United States Department of the Interior

FISH AND WILDLIFE SERVICE
Asheville Field Office
160 Zillicoa Street
Asheville, North Carolina 28801

April 22, 2008

Mr. Felix Davila, Area Engineer
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Dear Mr. Davila:

Subject: Biological Assessment on the Effects of the Replacement of Bridge No. 60 on NC 8/NC 89 over the Dan River (Project B-4281) in Stokes County, North Carolina, and Its Effects on the Federally Endangered James Spinymussel

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the subject Biological Assessment (BA) on the effects of the subject bridge replacement on the James spinymussel (*Pleurobema collina*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). In addition, we have reviewed the information and survey results for the federally endangered small-anthered bittercress (*Cardamine micranthera*). Based on the information provided, we concur with the Federal Highway Administration's (FHWA) determination of "not likely to adversely affect" for the small-anthered bittercress in the project area.

To avoid impacts to the small-anthered bittercress, the North Carolina Department of Transportation (NCDOT) has changed the design to avoid effects to Buck Island Creek through informal consultation and has agreed to adhere to the following environmental commitments:

- Orange fencing will be installed to protect the wooded buffer on Buck Island Creek prior to construction. In addition, a preconstruction meeting will be held between the contractor and a Service biologist to discuss the location of the plants and answer any questions the contractor may have regarding implementing the project so that the small-anthered bittercress plants are avoided.

- No direct or indirect impacts will occur to Buck Island Creek. No material will be stored in the floodplain of Buck Island Creek. No drainage will be directed from the project toward Buck Island Creek.

- Vegetation will be maintained wherever possible, and the removal of vegetation will be minimized to the maximum extent possible in order to avoid any indirect effects to small-anthered bittercress associated with changes in microclimate.

- Reforestation of the floodplain between the fill slope and Buck Island Creek will be conducted after construction is completed.

- The planting of hand-seeded lespedeza will be restricted to the fill slope.

In view of these commitments, we believe the requirements under section 7(c) of the Act are fulfilled for this species. However, obligations under section 7 of the Act must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner that was not considered in this review, or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

We received a request from the FHWA for formal consultation on December 10, 2007. This Opinion is based on information provided in the December 7, 2007, BA; other available literature; personal communications with experts on the federally endangered James spinymussel; and other sources of information. A complete administrative record of this consultation is on file at this office.

CONSULTATION HISTORY

February 2004 - The NCDOT began studying proposed improvements to Bridge No. 60 on NC 8/NC 89 over the Dan River.

October 2006 - Ms. Denise Moldenhauer (Service) attended an on-site field meeting with the NCDOT to discuss plans for B-4281 as well as avoidance and minimization measures that could be used for the James spinymussel and small-anthered bittercress. The NCDOT was represented at the meeting by members of their Roadway Design, Structures, Natural Environment, Hydraulics, Roadside Environmental, and Right-of-Way Units and their Division Engineers.

March 2007 - The Service received a section 7 concurrence request for Project B-4281 for the small-anthered bittercress.

April 2007 - The Service concurred with a "not likely to adversely affect" determination for the small-anthered bittercress for Project B-4281, referencing commitments made by the NCDOT.

August 2007 - Ms. Marella Buncick of our staff met with members of the NCDOT's Roadway Design, Structures, Right-of-Way, Hydraulics, and Natural Environment Units and their Division Engineers to discuss updated design information and any outstanding issues.

August 2007 - Ms. Buncick met with the NCDOT's Roadside Environmental Unit and the Natural Environment Unit to discuss concerns regarding sediment and erosion control pertaining to the James spinymussel. Discussion also included issues with Buck Island Creek and the

commitments put in place for the Service to concur with the "may affect but not likely to adversely affect" determination for the small-anthered bittercress.

