) downstream of the structure to an area 50 feet (15.5) meters upstream of the structure. The purpose of this survey will be to find and relocate JSM individuals that are in danger of mortality caused by project related demolition and construction.

During the surveys in 2006 and 2007 the several other species of rare native mussels were also identified. NCDOT is proposing to remove these individuals and any JSM from the impact site and relocate them to the USFWS approved relocation site (see Appendix C). NCDOT has come up with a relocation plan (see Appendix E).

Habitat/Riparian Buffer Conservation

The importance of wide, undisturbed riparian buffers for the protection of aquatic resources, including freshwater mussels, is well documented. The Recovery Plan for the JSM (USFWS 1990) identifies preservation of essential habitat in the form of establishment of stream buffer zones as a major Recovery Task (Task 2.33). NCDOT has initiated a watershed search for potential riparian properties within the Dan River subbasin upstream from Danbury. NCDOT purchased two sites the Clark and the Venable properties, which lie directly across from each other on the Dan River for the proposed project. Table 7 shows the properties that have been purchased in the Dan River drainage and how each site was allocated to NCDOT projects.

Table 7.Buffer Sites Purchased for Affects to the JSM

B-3045, B-2639, & B-4281 Buffer Sites	Acreage	Price per acre	Total Cost	Average Buffer Width (ft.)	Stream Length (Linear ft.)	Project Description
Farrell Property (B-3045)	8.524	2,500	21,310	260	1,645	Removed pine plantation and planted riparian buffer in Dan River floodplain 2004
Friends of Horseshoe (B-3045/B-2639)	59.34	2,500	148,350	230	7,695	Combination of riparian buffer preservation and restoration. Planted approx. 9 acres in March 2005
Clark Property (B-2639/B-4281)	15.954	3,625	57,833.25	420	1,745	Purchased entire parcel and planted in January 2006.
Venable Property (B-4281/asset)	26	3,625	94,250	960	1,346	Located on Dan River floodplain across from the Clark Site.
Martin Site (asset)	19.274	2,500	48,185	50	8,000	Riparian buffer 8,000ft. and Stream enhancement 600 ft.
Totals	**129.092**		**369,928.25**		**20,431**	

The Clarke property is 15.95 acres and has approximately 1580 linear feet of stream and will provide an average of 490 feet of buffer over the 1580 linear feet of stream. The Clarke site has been stripped of existing vegetation and replanted. A copy of the Clark property mitigation plan is attached to the Biological Assessment (Appendix F). The Venable site is 26 acres and has approximately 1,350 linear feet of stream and will provide an average of 926 feet of buffer over the 1,350 linear feet of stream. The Venable mitigation plan will follow the same protocols that were used on the Clarke site. The Venable site plan at this time is not available, but will be supplied to USFWS when it has been completed. Appendix G. is an aerial location map showing the Clark and Venable sites. Appendix H is a signed copy of the Right of Entry Agreement for the relocation site.

Additional Species

Schweinitz's sunflower *(Helianthus schweinitzii)*

Plant Family: Aster (Asteraceae)
Federal Status: Endangered, May 7, 1991
Flowers Present: late August or early September-through first frost
Survey Window: same as flowering season
NC Distribution: Anson, Cabarrus, Davidson, Gaston, Mecklenburg, Montgomery, Randolph, Rowan, Stanly, Stokes and Surry

Description:

Schweinitz's Sunflower is a perennial herb that grows from 1 to 2 m tall from a cluster of tuberous roots. The stems are usually solitary, branching only at or above mid-stem. The stem is usually pubescent and is often purple. Schweinitz's sunflower begins flowering in late August or early September and continues flowering until the first frost. The yellow disk and ray flowers are formed on small heads; the involucre (disc) is less than 1.5 centimeter across. The petals are 2 to 3 centimeters long. The nutlets are 3.3 to 3.5 millimeters long and are glabrous with rounded tips. The lanceolate leaves are opposite on the lower stem and alternate near the flowers. They are generally larger on the lower stem and gradually reduced upwards and are thick and stiff in texture. The pubescence of the leaves is distinctive and is one of the best characters to distinguish Schweinitz's sunflower from its relatives. The upper surface of the leaves is scabrous (rough), with the broad-based spinose hairs directed toward the tip of the leaf. The lower surface is more or less densely pubescent, with soft white hairs obscuring the leaf surface. Lower stem leaves average 10 to 20 centimeters long and 1.5 to 2.5 centimeters wide while upper leaves are half this size. The leaves are five to 10 times as long as wide and either sessile or have short petioles. Leaf margins are entire or with a few obscure serrations and are generally also somewhat revolute. Reproduction is accomplished both sexually (by seed) and asexually (by tuberous rhizome) (USFWS 2003b).

It is believed that this species formerly occupied prairie like habitats or Post Oak - Blackjack Oak savannas that were maintained by fire. Current habitats include roadsides, power line clearings, old pastures, woodland openings and other sunny or semi-sunny

situations. Schweinitz's sunflower is known from a variety of soil types but is generally found growing on shallow, poor, clayey and/or rocky soils, especially those derived from mafic rocks. In the few sites where Schweinitz's sunflower occurs in relatively natural vegetation, the natural community is considered a Xeric Hardpan Forest (Schafale and Weakley 1990).

Biological Conclusion: No Effect

NCDOT biologists Greg Price, James Mason, Sara Easterly and Ashley Cox visited B-4281 on September 13, 2007, to survey for Schweinitz's sunflower. The search for Schweinitz's sunflower extended 100 feet from the existing roadway to ensure no populations existed either within or in the immediate vicinity of the proposed construction. Reference populations for both species were visited prior to conducting the surveys. Plant by plant surveys was conducted in these areas, and no Schweinitz's sunflower individuals were located. The North Carolina Natural Heritage Program (NCNHP) does not list a known population within 1.0 mile of the proposed project. Given the results of the survey, it can be concluded that project construction will not effect Schweinitz's sunflower.

small-anthered bittercress *(Cardamine microanthera)*

Plant Family: Mustard (Brassicaceae)
Federal Status: Endangered, October 8, 1992
Flowers Present: April-May
Survey Window: April-May
NC Distribution: Stokes and historic record from Forsyth

Description:

Small-anthered bittercress is an erect, slender, perennial herb that is 8-16 inches tall, white flowers with anthers .2 inch long and petals .05-08 inch wide; distinguished from the similar *C rotoundifolia* by its much smaller nearly round anthers (instead of oblong), smaller flowers, and more angulate and non-clasping leaves (USFWS 2003c).

Habitat and Distribution:

Small-anthered bittercress is commonly found in seepages, wet rock crevices, streambanks, sandbars and wet woods along small streams, Dan River drainage. Small-anthered bittercress is endemic to the Dan River drainage in north central North Carolina and south central Virginia.

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Surveys were conducted at B-4281 on May 24, 2006 by NCDOT biologists Sara Easterly, Karen Lynch, Deanna Riffey and Susan Thebert. Prior to the surveys a known population of this species along Peters Creek was visited. Survey methodology included examination of aerial photographs and design plans to determine the project limits. The area was surveyed by wading in the Dan River and Buck Island Creek visually surveying the stream and riverbanks for species of Cardamine, plant by plant. small-anthered

bittercress was found in two locations just upstream of the confluence of the Dan River on Buck Island Creek. NCDOT has changed the design to avoid effects to Buck Island Creek through informal consultation with USFWS. NCDOT will also have to adhere to the following environmental commitments.

- NCDOT will commit to putting up orange fencing to protect the wooded buffer on Buck Island Creek preconstruction. NCDOT commits to having a preconstruction meeting between the contractor and USFWS.
- No direct or indirect impacts will occur to Buck Island Creek. NCDOT commits that no drainage will be directed from the project toward Buck Island Creek.
- Vegetation will be maintained wherever possible. The removal of vegetation should be minimized to the maximum extent possible in order to avoid any indirect effects to small-anthered bittercress associated with the change in the microclimate.
- Post-construction NCDOT commits to reforestation of the floodplain between fill slope and Buck Island Creek.
- NCDOT commits to keeping the lespedeza strictly to the fill slope.

USFWS had also requested that NCDOT to treat the fescue currently in the field between Buck Island Creek and the fill slope of the proposed project. NCDOT is aware that this plant is not a preferred species to have near an endangered plant, but is concerned about trying to eliminate the existing vegetation before planting trees. This creates the potential for more exposed soil to erode into Buck Island Creek. NCDOT is also concerned about how the fescue was going to be eliminated. If herbicides are used to eliminate fescue, this poses a potential risk to the small-anthered bittercress as well. In addition, the affects of herbicides on JSM are also potentially detrimental. NCDOT believes that if they can get a successful stand of trees growing there, that will cause the fescue to deteriorate over time anyway.

The Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA), originally passed in 1918, implements the United States' commitment to four bilateral treaties, or conventions, for the protection of a shared migratory bird resource. The original treaty upon which the MBTA was passed was the Convention for the Protection of Migratory Birds signed with Great Britain in 1916 on behalf of Canada for the protection "of the many species of birds that traverse certain parts of the United States and Canada in their annual migration." The primary motivation for negotiation of the 1916 treaty and the passage of the MBTA was to stop the "indiscriminate slaughter" of migratory birds by market hunters and others. The MBTA was subsequently amended as treaties were signed with Mexico (1936, amended 1972 and 1999), Japan (1972), and Russia (1976). The Canadian treaty was amended in December 1995 to allow traditional subsistence hunting of migratory birds (USFWS 2005).

Each of the treaties protects selected species of birds and provides for closed and open seasons for hunting game birds. The MBTA protects over 800 species of birds by implementing the 4 treaties within the United States. The list of migratory bird species

protected by the MBTA appears in Title 50, section 10.13, of the Code of Federal Regulations (50 CFR 10.13) (USFWS 2005).

The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg or any such bird, unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. Take is defined in regulations as: "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect." The MBTA protects over 800 species of birds that occur in the U.S (USFWS 2005)..

There are barn swallows (*Hirundo rustica*) currently nesting under the existing bridge. NCDOT will commit to using some device, for example netting, to exclude the birds from nesting in late February until September when they normally start to migrate south for the winter.

Literature Cited

Alderman, J.M. 1997. Monitoring the Swift Creek freshwater mussel community. Pages 98-107 in K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. 1997. Conservation and Management of Freshwater Mussels II Initiatives for the future. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island Illinois. 293 pp.

Brown, A.V., M.M. Lyttle, and K.B. Brown. 1998. Impacts of gravel mining on gravel bed streams. Transactions of the American Fisheries Society 127:979-994.
Clarke, A. H. and R. J. Neves. 1984. Status survey of the James River spinymussel Cathyria collina, in the James River, Virginia. A report for Region 5 of the U.S. Fish and Wildlife Service. 32pp.

Ellis, M.M. 1936. Erosion silt as a factor in aquatic environments. Ecology. 17:29-42.

Fuller, S.L.H. and C.E. Powell. 1973. Range extensions of *Corbicula manilensis* (Philippi) in the Atlantic drainage of the United States. Nautilus. 87(2): 59.

Fuller, S.L.G. 1974. Clams and mussels (Mollusca: Bivalvia), p. 215-273. In Hart, Jr., C.W. and S.L.H. Fuller [eds.] Pollution ecology of freshwater invertebrates. Academic Press, New York.

Goudreau, S.E., R.J. Neves, and R.J. Sheehan. 1988. Effects of sewage treatment effluents on mollusks and fish of the Clinch River in Tazewell County, Virginia. Final Rep., U.S. Fish and Wildl. Serv. 128 pp.

Kanehl, P., and J. Lyons. 1992. Impacts of in-stream sand and gravel mining on stream habitat and fish communities, including a survey on the Big Rib River, Marathon County, Wisconsin. Wisconsin Department of Natural Resources Research Report 155, Madison.

Kondolf, G.M. 1997. Hungry water: effects of dams and gravel mining on river channels. Environmental Management 21:533-551.

Llhardt, B.L., E.S. Verry, and B.J. Palik. 2000. Defining riparian areas. Pages 23-42 in E.S. Verry, J.W. Hornbeck, and C.A. Doloff, eds. Riparian management of forests of the continental eastern United States. Lewis Publishers, Boca Raton, Florida.