December 2007 - The FHWA submitted a BA and requested the initiation of formal consultation.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

As defined in the Service's section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas." The 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." The direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present federal, state, or private activities as well as the cumulative effects of reasonably certain future state or private activities within the action area. This Opinion addresses only those actions from which the Service believes adverse effects may result. In their BA, the FHWA outlined activities involved in the construction and demolition of Bridge No. 60 on NC 8/NC 89 over the Dan River (B-4281) that would affect the James spinymussel. The FHWA also considered the effects of their proposal to protect over 3,000 linear feet of riparian buffers along the Dan River. This Opinion addresses whether replacing the existing bridge is likely to jeopardize the continued existence of the James spinymussel.

The NCDOT has determined that the subject bridge is deficient because of deteriorating structural integrity and is functionally obsolete due to narrow roadway geometry and substandard design. The proposed action, as defined in the BA, is to replace and demolish Bridge No. 60 on NC 89/NC 8 over the Dan River. Bridge No. 60 has a superstructure composed of a reinforced concrete deck on reinforced concrete. The existing bridge is proposed to be replaced with a three-span (two spans at 120 feet; one span at 160 feet) reinforced concrete deck slab on 54-inch steel plate girders with 9.5-foot 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 north side, and traffic will be maintained on the existing structure as an on-site detour. Roughly 1,500 feet of new approaches to the bridge will be required, providing 12-foot travel lanes with 8-foot shoulders, including 2-foot paved shoulders.

The NCDOT's Guidelines for Best Management Practices (BMPs) for the Protection of Surface Waters, Erosion and Sediment Control Guidelines for Contract Construction, and BMPs for Bridge Demolition and Removal are incorporated into projects that occur within or upstream of water bodies that contain federally protected aquatic species. These are considered "environmentally sensitive areas," within which the following stipulations apply:

- The contractor may perform clearing operations, but no grubbing operations will be performed until immediately prior to beginning grading operations.

- Once grading operations begin in identified environmentally sensitive areas, work will progress in a continuous manner until it is completed.

- Erosion-control devices will be installed immediately following the clearing operation.

- Seeding and mulching will be performed on the areas disturbed by construction immediately following final grade establishment.

- Seeding and mulching will be accomplished 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.

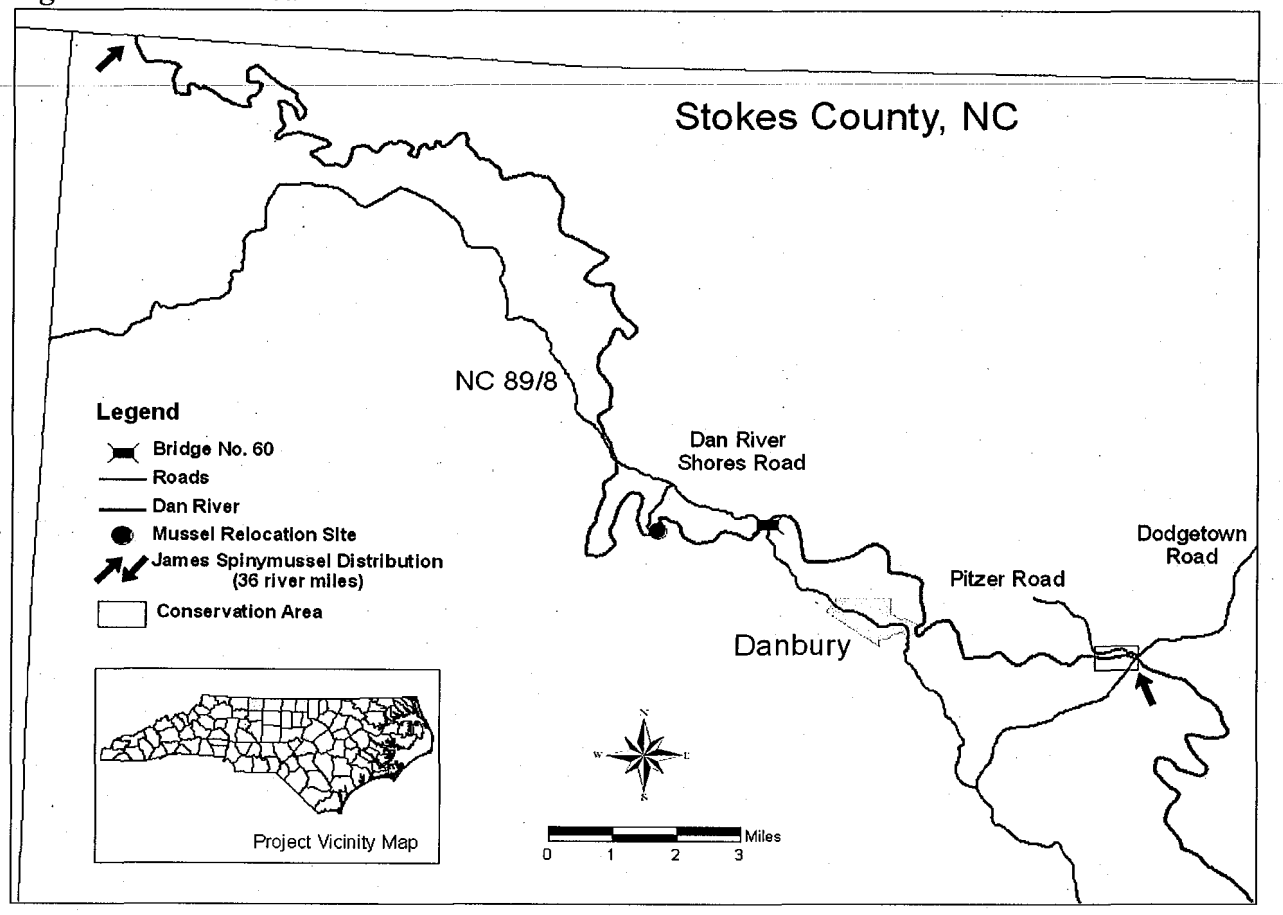
No bents will be required in the river. A collection system for deck drainage will be discharged into a preformed scour hole located at the approach of the bridge, away from the Dan River, Buck Island Creek, and an unnamed tributary to the Dan River

This project will require temporary structures in the river for construction and demolition. No debris will enter the river during demolition of the existing structure or during construction of the new bridge. The temporary structures will consist of either precast concrete footings or steel A-frame foundations. The foundations will be lifted into place using a crane and will rest on the riverbed rather than being anchored in the substrate. Girders and decking will be added to the foundations, and equipment will be driven out onto the bridges to advance construction. The demolition of the existing bridge will be accomplished from the existing structure, the riverbanks, or from temporary work bridges. All materials from the bridges will be removed from the sites.

A. 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). The action area for this Opinion is located on the Dan River in Stokes County, North Carolina (see Figure 1). 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 runoff from the construction activity, including the receiving stream, extending 400 meters downstream of the structure. The project includes the relocation of mussels to suitable habitat upstream of the immediate project area. Therefore, the action area will extend 2.0 miles upstream to the relocation site off of SR 1456 (Dan River Shores Road). Also to be included in the action area are two sites (Clark and Venable sites) that were purchased as conservation measures for the James spinymussel. This extends the action area 8.6 miles downstream of the immediate project area to the Clark and Venable sites off of Dodgetown Road and Pitzer Road (for details, see the "Conservation Measures" section of this Opinion).

Figure 1. Action Area



The Dan River subbasin occurs within the Roanoke River basin, which begins in the Blue Ridge Mountains of northwestern Virginia and flows in a generally southeasterly direction for 400 miles before emptying into Albemarle Sound and the Atlantic Ocean along North Carolina's northeast coastline. The North Carolina portion of the Roanoke River basin is composed of two major parts--(1) the Dan River and its tributaries in the western section, upstream of Kerr Lake, and (2) the Roanoke River as it enters North Carolina in the eastern section. The bridge project lies in subbasin 03-02-01 of the Roanoke River basin. (Subbasin classifications are assigned by the North Carolina Department of Environment and Natural Resources [NCDENR], Division of Water Quality [DWQ]). The estimated subbasin population, based on the 2000 census, is 108,615. By the year 2020, the estimated population growth for Stokes County is 24 percent (NCDENR 2006).