Lynch, J.A., E.S. Corbett, and K. Mussallem. 1990. Best management practices for controlling nonpoint source pollution on forested watersheds. Journal of Soil and Water Conservation 40:164-167.

Marking, L.L., and T.D. Bills. 1979. Acute effects of silt and sand sedimentation on freshwater mussels. Pp. 204-211 in J.L. Rasmussen, ed. Proc. of the UMRCC symposium on the Upper Mississippi River bivalve mollusks. UMRCC. Rock Island IL. 270 pp.

Meador, M.R., and A.O. Layher. 1998. Instream sand and gravel mining: environmental issues and regulatory process in the United States. Fisheries 23(11):6-13.

Neves, R.J., and J.C. Widlak. 1987. Habitat ecology of juvenile freshwater mussels (Bivalvia: Unionidae) in a headwater stream in Virginia. Amer. Malacol. Bull. 1(5):1-7.

Neves, R.J. 1993. A state of the Unionids address. Pp. 1-10 in K.S. Cummings, A.C. Buchanan, and L.M. Kooch, eds. Proc. of the UMRCC symposium on the Conservation and Management of Freshwater Mussels. UMRCC. Rock Island IL.189 pp.

NCDENR-Division of Parks and Recreation, 1995. North Carolina Natural Heritage Program Biennial Protection Plan, Natural Heritage Areas Priority List, Raleigh Dept. of Environment Health and Natural Resources, 73 pp.

NCDENR-Division of Water Quality. 2001. Roanoke River Basinwide Water Quality Plan. Water Quality Section, Raleigh, North Carolina, 181pp.

NCDENR, 2006. Roanoke River Basinwide Water Quality Plan. Web Resource. http://h2o.enr.state.nc.us/basinwide/Roanoke2006.htm

NCDOT, 2002. Programmatic Section 7 Consultation; For the James spinymussel (*Pluerobema collina*); Bridge Replacement Projects on the Dan River (B-2639 and B-3045).

NCDOT, 2005. Categorical Exclusion: Replacement of Bridge No. 60 on NC 89/8 over the Dan River in Stokes County, North Carolina (B-4281) State Project No. WBS 33621.1.1; Federal Aid Project No. BRSTP-008(4).

North Carolina Department of Natural Resources and Community Development. 1985. Geologic map of North Carolina: 1 sheet, scale1:500,000.

NRCS 1995. Soil Survey of Stokes County, North Carolina. US Dept. of Agriculture, Natural Resources Conservation Service.

O'Neill, C.R., Jr., and D.B. MacNeill. 1991. The zebra mussel (Dreissena polymorpha): an unwelcome North American invader. Sea Grant, Coastal Resources Fact Sheet. New York Sea Grant Extension. 12 pp.

Palik, B.J., J.C. Zasada, and C.W. Hedman. 2000. Ecological principles for riparian silviculture. Pages 233-254 in E.S. Verry, J.W. Hornbeck, and C.A. Doloff, eds. Riparian management of forests of the continental eastern United States. Lewis Publishers, Boca Raton, Florida.

Pickett, T.E. 1962. Stratigraphy of the Dan River Triassic Basin in North Carolina. Masters of Science Thesis submitted to the Department of Geology and Geography, University of North Carolina, Chapel Hill, 46pp.

Rohde, F.C., R.G. Arndt and S.M. Smith. 2001. Longitudinal Succession of fishes in the Dan River in Virginia and North Carolina (Blue Ridge/Piedmont Provinces). Southeastern Fishes Council Proceedings, 42:1-13.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh. 325 pp.

Semilitsch, R.D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12:1113-1119.

Smith, D. 1981. Selected freshwater invertebrates proposed for special concern status in Massachusetts (Mollusca, Annelida, Arthropoda). MA Dept. of Env. Qual. Engineering, Div. of Water Pollution Control. 26 pp.

Starnes, L.B., and D.C. Gasper. 1996. Effects of surface mining on aquatic resources in North America. Fisheries 21(5):24-26.

Strayer, D.L., S.J. Sprague and S. Claypool, 1996. A range-wide assessment of populations of Alasmidonta heterodon, an endangered freshwater mussel (Bivalva: Unionidae). J.N. Am. Benthol. Soc., 15(3): 308-317

U.S. Fish and Wildlife Service. 1990. James Spinymussel (Pleurobema collina) Recovery Plan. Newton Corner, Massachusetts, 38 pp.

U.S. Fish and Wildlife Service. 1992. Endangered and Threatened species of the southeast United States (The red book). Prepared by Ecological Services, Div. of Endangered Species, Southeast Region. Government Printing Office, Wash. D.C. 1,070 pp.

USFWS 1993. Dwarf-wedgemussel (*Alasmidonta heterodon*) Recovery Plan. Hadley, Massachusetts. 52 pp.

USFWS 1996. Revised Technical/Agency Draft Carolina Heelsplitter Recovery Plan. Atlanta GA. 47 pp.

USFWS 2003a. James spinymussel in North Carolina. http://www.fws.gov/nc-es/mussel/jamesspiny.html (viewed on September 4, 2007).

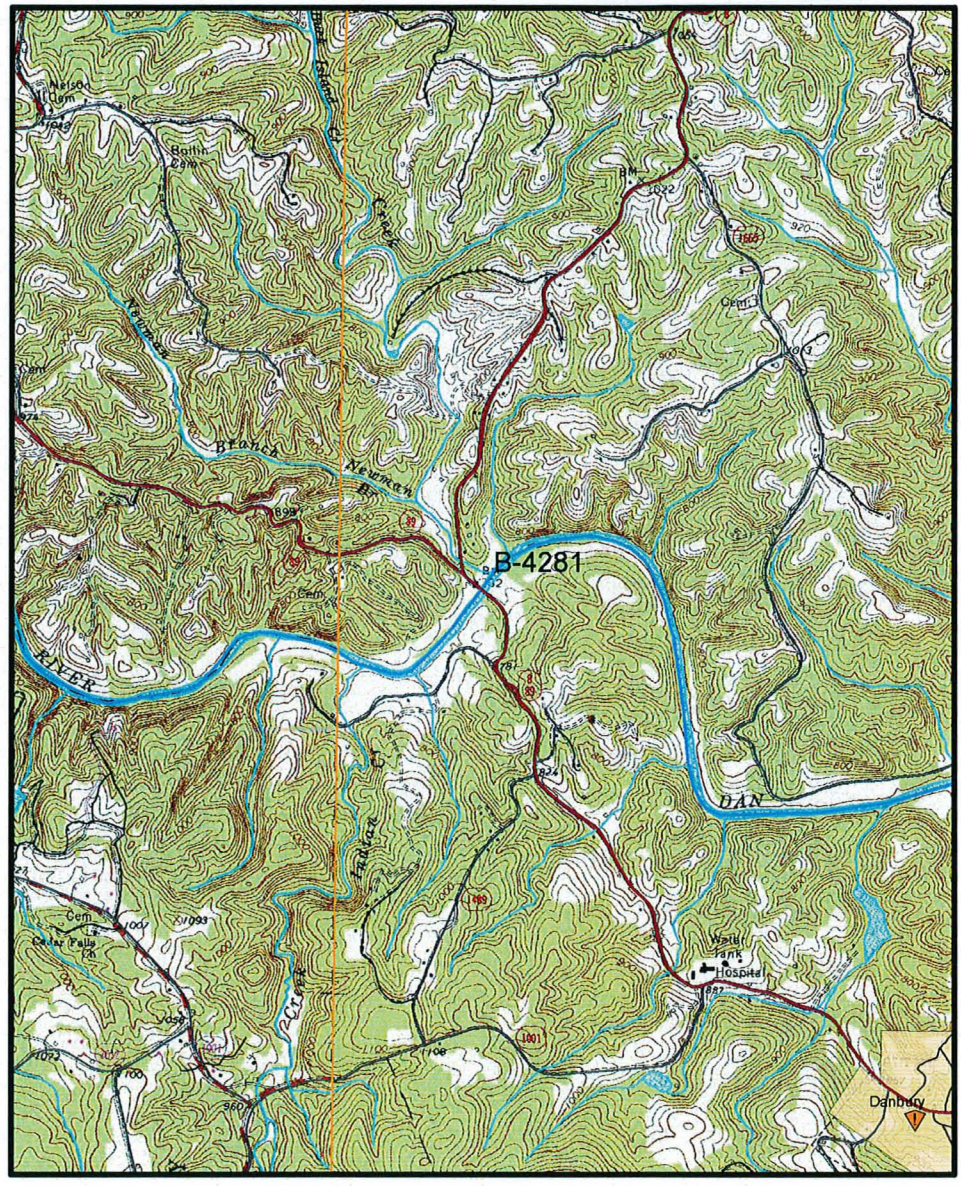
USFWS 2003b. Schweinitz's sunflower in North Carolina. http://www.fws.gov/nc-es/plant/schwsun.html (viewed on September 4, 2007).

USFWS 2003c. small-anthered bittercress in North Carolina. http://nc-es.fws.gov/plant/sabittercress.html (viewed on September 4, 2007).

USFWS 2005. The Migratory Bird Treaty Act. http://www.fws.gov/permits/mbpermits/ActSummaries.html. (viewed September 4, 2007).

APPENDIX A

TIP B-4281 DANBURY QUAD (1:24,000 Scale)



0 0.5 1 Miles

N

APPENDIX B

WETLAND PERMIT IMPACT SUMMARY

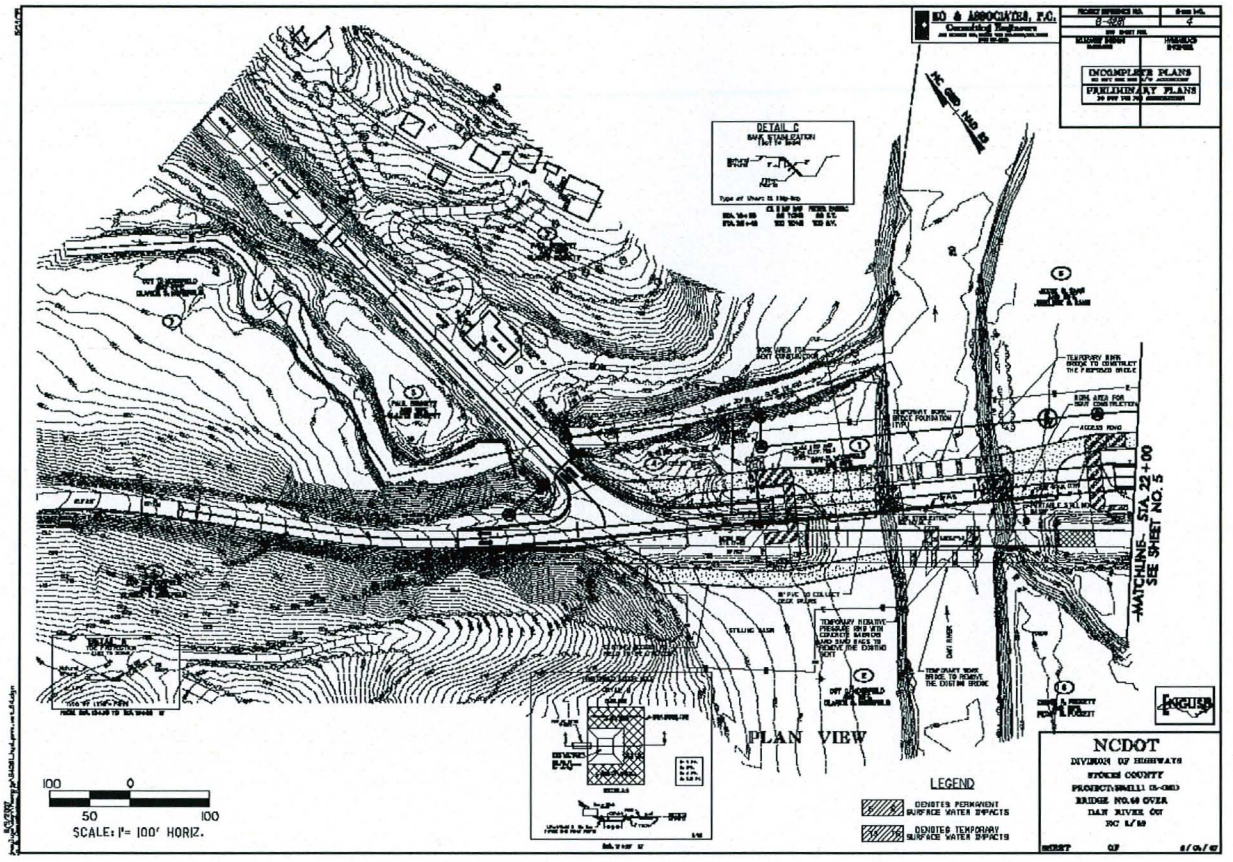
			WETLAND IMPACTS					SURFACE WATER IMPACTS				
Site No.	Station (From/To)	Structure Size / Type	Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)
1	18+80 to 20+36 LT	Temporary Work							0.01		20	
		Bridge, L= 156'										
1	18+95 & 20+20	Bank Stabilization						0.02		33		
		with CL. II Rip Rap										
1	19+40 & 19+90 RT	Temporary Negative							0.02		30	
		Pressure Ring										
1	18+84 to 19+94 RT	Temporary Work							0.01		20	
		Bridge, L=110'										
TOTALS:			0.00	0.00	0.00	0.00	0.00	0.02	0.04	33	70	0

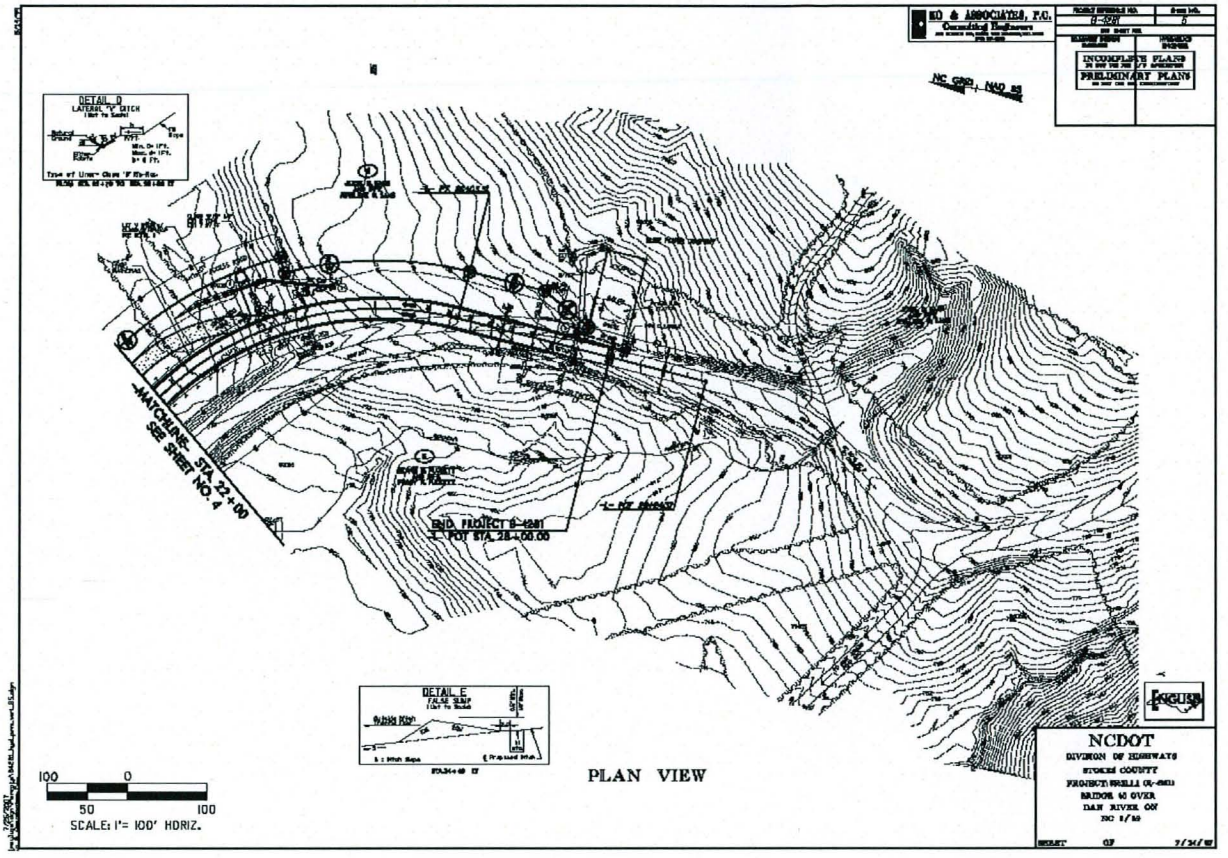
NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

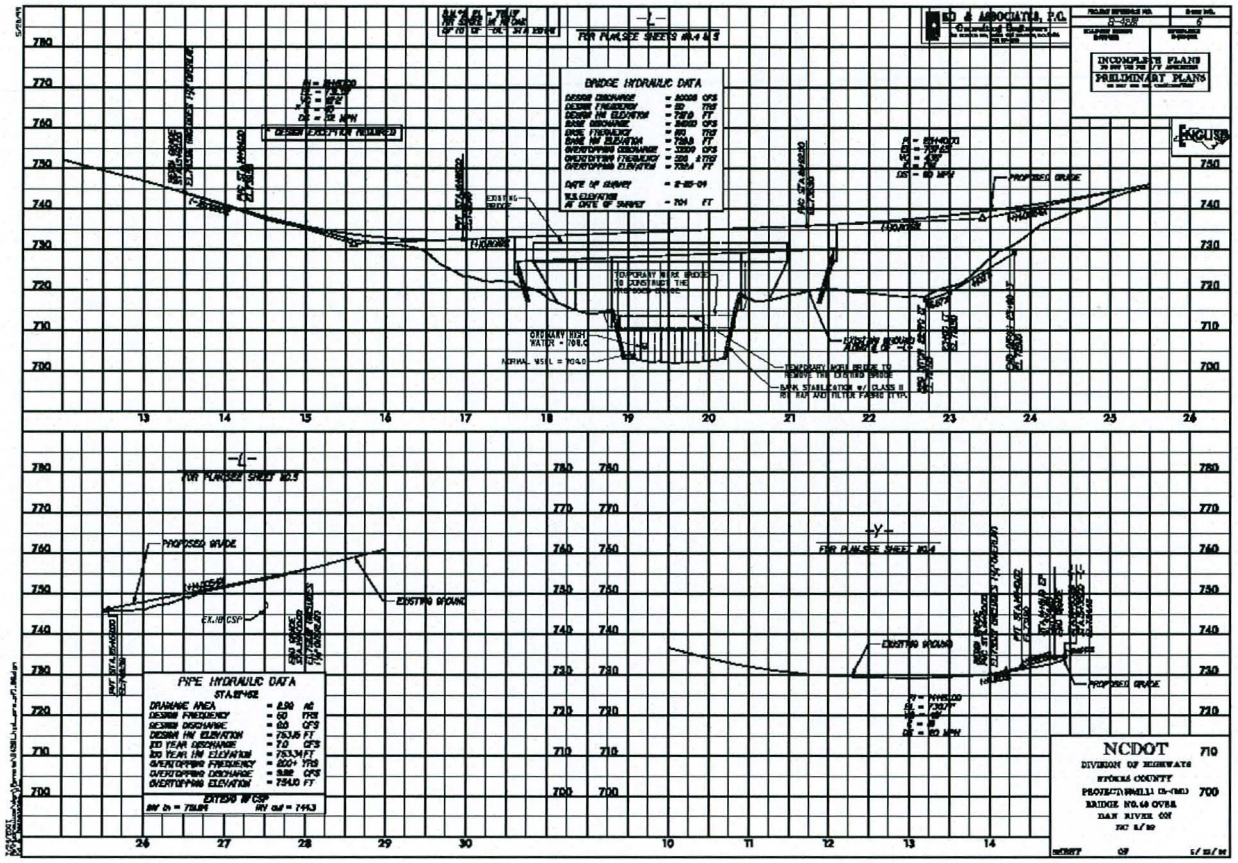
STOKES COUNTY
WBS - 38621.1.1 (B-4281)

SHEET 7/24/2007

ATN Revised 3/2108

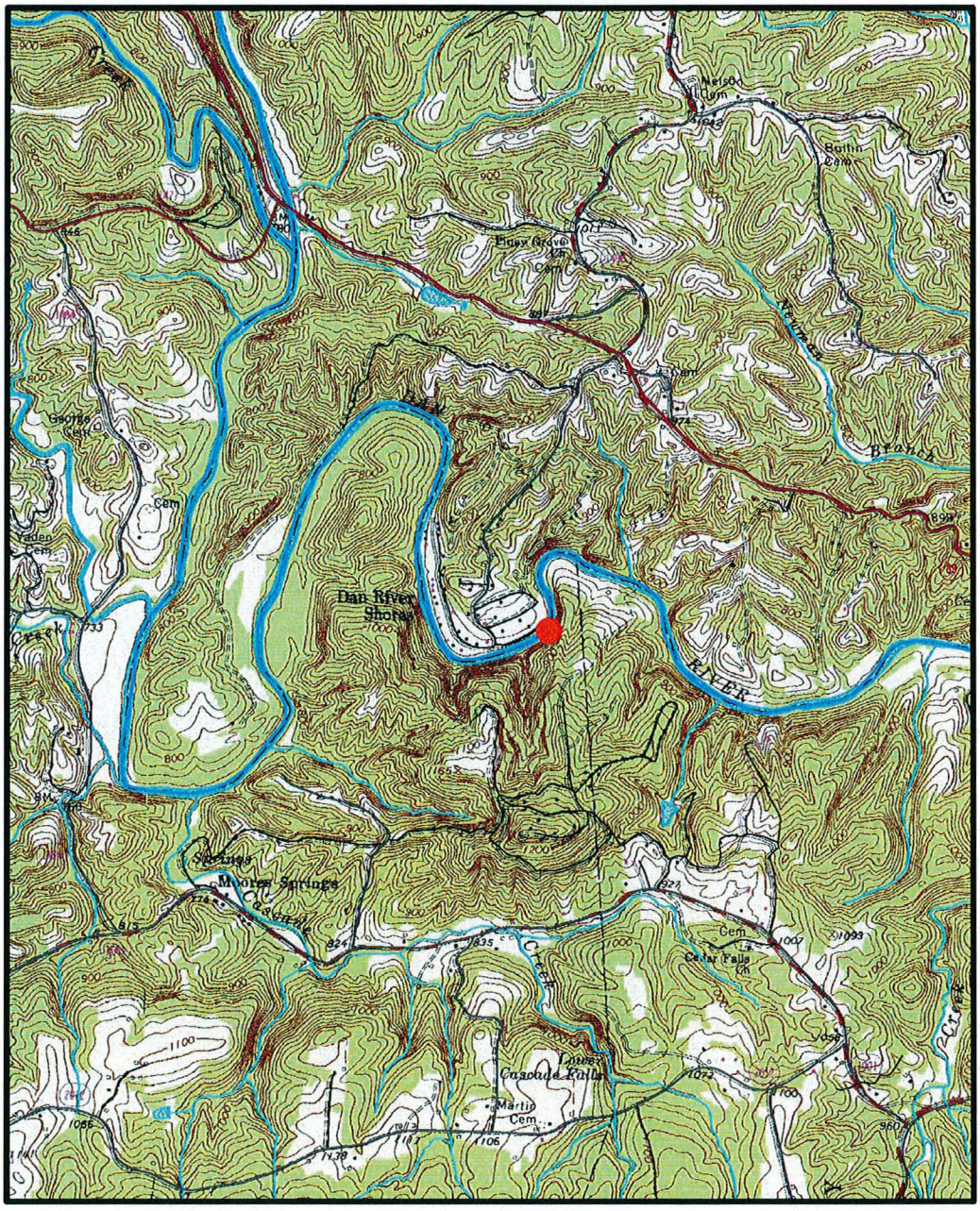

DETAIL C
PLAN VIEW
LEGEND
DENOTES PERMANENT SURFACE WATER IMPACTS
DENOTES TEMPORARY SURFACE WATER IMPACTS
100 0
50 100
SCALE: 1"= 100' HORIZ.
NCDOT
DIVISION OF HIGHWAYS
STOKES COUNTY
DAN RIVER
INCOMPLETE PLANS
PRELIMINARY PLANS
MATCHLINE STA. 22+00
SEE SHEET NO. 5