Dan River Physical Characteristics - The Dan River arises in the uplands of the Blue Ridge Province in Patrick County, Virginia, and flows south through the Blue Ridge escarpment before crossing into North Carolina in northwestern Stokes County, North Carolina, at river mile (RM) 162. It then flows southeast across most of Stokes County before turning sharply to the northeast near Walnut Cove, flowing through most of Rockingham County, North Carolina. The river flows into southern Pittsylvania County,

Virginia, back into Rockingham County, North Carolina, east into Caswell County, North Carolina, then north back into Pittsylvania County, Virginia. The River then flows east through the City of Danville, turns to the south and reenters North Carolina in north-central Caswell County, and flows east before turning back to the north, reentering Virginia, and flowing generally to the northeast before entering the Kerr Reservoir. A dam on the Roanoke River created this reservoir. From its origin to the confluence with the Roanoke River at the Kerr Reservoir, the Dan River is 199 RM long and drains 4,101square miles (Rohde et al. 2001).

According to information provided in the BA, most of the land in this portion of the basin is forested (73 percent), but a significant portion is cultivated cropland and pasture (25 percent). A large number of tributaries and major sections of the Dan River are deeply entrenched, 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. This compares 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 NCDENR's Division of Parks and Recreation (1995). Characteristics of this subbasin are transitory between the mountain and piedmont ecoregions. As a result of fairly steep to moderate topography, the headwater reaches of most tributaries are forested, while many downstream sections are intensively farmed.

The primary soil types, which run the length of the Dan River in Stokes County, are (1) Riverview and Toccoa soils (RtA), 0 to 4 percent slopes, occasionally flooded, and (2) Rion, Pacolet, and Wateree (RpE), 25 to 60 percent slopes. Both are deep and well-drained or moderately well-drained. Neither is generally recommended for building sites (RtA, due to its high erodability; 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 (Natural Resources Conservation Service [NRCS] 1995).

Historically, the economy of the Dan River subbasin depended on natural resources. The farming of tobacco, corn, wheat, rye, and other crops was the main source of income for the area. Forest products were also important, especially in the late 1700s (NRCS 1995). Tobacco was once the predominant crop; at its peak in the 1950s, 137,034 acres in Stokes County were in production. Currently, less than 10,000 acres are being farmed for tobacco.

Ecological Significance - The Dan River subbasin supports a number of rare fish and mussel species, including the federally protected James spinymussel (Table 1). The federally endangered Roanoke logperch (*Percina rex*) has been found in a few isolated areas in the Dan River drainage in Virginia and in the Smith River in Rockingham County, North Carolina.

Table 1. Rare Aquatic Species in the Dan River.

Scientific Name	Common Name	North Carolina 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 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	FSC

*Known only from tributaries in the Dan River basin.
^Known from the subbasin in Virginia.
E, T, SC, SR, PT, and FSC denote Endangered, Threatened, Special Concern (North Carolina), Significantly Rare (North Carolina), Proposed Threatened (North Carolina) and Federal Species of Concern.

The North Carolina Natural Heritage Program considers the Dan River aquatic habitat in Stokes County to be of "National Significance."[1] The significance of this site was assigned to the Dan River prior to finding out that rare freshwater mussel species occurred there, including the James spinymussel.