NC GRID, NAD 83
DETAIL D
LATERAL "V" DITCH
MATCHLINE STA 22+00
SEE SHEET NO. 4
END PROJECT B-4281
1- POT STA 28+00.00
DETAIL E
FALSE SLOPE
PLAN VIEW
100 0 50 100
SCALE: 1"= 100' HORIZ.
INCOMPLETE PLANS
PRELIMINARY PLANS
NCDOT
DIVISION OF HIGHWAYS
STOKES COUNTY
BRIDGE 40 OVER
DAN RIVER CO
NC 8/66


BRIDGE HYDRAULIC DATA
DESIGN DISCHARGE = 8000 CFS
DESIGN FREQUENCY = 50 YRS
DESIGN HW ELEVATION = 709.0 FT
500YR DISCHARGE = 8800 CFS
500YR FREQUENCY = 500 YRS
500YR HW ELEVATION = 709.8 FT
OVERTOPPING DISCHARGE = 10000 CFS
OVERTOPPING FREQUENCY = 200 & 1700 YRS
OVERTOPPING ELEVATION = 709.4 FT
DATE OF SURVEY = 2-25-04
W.S. ELEVATION AT DATE OF SURVEY = 704 FT
DESIGN EXCEPTION REQUIRED
EXISTING BRIDGE
TEMPORARY WIRE BRIDGE TO CONSTRUCT THE PERMANENT BRIDGE
ORDINARY HIGH WATER = 706.0
NORMAL WSEL = 704.0
TEMPORARY WIRE BRIDGE TO REMOVE THE EXISTING BRIDGE
BANK STABILIZATION w/ CLASS B RIP RAP AND FILTER FABRIC (TYP)
PROPOSED GRADE
EXISTING GROUND
-L-
FOR PLANSHEET SHEETS NO.4 & 5
-L-
FOR PLANSHEET SHEET NO.5
-Y-
FOR PLANSHEET SHEET NO.4
EXISTING GROUND
PROPOSED GRADE
EX.18" CSP
PIPE HYDRAULIC DATA
STA.=452
DRAINAGE AREA = 0.90 AC
DESIGN FREQUENCY = 50 YRS
DESIGN DISCHARGE = 80 CFS
DESIGN HW ELEVATION = 753.95 FT
10 YEAR DISCHARGE = 70 CFS
100 YEAR HW ELEVATION = 753.94 FT
OVERTOPPING FREQUENCY = 200+ YRS
OVERTOPPING DISCHARGE = 100 CFS
OVERTOPPING ELEVATION = 754.0 FT
ENTERS 18" CSP
INV in = 751.04 INV out = 749.3
NCDOT
DIVISION OF HIGHWAYS
STOKES COUNTY
PROJECT\PHILLI (B-[illegible])
BRIDGE NO.40 OVER
DAN RIVER CO
INCOMPLETE PLANS
PRELIMINARY PLANS
SHEET OF

APPENDIX C

Mussel Relocation Site (1:24,000 Scale)

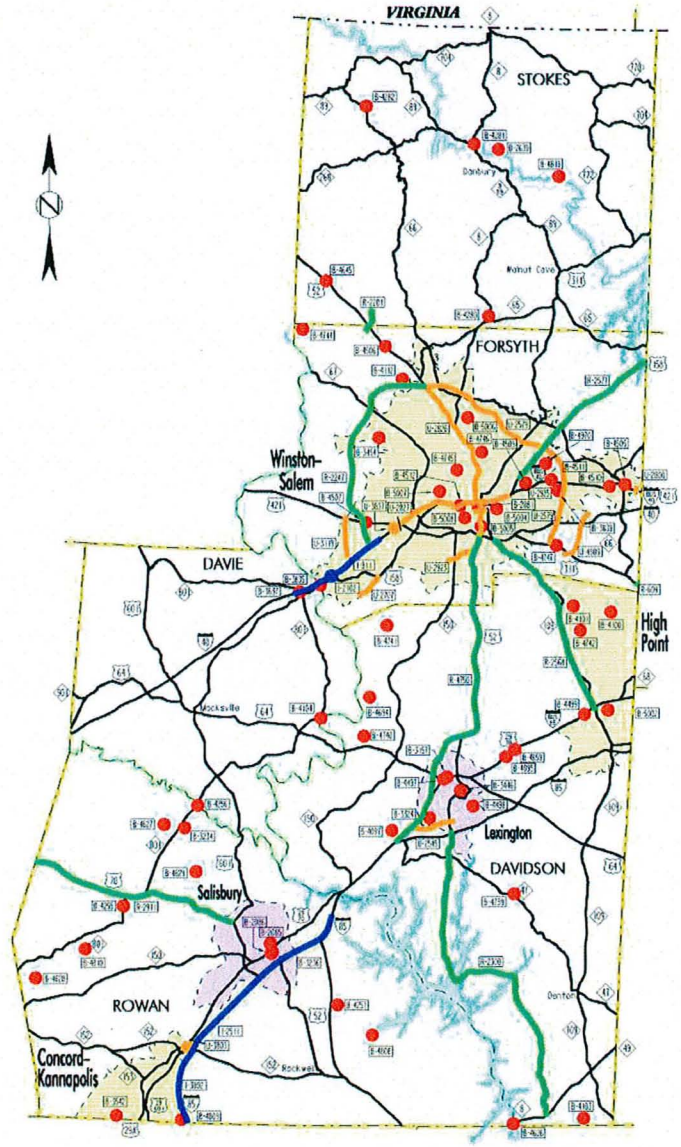


0 0.5 1 Miles

Relocation Site

N

APPENDIX D



DIVISION 9

LEGEND

- INTERSTATE PROJECTS
- RURAL PROJECTS
- URBAN PROJECTS
- BRIDGE REPLACEMENT PROJECTS

APPENDIX E

MUSSEL RELOCATION PROCEDURES

Adapted from Tim Savidge's Dan River (B-2639 & B-3045) Biological Assessment

Freshwater mussels have often been relocated to minimize negative effects of in-stream construction activities with varying degrees of success (Dunn et al. 2000, Cope and Waller 1995). Cope and Waller (1995) revealed that mortality of relocated mussels was >70% in 30% of the relocation studies reported in the literature, with mortality exceeding 90% mortality in some projects. Several factors can be attributed to the successful relocation of freshwater mussels. The most important stream attributes to consider include stream size, substrate stability, hydrology and riparian vegetation (Cope et al. 2003, Morris and Corkum 1996, DiMaio and Corkum 1995, Lewis and Riebel 1984, Strayer 1983, Vannote and Minshall 1982). Vaughn (1977) suggested that most riverine unionids are located in areas with stable substrate but with the current substantial enough to keep fine silts and sand from depositing.

Relocation methods must be developed to minimize stress caused by handling and movement of the mussels (Cope et al. 2003, Cope and Waller 1995). Dunn et al. (2000) noted that the use of personnel experienced in handling mussels is crucial to insure the proper placement of the animal back in the substrate. In addition, avoiding extreme temperatures, and keeping the animals moist are also critical considerations for a successful relocation (Dunn 1994). Minimizing the amount of aerial exposure increases the chance of survival of relocated mussels (Dunn et al. 2000). Waller et al. (1995) reported a decreasing trend of survival of relocated mussels with increased duration of exposure.

Carefully planned and implemented relocation plans can lead to success. For instance, Watson (2002) reported that only 3 Elliptio mussels out of 334 relocated in North Carolina were found dead on the two week monitoring date. The small amount of mortality observed was attributed to predation and it was surmised that this mortality did not result from stress. However, more evidence regarding the success or failure of the project will be determined following the one-year monitoring period.

MUSSEL RELOCATION METHODS

The following methods were developed based on recommendations outlined by Dunn et al. 2000 and from procedures developed by the North Carolina Wildlife Resources Commission (Watson 2002). This plan was developed to reduce stress and minimize the risk of injury while the mussels are being handled and transported. Relocation efforts should be carried out under the direct supervision of a permitted biologist within the NCDOT Office of Natural Environment Biological Survey Unit. If at any time during a relocation it is determined that the relocation efforts are not meeting the stated objectives, the relocation procedures may be modified by NCDOT in cooperation with the United States Fish and Wildlife Service and NC Wildlife Resources Commission.

Selection of Relocation Site

Habitat quality is a major factor influencing mussel survival. The loss and alterations of aquatic habitats are the primary reasons for decline, extirpation, and extinction of freshwater mussels in this country (Neves 1993). Despite the importance of suitable habitat, very few mussel relocation projects have combined quantitative analysis of habitat characteristics with the selection of suitable relocation sites (Cope and Waller 1995). Hinch et al. (1986) and Hinch and Green (1989) found that mussels response to relocation is greatly influenced by their previous environment, thus sites selected for relocation should have similar components as the source site.

Upstream areas should be surveyed thoroughly, preferably multiple times, in order to find suitable relocation sites. Potential relocation sites should be evaluated for similar habitat components (deposition islands, substrate, gradient, calm waters, channel morphology, etc.) as those occurring at the sites where the mussels are to be removed from. Survey techniques should be selected to best fit the site characteristics, including canoeing or walking the entire reach being evaluated and conducting visual surveys for mussels (batiscopes, mask/snorkel). Information such as species present (especially the target species), flow and depth, stream bank stability, riparian buffer quality, and apparent land use impacts should be recorded.

The quality criteria of potential relocation sites includes the presence of microhabitat similar to that which occurs at the impact sites, highly stable stream banks and substrate, the presence of large undisturbed riparian buffers, and the presence of an apparently healthy mussel fauna. One area for each impact site containing these qualities that is most easily accessible to the salvage site (to minimize transport time) should be chosen and approved by US Fish and Wildlife Service staff. Ideally, land use adjacent to the relocation site change should not change or become developed.

The relocation sites can be marked by driving a 2-foot long rebar stake into the adjacent bank, marking the upstream and downstream limits of the relocation area. Depending on the length of the area, rebar stakes can also be driven into the bank to indicate the center of the relocation area. Flagging tape should also be tied to various trees and other landmarks to mark the general area of the relocation sites. In addition, GPS should be used to delineate the area. The relocation sites must be delineated prior to the salvage of mussels from the impact area.

Collection of Mussels at Impact Site

All federally listed mussels found in the project footprints should be moved upstream to the relocation site. The salvage areas will consist of the area of the river that will be disturbed by construction procedures (piles, work bridges etc.) and extend downstream far enough to include any area affected by construction/demolition work. This area should be delineated with flagging along the banks prior to beginning salvage efforts. Other freshwater mussels found at the impact site may be moved to the relocation site as well. All species should be tagged and measured, prior to being transported to the relocation site.

Two types of collection methods can be used in combination: surface (visual), and excavation. Freshwater mussels should first be collected using visual methods. The type of

visual method used (mask/snorkel, batiscope, SCUBA etc.) should be determined during the salvage effort and will be based on depth, flow, visibility and temperature. Excavation of the substrate may also be used because it is well documented that visual surveys of mussels at the substrate surface can significantly underestimate the number of mussels present at a site. Detection of mussels at the surface can vary between sites and can be dependent on the season, observer, species, mussel size and visibility (Smith et al. 2000, Miller and Payne 1988). The reasons for first performing visual surveys before excavation is to limit the amount of stress (disturbance and damage) to as many of the individuals as possible. Using both collection methods will also provide detection information for the target species.

Dunn et al. (2000) stressed the importance of personnel experienced with handling freshwater mussels in successful relocation projects. The relocation crew should be supervised by an experienced biologist, and all of the personnel must be experienced with handling freshwater mussels. A review/training session should be conducted prior to beginning the relocation efforts to insure each member of the relocation team is properly briefed and understands their respective roles in the operation. The relocation efforts should be scheduled to avoid excessively hot weather and/or the mussels' reproductive season.

Hand collecting of mussels should be performed by surveyors spread out across the waterway beginning at the downstream end of the salvage area and proceeding upstream. Each surveyor will carry a mesh bag to place the mussels into. One person (runner) will be in the river behind the surveyors to collect mussels from them and carry them to a holding area, where they will remain in the water and shaded until they can be tagged and measured prior to removal to the relocation site.

After the salvage area has been visually surveyed, the same collection crew may begin excavating (by hand) the substrate to a depth of 15 cm, beginning at the downstream end and proceeding upstream as before, if it is determined that this will be of benefit. The excavations should be performed in areas that were determined to contain mussels based on the visual surveys, and other areas determined by the lead biologist to contain suitable habitat. Mussels collected with this method will be processed as before.

Data Processing

All listed mussels should be measured (mm), photographed and tagged and then placed in mesh dive bags and kept in shaded portions of the river until ready for transport. All listed mussels must be kept separately from other species to minimize the chances of injury. Periodically, all other mussels can be measured and tagged and pooled into a single bag and left within the stream while the survey continues.

All mussel species should be tagged on both valves. Numerous relocation projects report scrubbing mussels with burlap to remove any algae, mud, or other debris and then drying to apply tags. This creates additional stress on the mussels, and does not appear to be necessary. Tags have been successfully applied to un-cleaned, moist mussels in other areas of North Carolina (John Fridell, USFWS personal communication). Mussels must be kept as moist as possible while measuring and affixing the tags to avoid unnecessary stress. Tags that have been

used previously (Hallprint Tags) are made of polyethylene, oval in shape, and approximately 9 mm long by 4 mm wide. The tags are colored (e.g., green) and each has a unique 4-character code, which begins with a letter followed by 3 numbers. The tags can be applied to the mussels using Krazy Glue, or a quick dry epoxy. Once the adhesive is dry, the mussels should be placed back into the stream in the designated mesh bags. This procedure should be repeated until all the collected mussels are tagged and measured and ready for transport. Each individual mussel should be kept out of the water for a period less than 5 minutes for data recording and tagging.

Transportation to Relocation Site

After the animals are collected from their source area, they should be transported to the selected relocation site. This involves layering the mussels in damp burlap within appropriately sized coolers. Pieces of burlap soaked in the stream can be placed in the coolers. The tagged mussels will then be placed on top of the damp burlap so no mussels are stacked on each other. A maximum of 100 mussels can be placed in each cooler with about 3 to 4 layers per cooler. Ice packs should be placed in the cooler to maintain temperature, but the mussels must not be in direct contact with the packs.

Preparation of Relocation Site

The relocation site should be divided into a grid of 1-m^2 segments. Each segment will be assigned a number. A permanent grid should not be placed into the river if there are concerns of an increased chance of vandalism due to the shallow depth, or high recreational use of the river. The grids are typically portable 1-m^2 squares constructed from 5-cm schedule 40 polyvinyl chloride (PVC) or welded rebar. Grid placement will be determined by locating resident target mussels at the relocation site and using their distribution to determine the area with the most suitable habitat. A corner square will be marked by driving rebar into the substrate and the location recorded using GPS with sub-meter accuracy. The layout of the grid will be designed to maintain the whole grid within suitable habitat.

After the relocated mussels are brought to the relocation site, resident mussels in the site must be collected. The relocated mussels should be kept in the river while this is being done. All mussels within the relocation grid should be collected (using surface visual collection) from within the squares, measured and tagged. Relocated and resident mussels should then be placed by hand into the substrate within the numbered squares. The number (resident and relocated) of each mussel species placed in each square must be recorded. Density of each species within the 1-m^2 square should not be increased by more than 3 times. Cope et al. (2003) demonstrated that increasing the density of mussels 2-3 times did not adversely affect survival rates. The number of mussels placed into each 1-m^2 square will be dependent on the number of mussels collected at the salvage sites. This method of collecting and tagging resident mussels and placing relocated musssels into the 1-m^2 squares continues until all squares (except control squares) within the grid are sampled. Randomly selected squares (from the lower, middle and upper portions of the grid respectively) serve as controls to assess natural mortality. Resident mussels will not be disturbed in these squares; they will be observed only.

Monitoring

The relocation sites should be monitored for recovery, survival (of recovered mussels), movement and growth for a period of 1 year. It is preferable that the staff conducting the monitoring include biologists who were involved with the salvage and relocation work. One month after relocating the mussels, visual surveys for mussels should be conducted at the relocation site. Mussels observed at the surface should be taken from the substrate and recorded and placed back into the squares they were taken from. Any untagged mussels should be processed and tagged as before and placed back into the square. This initial survey will be conducted to record any mortality that would result from the handling of mussels. Excavation of the grid will not be performed to avoid additional stress on the mussels and to maintain substrate stability. After this initial survey, a visual substrate survey for mussel will be conducted approximately 1 year after the initial relocation with timing selected for conditions similar to those that occurred during the relocation. All tagged mussels should be collected, measured and returned to the 1-m^2 square it was collected from. Data should be recorded as before. Visual surveys must also be conducted in the area downstream of the relocation grid to record any mussels moving out of the grid.

Excavation surveys should not be conducted at the relocation sites during monitoring. This decision was made, because of the importance of substrate stability on the survival of mussels. All efforts must be made to minimize the disturbance to mussels and the habitat during monitoring. Although it is likely that all resident mussels in the relocation sites will not be counted during site preparation, the objective of these efforts is to give the best chance of survival to the mussels relocated from the impact site, that otherwise would be lost.

LITERATURE CITED

Cope, W.G., M.C. Hove, D.L. Waller, D.J. Hornbach, M.R. Bartsch, L.A. Cunningham, H.L. Dunn and A.R. Kapuscinski. 2003. Evaluation of relocation of Unionid mussels to *in situ* refugia. J. Moll. Stud. 69: 27-34.

Cope, W.G. and D.L. Waller. 1995. Evaluation of freshwater mussel relocations as a conservation and management strategy. Regulated Rivers: Research and Management 11: 147-155.

DiMaio, J. and L.D. Corkum. 1995. Relationship between the spatial distribution of freshwater mussels (Bivalvia:Unionidae) and the hydrological variability of rivers. Canadian Journal of Zoology 73: 663-671.

Dunn, H.L., B.E. Sietman, and D.E. Kelner 2000. Evaluation of recent Unionid (Bivalvia) relocations and suggestions for future relocations and and reintroductions. Pages 169-183. In: Freshwater Mollusk Symposia Proceedings (R.A. Tankersly, D.I. Warmolts, G.T. Waters, B.J. Armitage, P.D. Johnson & R.S. Butler eds), 169-183. Ohio Biological Survey, Columbus Ohio.

Lewis, J.B. and P.N. Riebel. 1984. The effects of substrate on burrowing in freshwater mussels (Unionidae). Canadian Journal of Zoology 62: 2023-2025.

Morris, T.J. and L.D. Corkum. 1996. Assemblage structure of freshwater mussels (Bivalvia: Unionidae) in rivers with grassy and forested riparian zones. Journal of North American Benthological Society 15: 576-586.

Neves, R.J. 1993. A state of the Unionids address. Pp. 1-10 in K.S. Cummings, A.C. Buchanan, and L.M. Kooch, eds. Proc. of the UMRCC symposium on the Conservation and Management of Freshwater Mussels. UMRCC. Rock Island IL.189 pp.

Rohde, F.C., R.G. Arndt and S.M. Smith. 2001. Longitudinal Succession of fishes in the Dan River in Virginia and North Carolina (Blue Ridge/Piedmont Provinces). Southeastern Fishes Council Proceedings, 42:1-13.

Rosgen, D. L. 1998. River Restoration and Natural Channel Design. Course Handbook. Wildland Hydrology. Pagosa Springs, CO.

Strayer, D.L. 1983. The effects of surface geology and stream size on freshwater mussel (Bivalvia, Unionidae) distribution in southeastern Michigan, U.S.A. Freshwater Biology 13: 253-264.

Vannote, R.L. and G.W. Minshall. 1982. Fluvial processes and local lithology controlling abundance, structure, and composition of mussel beds. Proceedings of the National Academy of Science 79: 4103-4107.

Vaughn, C.C. 1997. Regional patterns of mussel species distributions in North American rivers. Ecography 20: 107-115.

Watson, B.T. 2002. Freshwater Mussel and Snail Restoration in the Piedmont of North Carolina: 2001 Progress Report. North Carolina Wildlife Resources Commission. 15 January 2002.

APPENDIX F

CLARK PROPERTY
DAN RIVER DETAILED BUFFER MITIGATION PLAN
STOKES COUNTY, NORTH CAROLINA

Prepared for:

North Carolina Department of Transportation
Raleigh, North Carolina

June 2006

EXECUTIVE SUMMARY

The North Carolina Department of Transportation is currently evaluating riparian buffer restoration on the northern bank of the Dan River within the Clark property. The Clark property is located approximately four miles east of Danbury, North Carolina in Stokes County. The mitigation area is approximately 10.5 miles downstream from B-3045 (Bridge No. 17 over the Dan River on Highway 89). Riparian buffer restoration is expected to provide a portion of the mitigation to offset impacts to known mussel populations identified within, and adjacent to, bridge replacement projects B-2639 and B-4281. This detailed mitigation document will outline plans to restore riparian buffer functions associated with water quality, and aquatic and terrestrial wildlife habitat.

A 15.95 acre parcel purchased fee simple by the NCDOT, hereafter referred to as the Site, has been proposed for mitigation activities. The Site is composed entirely of floodplain that will be utilized for riparian buffer restoration adjacent to the Dan River. The Site watershed is comprised of mixed hardwood forest, agricultural land, and low-density residential development. The primary land use within the Site, prior to purchase by NCDOT, was agricultural production.

Site reforestation will occur within the entire Site (northern bank of the Dan River and adjacent floodplain) to protect water quality and reduce sedimentation inputs into a reach of the Dan River with known federally protected mussel populations. Reforestation efforts will include streamside and bottomland hardwood forest communities.

After implementation, restoration activities are expected to result in restoration of streamside and floodplain buffer vegetation within the entire 15.95 acre site.

TABLE OF CONTENTS

1.0 INTRODUCTION **3**

2.0 METHODS **5**

3.0 EXISTING CONDITIONS **5**

3.1 PHYSIOGRAPHY, TOPOGRAPHY, AND LAND USE 5
3.2 SOILS 6
3.3 PLANT COMMUNITIES 10

4.0 REFERENCE FOREST ECOSYSTEM **11**

5.0 RESTORATION PLAN **17**

5.1 MOWING OF EXISTING PINE PLANTATION 17
5.2 PLANT COMMUNITY RESTORATION 17
5.3 PLANTING PLAN 18

6.0 FINAL DISPENSATION OF THE PROPERTY **20**

7.0 REFERENCES **20**

LIST OF FIGURES

Figure 1. Site Location 4
Figure 2. Topography 7
Figure 3. On-Site Land Use 8
Figure 4. NRCS Soils Map 9

LIST OF TABLES

Table 1. Reference Forest Ecosystem Plot Summary 10
Table 2. Planting Plan 14

CLARK PROPERTY
DAN RIVER DETAILED BUFFER MITIGATION PLAN

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT) is currently evaluating riparian buffer restoration for 15.95 acres of the Clark property on the northern bank of the Dan River in Stokes County, North Carolina. The mitigation area is located approximately 4 miles east of Danbury, North Carolina directly south of State Road 1697 (Pitzer Road), approximately .25 miles west of the intersection of Pitzer Road and Dodgetown Road (Figure 1). The mitigation area is approximately 10.5 miles downstream from B-3045 (Bridge No. 17 over the Dan River on Highway 89). Riparian buffer restoration at the Clark property is expected to serve as a portion of the mitigation proposed to offset impacts to known mussel populations identified within, and adjacent to, bridge replacement projects B-2639 and B-4281. The mitigation area, hereafter referred to as the Site, encompasses 15.95 acres of the Clark property located south of Pitzer Road. This land was previously cleared of vegetation for agricultural practices and is currently comprised of early succession species.