Best Usage Classification and Water Quality Assessment - The NCDENR assigns a best usage classification to all the waters of North Carolina. These classifications provide for a level of water quality protection to ensure that the designated usage of that water body is maintained. The portion of the Dan River that is occupied by the James spinymussel

[1]The North Carolina Natural Heritage Program maintains a database of rare plant and animal species and significant natural areas for the State of North Carolina. Natural areas (sites) are inventoried and evaluated on the basis of rare plant and animal species, rare or high-quality natural communities, and geological features occurring in the particular site. These sites are rated with regard to national, state, and regional significance. This list contains those areas that should be given priority for protection; however, it does not imply that all of the areas currently receive protection (NCDENR, Division of Parks and Recreation, 1995).

has two best usage classifications. From the Virginia/North Carolina border to Big Creek (DWQ Index No. 22-(1) 09/01/57), it is classified "C;Tr." Class "C" refers to waters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and agricultural and other uses. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development activities. The supplemental classification "Tr" is used to designate trout waters. These are freshwaters protected for natural trout propagation and the survival of stocked trout. The Dan River from Big Creek to a point 0.2 mile downstream of Town Fork Creek is classified WS-V (DWQ Index No. 22-(8) 08/01/98). Project B-4281 occurs in this reach. WS-V is an abbreviation for "water supply five." These are waters that are protected as water supplies, which are generally upstream and drain into Class WS-IV waters (waters used by industry to supply their employees with drinking water or as waters formerly used as water supply). WS-V has no categorical restrictions on watershed development or wastewater discharges like other WS classifications, and local governments are not required to adopt watershed protection ordinances (NCDENR Surface Freshwater Classification used in North Carolina 08/99). Monitoring data, including biological and chemical measurements, indicate that, overall, the Dan River in North Carolina has good to excellent water quality.

Point-source Pollution[2] - Under Section 301 of the Clean Water Act of 1977 (CWA), the discharge of pollutants into surface waters is regulated by the Environmental Protection Agency. 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 NCDENR's DWQ is responsible for the permitting and enforcement of the NPDES program. There are 23 NPDES permitted dischargers in subbasin 03-02-01, most of which are small wastewater treatment plants that serve schools or subdivisions. There were no indications of toxicity problems in 1999, and substantial improvements in effluent toxicity were observed relative to earlier data. Five dischargers are required to monitor their effluent toxicity. There were no indications of toxicity problems in 1999. There have been substantial improvements in the level of effluent toxicity relative to earlier self-monitoring data.

[2]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 residences), and storm-water 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).

Nonpoint-source Pollution[3] - The North Carolina Sedimentation and Erosion Control Program (SECP) applies to construction activities, such as roadway construction, and is established and authorized under the Sedimentation Pollution Control Act of 1973. The SECP requires, prior to construction, the submission and approval of erosion-control plans on all projects that disturb an acre or more. The NCDOT, in cooperation with the DWQ, has developed a sedimentation-control program for highway projects that adopts formal BMPs for the protection of surface waters. Additional erosion-control measures as outlined in Design Standards in Sensitive Watersheds[4] are implemented by the NCDOT for projects within WS-I or WS-II water supply watersheds, critical areas, waters designated for shell fishing, or any waters designated by the DWQ as high-quality waters. When crossing an aquatic resource that contains a federally listed species, the NCDOT has committed to implement erosion-control guidelines that go beyond both the standard BMPs and the Design Standards in Sensitive Watersheds, regardless of the DWQ classification. These areas are designated as environmentally sensitive areas on the erosion-control plans.

B. Conservation Measures

Conservation measures represent actions, pledged in the project description, that the action agency will implement to minimize the effects of the proposed action and further the recovery of the species under review. Such measures should be closely related to the