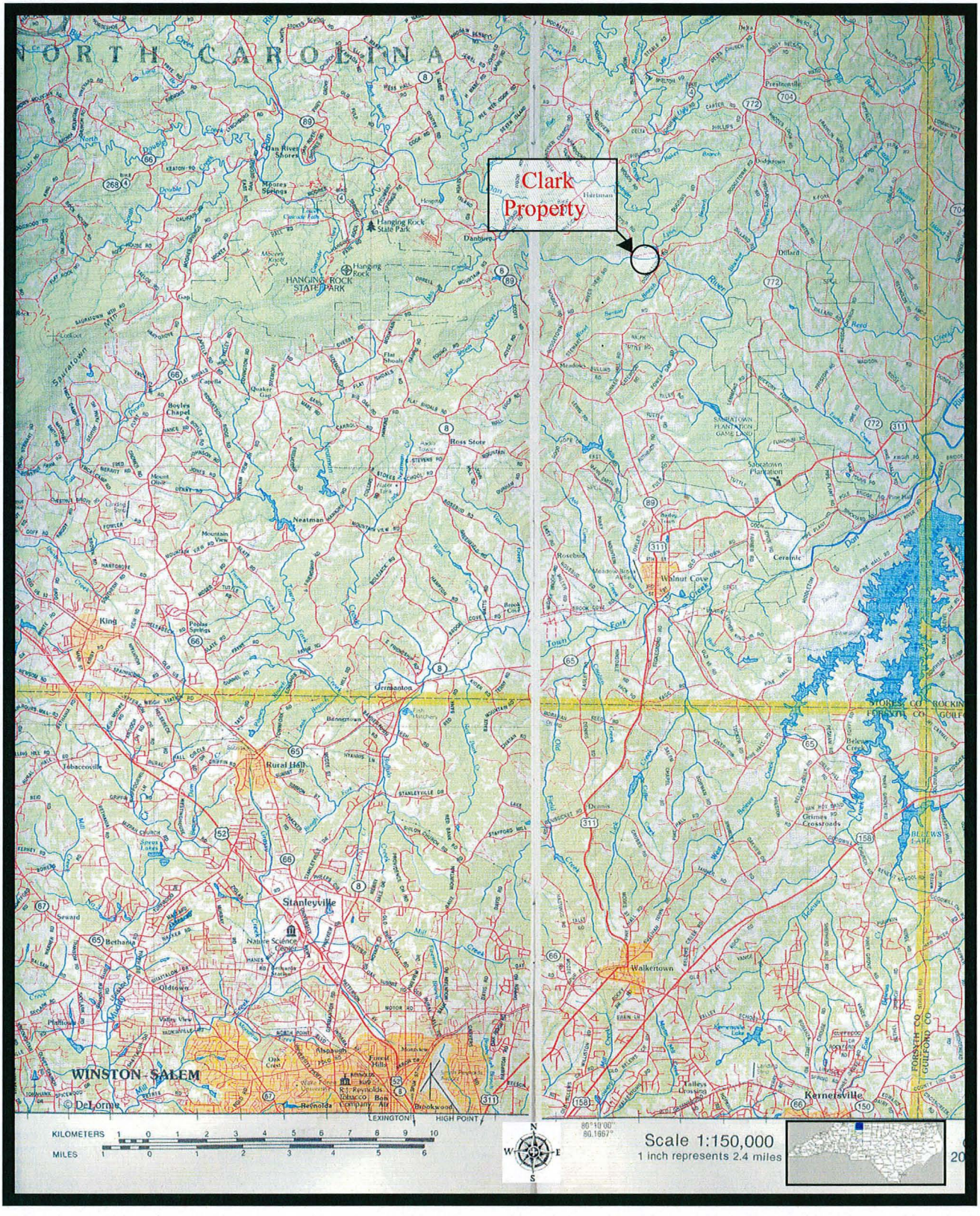
The purpose of this study is to establish a detailed Site mitigation plan for riparian buffer restoration. The objectives of this study are as follows:

- Identify a suitable reference forest to model Site mitigation attributes.
- Develop a detailed plan of riparian buffer restoration activities within the 15.95 acre Site.

The goals of the restoration effort include reforestation of the floodplain with native species to 1) increase channel bank stability; 2) reduce sedimentation/siltation within the Dan River; 3) filter and reduce pollutants prior to entering the Dan River; 4) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 5) provide increased habitat for aquatic and terrestrial wildlife; 6) increase organic matter, carbon export, and woody debris in the stream corridor; 7) restore shade to open water of the Dan River; and 8) restore characteristic macroinvertebrate species populations in the channel.

This document represents a detailed mitigation plan summarizing activities proposed within the Site. The plan includes 1) descriptions of existing conditions, 2) reference forest studies, and 3) restoration plans. Upon approval of this plan by regulatory agencies, activities will be implemented as outlined. Proposed mitigation activities may be modified due to constraints such as access issues or planting considerations.

Figure 1. Site Location



2.0 METHODS

Natural resource information was obtained from available sources. U.S. Geological Survey (USGS) 7.5 minute topographic mapping (Danbury, NC), U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping, Natural Resource Conservation Service (NRCS) soils mapping for Stokes County (NRCS 1995), and recent aerial photography were utilized to evaluate existing landscape and soil information prior to on-site inspection. Characteristic and target natural community patterns were classified according to Schafale and Weakley's, *Classification of the Natural Communities of North Carolina* (1990).

Detailed field investigations were performed in May 2005. Plant communities were delineated and described by structure and composition. Information collected, reference ecosystem analyses, and field observations were used to evaluate existing conditions. Subsequently, this mitigation plan was developed to provide a portion of riparian buffer mitigation for mussel impacts involved in the NCDOT bridge replacement projects B-2639 and B-4281.

3.0 EXISTING CONDITIONS

3.1 PHYSIOGRAPHY, TOPOGRAPHY, AND LAND USE

The Site is located in the central portion of Stokes County, approximately 4 miles east of Danbury (Figure 1). This portion of the state is underlain by metamorphic rocks of the Inner Piedmont geologic formation within the Northern Inner Piedmont ecoregion of North Carolina (USGS Subbasin 03010103). This hydrophysiographic region is characterized by dissected irregular plains, low to high hills, ridges, and isolated monadnocks with low to moderate gradient streams containing cobble, gravel, and sandy substrates. This region is characterized by moderately high rainfall with precipitation averaging approximately 45 inches per year (NRCS 1995).

Topography within the Site is nearly level at an elevation of approximately 660 feet National Geodetic Vertical Datum (Figure 2). The Site encompasses floodplain adjacent to the northern bank of the Dan River. The Dan River flows in a west to east direction for a total of approximately 1580 linear feet adjacent to the southern property boundary.

The upstream watershed is comprised of mixed hardwood forest, agricultural land, and low-density residential development. Impervious surfaces appear to account for less than 10 percent of the upstream land coverage.

Site land use is predominantly composed of fallow agricultural fields (Figure 3). A 10 to 15 foot wide riparian buffer borders the northern bank of the Dan River. A dirt road approximately 10 to 15 feet wide is located between the existing riparian buffer and the fallow agricultural fields. An aboveground powerline extends from the western property boundary east approximately parallel to Pfitzer Road until it exits the property to cross Pfitzer Road. Another powerline crosses the property in a northwest to southeast direction in the eastern section of the parcel.

3.2 SOILS

Based on the *Soil Survey of Stokes County, North Carolina* (NRCS 1995), there are three soil map units within the Site (Figure 4). Riverview and Toccoa soils encompass the entire floodplain within the Site. The Riverview and Toccoa map unit consists of a complex generally composed of up to 50 percent Riverview soils and up to 40 percent Toccoa soils. Included within this map unit are Chewacla, Dogue, and Hornsboro soils and small areas of soils sandier than the major soils. Included soils make up approximately 10 percent of this map unit.

Figure 2. Topography

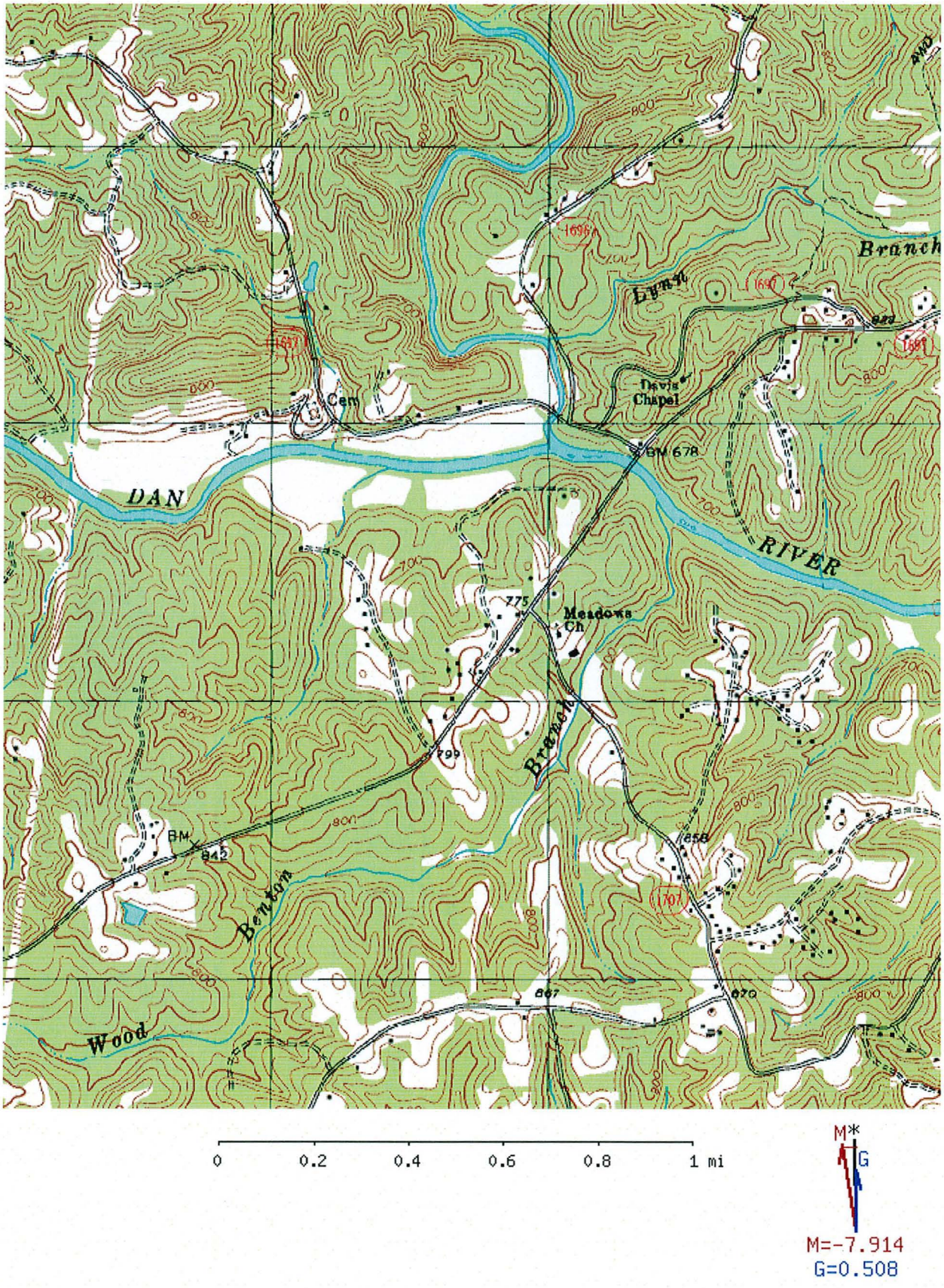


Figure 3. On-Site Land Use

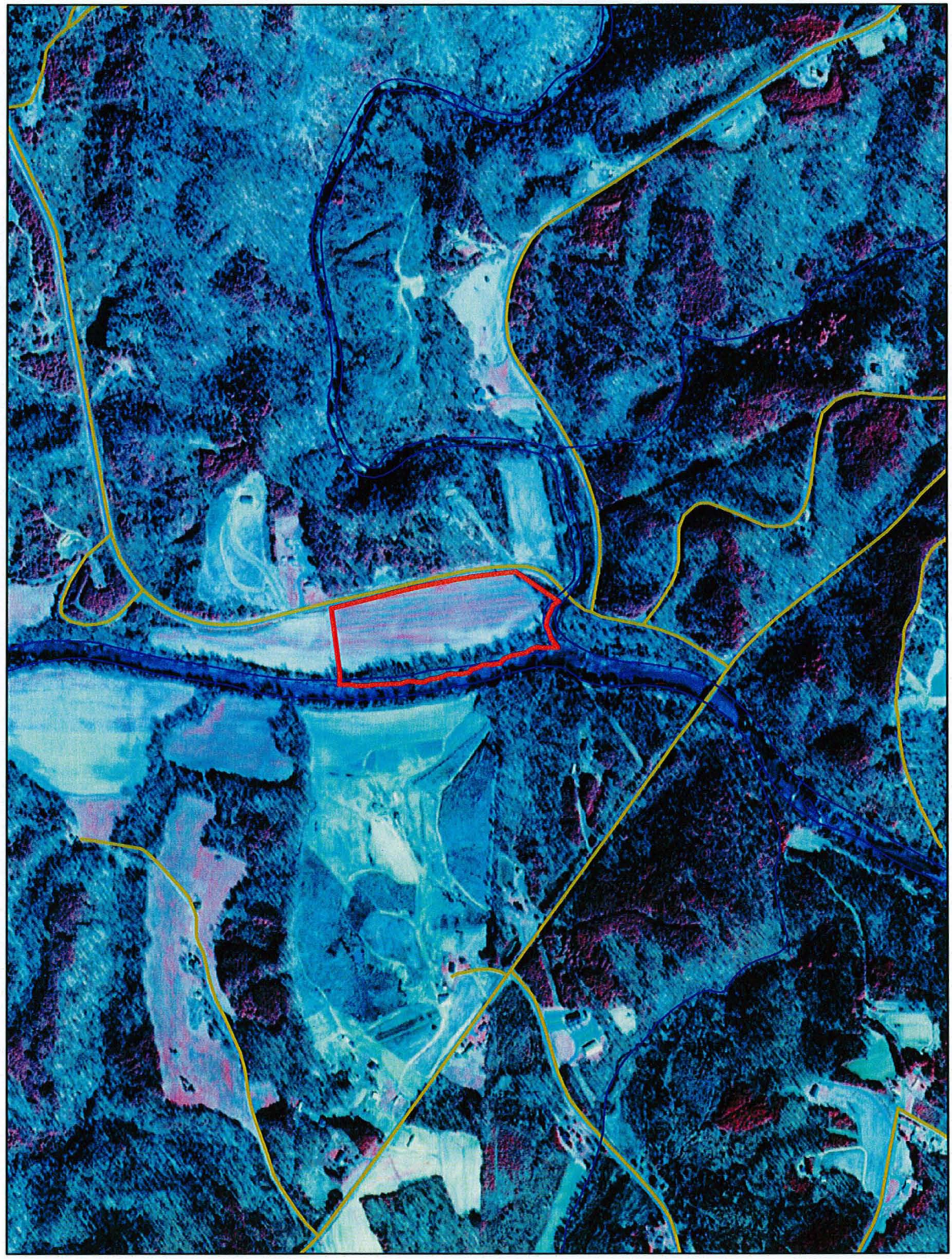
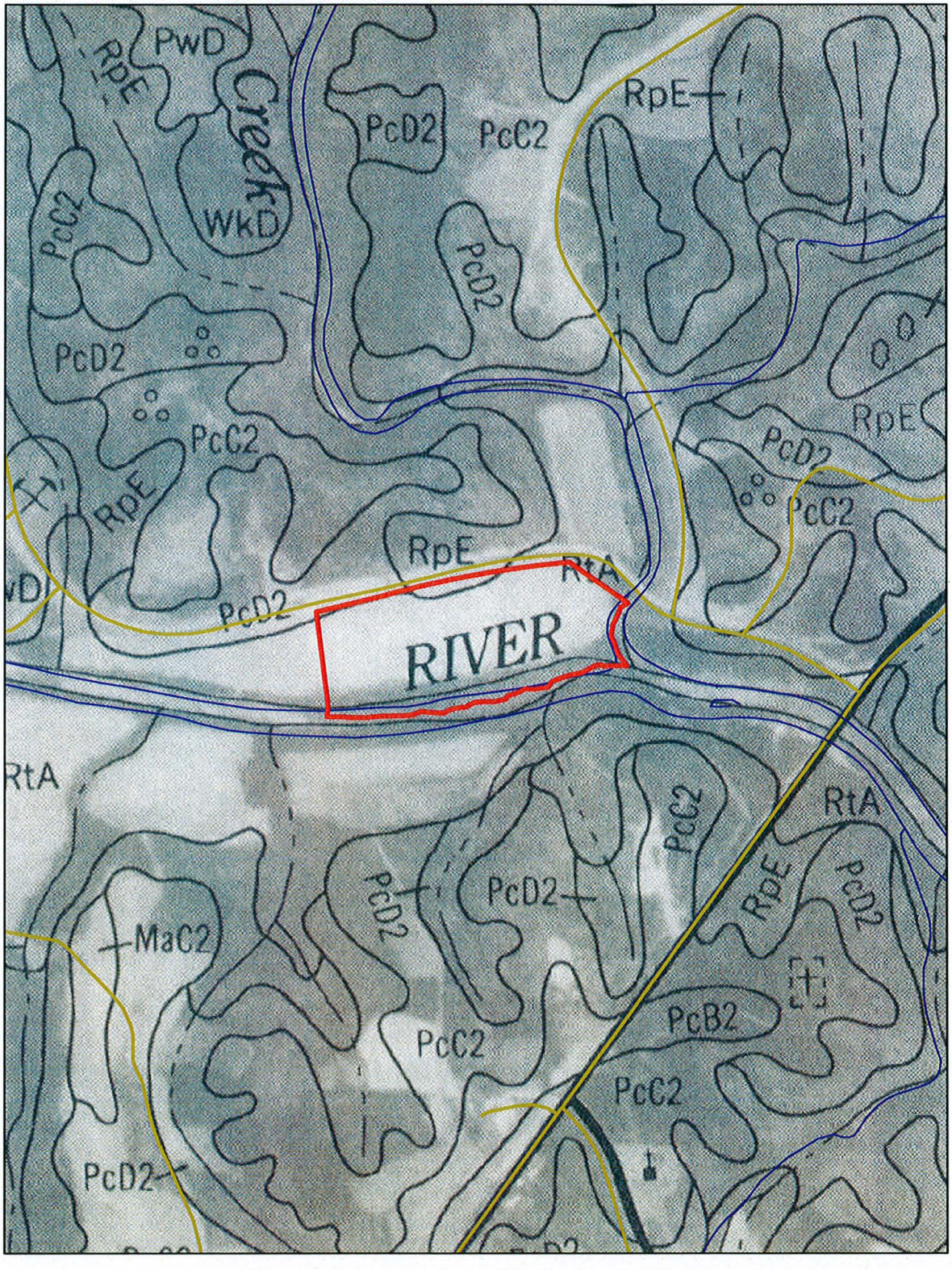


Figure 4. NRCS Soils Map



Riverview and Toccoa soils with 0 to 4 percent slopes consist of nearly level, very deep soils that are occasionally flooded.

- Riverview soils are well drained and moderately permeable with a high available water capacity and slow surface runoff. Depth to the seasonal high water table within Riverview soils ranges from 3 to 5 feet.

- Toccoa soils are well drained to moderately well drained with moderately rapid permeability, moderate available water capacity, and slow surface runoff. Depth to the seasonal high water table for Toccoa soils ranges from 2.5 to 5 feet (NRCS 1995).

Hydric soils are defined as "soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper soil layer" (SCS 1987). The Riverview and Toccoa soils map unit is not considered hydric. Included soils Chewacla, Dogue, and Hornsboro are not considered hydric although the Chewacla and Hornsboro soils may contain areas of poorly drained hydric soils within depressions (NRCS 1997). Hydric soil map units were not identified within the Site.

Rion, Pacolet, and Wateree soils with 25 to 60 percent slopes are found between the floodplain and Pfitzer Road on the Site. This soil unit consists of deep to very deep, well-drained soils where Rion soils make up about 40%, Pacolet makes up 25% and Wateree makes up 25%.

- Rion soils have moderate permeability with a low available water capacity.
- Pacolet soils have moderate permeability and available water capacity.
- Wateree soils have moderately rapid permeability and low available water capacity.

Pacolet sandy clay loam with 15 to 25 percent slopes is also found on the Site between the floodplain area and Pfitzer Road. This soil unit consist mostly of very deep, well drained Pacolet and similar soils that are found on very narrow ridges and side slopes within Stokes County. Characteristically, erosion has removed between 25 and 75 percent of the initial surface layer. This soil has moderate permeability and available water capacity. Small areas of Wateree, Masada, Poindexter, Rion, Wedowee, and Wilkes soils may be found within this soil unit.

3.3 PLANT COMMUNITIES

Distribution and composition of plant communities reflect landscape-level variations in topography, soils, hydrology, and past or present land use practices. Two plant communities have been identified on the Site and include: 1) abandoned agricultural fields and 2) streamside assemblage.

Abandoned agricultural fields dominates the Site, accounting for more than 90 percent (approximately 14.4 acres) of the area. This area was previously cleared of vegetation for agricultural purposes (rotating row crops including tobacco and corn) and has been fallow for approximately 1 year. Species contained within this area include black locust (*Robinia*

pseudoacacia), black willow (*Salix nigra*), red maple (*Acer rubrum*), blackberry (*Rubus argutus*), smooth sumac (*Rhus glabra*), and lespedeza (*Lespedeza* sp.).

A stream-side assemblage community creates an existing buffer averaging 10 to 15 feet in width on the northern bank of the Dan River. The existing vegetated buffer is comprised primarily of American sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), river birch (*Betula nigra*), American hornbeam (Carpinus carolinia), black cherry (Prunus serotina),

4.0 REFERENCE FOREST ECOSYSTEM

According to Mitigation Site Classification (MiST) guidelines (EPA 1990), Reference Forest Ecosystems (RFEs) must be established for mitigation sites. RFEs are forested areas on which to model restoration efforts of the mitigation site in relation to soils, hydrology, and vegetation. RFEs should be ecologically stable climax communities and should represent believed historical (pre-disturbance) conditions of the mitigation site. Quantitative data describing plant community composition and structure are collected at the RFEs and subsequently applied as reference data for design of the mitigation site planting scheme.

The selected RFE occurs in a bottomland hardwood forest located in the Turkey Cock Creek floodplain, approximately 6 miles northwest of the Site in Stokes County. The RFE is underlain by similar soils and is comparable to the Site in floodplain. The RFE supports plant community characteristics that riparian buffer restoration efforts will attempt to emulate. Four, circular, 0.1-acre plots were randomly established within the selected RFE. Data collected within each plot include 1) tree, shrub, and herb species composition; 2) number of stems for each tree and shrub species; and 3) diameter at breast height (dbh) for each tree and shrub species. From the pooled field data (Table 1), importance values (IV) of dominant tree species were calculated based on relative density, dominance, and frequency of tree species composition (Smith 1980). Hydrology, surface topography, and habitat features were also evaluated.

Within the RFE, forest tree vegetation was dominated by tulip poplar (*Liriodendron tulipifera*) (IV = 19.6 percent), green ash (*Fraxinus pennsylvanica*) (IV = 16.8 percent), ironwood (*Carpinus caroliniana*) (IV = 14.9 percent), and red maple (*Acer rubrum*) (IV = 14.3 percent) (Table 1). Other, less dominant tree species within the sample plots were northern red oak (*Quercus rubra*), black walnut (*Juglans nigra*), and American sycamore (*Platanus occidentalis*). The above tree species represent elements under consideration for forest community restoration in floodplains of the Site.