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

[4]**DESIGN STANDARDS IN SENSITIVE WATERSHEDS, 15A NCAC 04B.0124:** (a) Uncovered areas in HQW zones shall be limited at any time to a maximum total area within the boundaries of the tract of 20 acres. Only the portion of the land-disturbing activity within a HQW zone shall be governed by this Rule. Larger areas may be uncovered within the boundaries of the tract with the written approval of the Director. (b) Erosion and sedimentation control measures, structures, and devices within HQW zones shall be so planned, designed and constructed to provide protection from the runoff of the 25-year storm which produces the maximum peak rate of runoff as calculated according to procedures in the United States Department of Agricultural Soil Conservation Service's "National Engineering Field Manual for Conservation Practices" or according to procedures adopted by any other agency of this state or the United States or any generally recognized organization or association. (c) Sediment basins within HQW zones shall be designed and constructed such that the basin will have a settling efficiency of at least 70 percent for the 40 micron (0.04 mm) size soil particle transported into the basin by the runoff of that two-year storm which produces the maximum peak rate of runoff as calculated according to procedures in the United States Department of Agriculture Soil Conservation Services "National Engineering Field Manual for Conservation Practices" or according to procedures adopted by any other agency of this state or the United States or any generally recognized organization or association. (d) Newly constructed open channels in HQW zones shall be designed and constructed with side slopes no steeper than two horizontal to one vertical if a vegetative cover is used for stabilization unless soil conditions permit a steeper slope or where the slopes are stabilized by using mechanical devices, structural devices or other acceptable ditch liners. In any event, the angle for side slopes shall be sufficient to restrain accelerated erosion. (e) Pursuant to G.S. 113A-57(3) provisions for a ground cover sufficient to restrain erosion must be provided for any portion of a land-disturbing activity in a HQW zone within 15 working days or 60 calendar days following completion of construction or development, whichever period is shorter.

action and should be achievable within the authority of the action agency. The beneficial effects of conservation measures are taken into consideration in the Service's conclusion of a jeopardy versus a nonjeopardy opinion and in the analysis of incidental take. However, such measures must minimize impacts to listed species within the action area in order to be factored into the Service's analyses.

The following conservation measures are proposed by the NCDOT to avoid and/or minimize potential impacts from construction and demolition activities to the James spinymussel.

Conservation measures for bridge design.

1. Deck drains will be placed at the ends of the replacement bridge to direct storm water into catch basins; no drainage will occur over the Dan River channel. Storm water will be collected in the catch basins and then flow through a vegetated buffer so that no drainage will flow from the bridge into the Dan River. Currently, drainage from the deck of the existing structure flows directly into the river. The amount of discharge from the roadway entering the river will be reduced with the new structure.

2. Project B-4281 has been designed to completely span the river. The final design proposes to place new bents on the stream bank, about 10 feet from the normal edge of the water.

3. Design standards in sensitive watersheds will apply.

4. Temporary work bridges will be placed in locations where impacts to the unnamed tributary of the Dan River will be eliminated.

Conservation measures for bridge demolition.

The contractor will be required to submit a proposed demolition plan for our approval. This plan will be sealed by a professional engineer who is registered in North Carolina, using demolition techniques that do not allow debris to enter the river. The plan will incorporate the following:

1. Prior to bridge demolition, remove all asphalt-wearing surface from the concrete deck in a manner that does not allow asphalt to enter the river. Depending on the technique used, containment headers may be required.

2. Remove all concrete deck, rail, diaphragms, and girders by saw-cutting or nonshattering methods. Due to the deteriorated condition of the bridge deck, a containment system must be installed prior to deck removal. The containment system will only be used to catch debris that inadvertently falls due to the condition of the deck.

3. The proposed work bridge fingers will be used as access for bent removal. Equipment will need to be staged adjacent to the bent in order to facilitate sawing the bent into manageable sections above water elevation. Cranes on the main work bridge will lift sections out. When the bents have been removed to water elevation, the remaining mass of concrete will be removed to streambed elevation by underwater sawing or the use of a hoe ram to break the bent at the streambed interface and lift it out as a unit. During this process, turbidity curtains will be used, and disturbance of the steam bottom will be limited to a 3-foot-wide area around the perimeter of the bent. The existing footing below the streambed will be left in place to avoid additional streambed disturbance.