TABLE 1
Reference Forest Ecosystem Plot Summary
Bottomland Hardwood Forest (Canopy Species)
Turkey Cock Creek

Tree Species	Number of Individuals	Relative Density (%)	Frequency (%)	Relative Frequency (%)	Basal Area ft2/ acre	Relative Basal Area (%)	Importance Value (%)
Carpinus caroliniana	19	23.7	100	14.8	8.4	6.3	14.9
Fraxinus pennsylvanica	15	18.8	75	11.1	27.5	20.4	16.8
Liriodendron tulipifera	15	18.8	100	14.8	33.9	25.2	19.6
Acer rubrum	11	13.8	75	11.1	24.2	17.9	14.3
Quercus rubra	5	6.3	75	11.1	5.8	4.3	7.2
Juglans nigra	3	3.8	25	3.7	11.2	8.3	5.3
Platanus occidentalis	2	2.5	25	3.7	12.7	9.5	5.2
Cercis canadensis	2	2.5	25	3.7	0.5	0.4	2.2
Diospyros virginiana	2	2.5	25	3.7	2.6	2.0	2.7
Nyssa sylvatica	1	1.3	25	3.7	0.7	0.5	1.8
Carya tomentosa	1	1.3	25	3.7	1.7	1.3	2.1
Carya ovata	1	1.3	25	3.7	1.4	1.1	2.0
Viburnum prunifolium	1	1.3	25	3.7	0.2	0.2	1.7
Oxydendrum arboreum	1	1.3	25	3.7	2.0	1.5	2.1
Prunus serotina	1	1.3	25	3.7	1.9	1.4	2.1
TOTALS	80	100	676	100	135	100	100

5.0 RESTORATION PLAN

The primary goals of this restoration plan include: 1) enhancement of water quality functions in the on-site, upstream, and downstream segments of the Dan River; 2) creation of a natural vegetated buffer along the northern bank of the Dan River; and 3) restoration of aquatic and terrestrial wildlife functions associated with a riparian corridor.

Primary activities designed to restore the complex include 1) clearing of existing vegetation and 2) plant community restoration.

5.1 CLEARING OF EXISTING VEGETATION

Prior to plant community restoration, the existing vegetation will be cleared. Clearing may include, but is not limited to, bush-hogging, mowing, or other method that will not uproot existing vegetation. Care should be taken to avoid exposure of surficial soils during the clearing of existing vegetation. To avoid erosion of soils and sedimentation/siltation within the Dan River no site preparation will occur.

5.2 PLANT COMMUNITY RESTORATION

Restoration of floodplain forest and stream-side habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife.

RFE data, on-site observations, current lists of NCDOT approved plant species, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop the primary plant community associations that will be promoted during community restoration activities. The site will be planted with species characteristic of the Piedmont/Mountain Bottomland Hardwoods forest.

Piedmont/Mountain Bottomland Forest

1. Green Ash (*Fraxinus pennsylvanica*)
2. Northern Red Oak (*Quercus rubra*)
3. American Sycamore (*Platanus occidentalis*)
4. Cherrybark Oak (*Quercus falcata* var. *pagodaefolia*)
5. Willow Oak (*Quercus phellos*)
6. Black Gum (*Nyssa sylvatica* var. *sylvatica*)
7. Sugarberry (*Celtis laevigata*)
8. Black Walnut (*Juglans nigra*)
9. Black Willow (*Salix nigra*)
10. River Birch (*Betula nigra*)

Planting within areas adjacent to Pfizer Road beneath the powerline may be limited due to the interference of mature trees with the powerline.

Certain opportunistic species, which may dominate the early successional forests, have been excluded from riparian buffer community restoration efforts. Opportunistic species consist primarily of red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), and sweet-gum (*Liquidambar styraciflua*). These species should be considered important components of bottomland forests where species diversity has not been jeopardized.

5.3 PLANTING PLAN

The purpose of a planting plan is to re-establish vegetative community patterns across the landscape. The plan consists of 1) acquisition of available plant species, 2) clearing of existing vegetation, and 3) planting of selected species.

Species selected for planting will be dependent upon availability of local seedling sources. Advance notification to nurseries (1 year) will facilitate availability of various non-commercial elements.

Bare-root seedlings of tree and shrub species will be planted within specified map areas at a density of 680 stems per acre on 8-foot centers. Table 2 depicts the total number of stems and species distribution within each vegetation association. Planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season. A total of 9000 diagnostic tree and shrub seedlings will be planted during restoration (Table 2).

TABLE 2

Planting Plan

Clark Site

Vegetation Association (Planting Area)	**Piedmont/Mountain Bottomland Hardwood Forest**	**TOTAL**
Area (acres)	15.95	15.95
SPECIES	# planted[1] (% total)[2]	# planted (% total)
Green Ash	1350 (15)	1350
Northern Red Oak	900 (10)	900
American Sycamore	900 (10)	900
Cherrybark Oak	1350(15)	1350
Willow Oak	1350 (15)	1350
Black Gum	450(5)	450
Sugarberry	450 (5)	450
Black Walnut	1350 (15)	1350
Black Willow	450 (5)	450
River Birch	450 (5)	450
TOTAL	9000	9000

1: Planting densities comprise 680 trees and/or shrubs per acre within each specified planting area.

2: Some non-commercial elements may not be locally available at the time of planting. The stem count for unavailable species should be distributed among other target elements based on the percent (%) distribution. One year of advance notice to forest nurseries will promote availability of some non-commercial elements. However, reproductive failure in the nursery may occur.

6.0 FINAL DISPENSATION OF THE PROPERTY

NCDOT is expected to retain ownership of the parcel.

7.0 REFERENCES

Environmental Protection Agency (EPA). 1990. Mitigation Site Type Classification (MiST). EPA Workshop, August 13-15, 1989. EPA Region IV and Hardwood Research Cooperative, NCSU, Raleigh, North Carolina.

Natural Resources Conservation Service (NRCS). 1997. Hydric Soils: Stokes County, North Carolina. Natural Resources Conservation Service Technical Guide, Section II-A 2. United States Department of Agriculture.

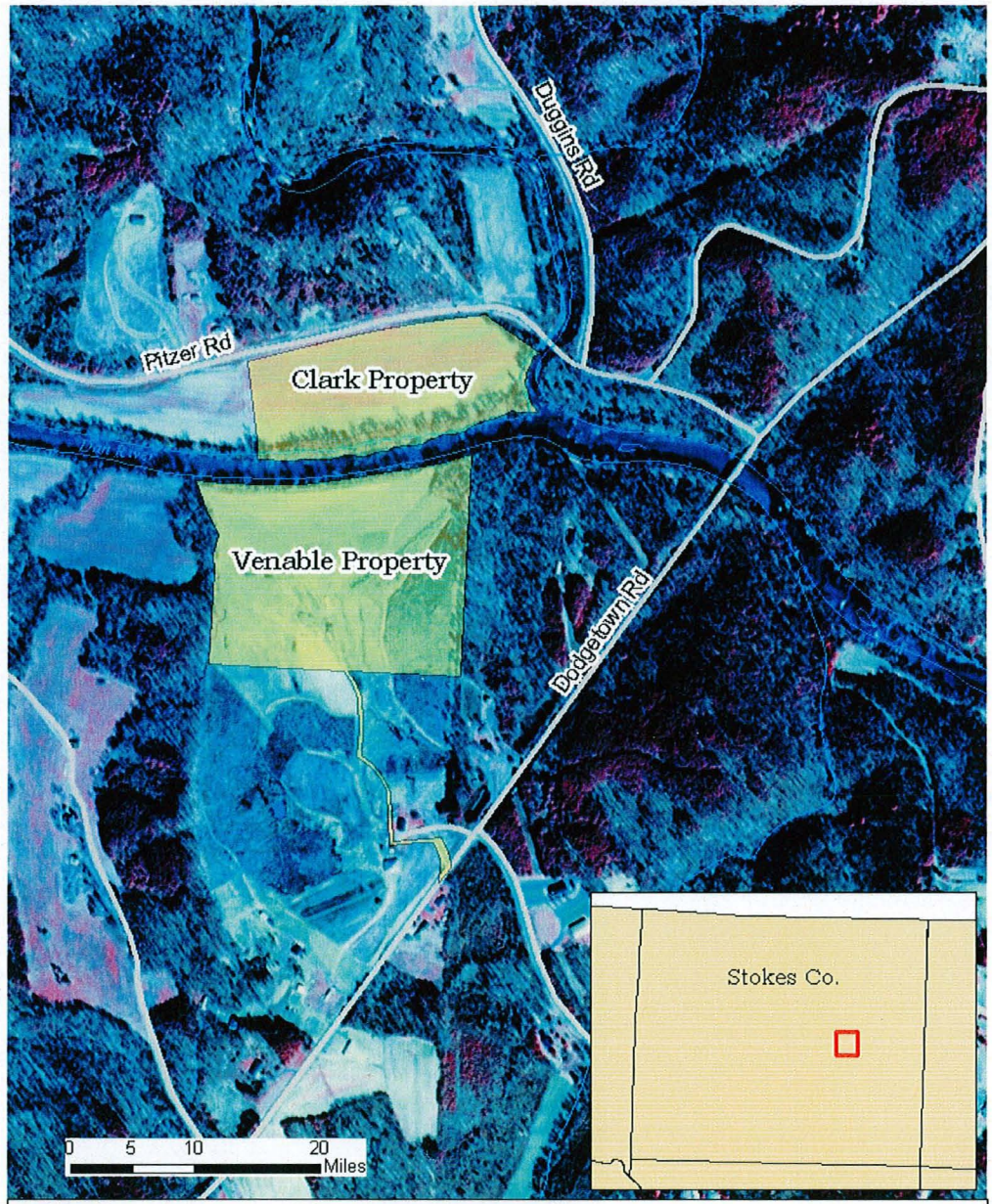
Natural Resources Conservation Service (NRCS). 1995. Soil Survey of Stokes County, North Carolina. United States Department of Agriculture.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

Smith, R. L. 1980. Ecology and Field Biology, Third Edition. Harper and Row, New York. 835 pp.

Soil Conservation Service (SCS). 1987. Hydric Soils of the United States. In cooperation with the National Committee for Hydric soils. United States Department of Agriculture.

APPENDIX G



Clark and Venable Buffer Mitigation Sites

Dan River, Stokes County

N

APPENDIX H

AGREEMENT FOR ENTRY

This Agreement made and entered into by and between the NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (the "Department") and Ilena Dillon (the "Owner") provides the following:

The Department wishes to conduct a survey and/or investigation of the subject property by taking soil evaluations, land surveys, hydrology samples, groundwater samples and other ecological type survey samples for possible stream bank and/or wetland mitigation. The samples and monitoring are to be conducted by standard survey practices, borings and shallow groundwater monitoring wells, and soil/vegetation sampling and analysis;

The Department needs access to Owner's property in the county that is the subject of this Agreement ("the subject property") in order to conduct said survey and/or investigation, said property being more particularly described as follows:

(insert property description) Pin # 6927014866 37 (Stokes County)

The Owner and the Department agree as follows:

1. The Department may enter the subject property for the limited purposes of conducting land surveys, hydrologic surveys, vegetation surveys, and other general purposes and requirements.

2. The Owner hereby grants the Department such reasonable access, including egress and ingress over its property, as needed for the Department's wetland/stream studies, with agreed upon notice.

3. The Department can enter Owner's property only for purposes set forth in this Agreement. If the Department, its contractors or assigns causes such damage to the property, in furtherance of the conduct allowed by this Agreement, the Department will promptly replace/repair said damage.

4. Neither this Agreement of Entry nor any activity of the Department undertaken in connection with the investigation shall be deemed a trespass on or a taking of the Owner's property by the Department.

5. The Department will share the results and conclusions of the investigation with the Owner; however, all written reports, conclusions, and other documents generated in connection with the investigation shall remain the sole property of the Department.

Ilena B. Dillon
(Property Owner's Signature)

10/10/07
(Date)