4. The use of explosives will not be allowed.

5. Saw slurry must be contained by approved vacuum methods.

6. All efforts will be made to keep existing bridge debris from entering 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. Where possible, debris will be lifted out with a crane and may require the manual installation of lifting devices in order to avoid further streambed disturbance.

Conservation measures for bridge construction.

1. The NCDOT will remove James spinymussels from the impacted area and relocate them to suitable locations upstream of the impacted area according to the procedures in the relocation plan (see enclosed Appendix A).

2. Erosion-control measures for environmentally sensitive areas will be implemented and will:

   a. Identify areas adjacent to the Dan River as environmentally sensitive areas on the erosion-control plans for this project;

   b. Provide a 50-foot buffer zone (both sides of stream), allowing clearing but not grubbing until immediately before grading operations;

   c. Limit grubbing operations to within 10 days of grading;

   d. Require "seeding and mulching" to be performed immediately following grade establishment;

   e. Require "staged seeding"—20-foot fill sections or 2 acres, whichever is less;

   f. Clean erosion- and sediment-control devices when they are half full;

g. Increase sediment storage capacity by 50 percent above standard BMPs guidelines; and

h. Establish a moratorium on clearing and grubbing (no work between November 15 and April 1).

3. Work bridges rather than stone causeways will be constructed according to plans. The work bridges will provide necessary in-stream work areas without significantly impeding flow.

4. Rock work pads will be used on uplands and in floodplains throughout the project area to accommodate heavy equipment.

5. In addition to relocating all mussels found in the footprint of the impact area, the NCDOT will conduct final surveys in the project footprint just prior to construction and will move any additional mussels found to appropriate upstream habitat.

Additional Conservation Measures

1. The NCDOT will relocate all native mussels, including the James spinymussel, from the footprint and extending 100 feet downstream and 50 feet upstream of the bridge replacement project. The relocation procedures (see Appendix A) provide for the relocation of freshwater mussels in such a way as to reduce stress and minimize the risk of injury while the species are in transit. If at any time during the relocation it is determined that these procedures are not meeting the stated objectives, more stringent methods may be developed, in cooperation with the North Carolina Wildlife Resources Commission (NCWRC) and the Service, to ensure that the mussels are relocated successfully. It was decided that the mussels from the bridge site would be moved to suitable habitat at a site upstream of the project area, within the current limits of the James spinymussel's distribution in the Dan River. The NCDOT and the Service worked together to choose a suitable relocation site. The relocation site will be monitored for the survival of relocated mussels and the movement of mussels 1 month, 3 months, 6 months, 1 year, and 2 years after they have been removed from the defined salvage areas.

2. The NCDOT has committed to purchase (for protection and/or restoration) at least 3,000 linear feet (lf) of a riparian buffer site (Table 2). Riparian buffers will be purchased to offset unavoidable impacts to the James spinymussel population associated with the bridge construction and demolition. The NCDOT has proposed floodplain buffer restoration, including 1,745 linear feet on the northern bank of the Dan River, about four miles east of Danbury, North Carolina, in Stokes County. The NCDOT will purchase a 15.95-acre parcel, composed entirely of floodplain, that is currently in agricultural production. The site will be reforested with native species appropriate to streamside and bottomland hardwood forest communities. The restoration should help protect known James spinymussel populations by: (1) increasing channel bank stability; (2) reducing sedimentation/siltation within the

reducing pollutants prior to entering the Dan River; (4) serving as a wildlife corridor by providing connectivity to forested areas adjacent to the site; (5) providing increased habitat for aquatic and terrestrial wildlife; (6) increasing organic matter, carbon export, and woody debris in the stream corridor; (7) restoring shade to open water of the Dan River; and (8) restoring characteristic macroinvertebrate species populations in the channel. After implementation, restoration activities are expected to result in the restoration of streamside and floodplain buffer vegetation with the entire 15.95-acre site. Appendix B (copy enclosed) contains the NCDOT's detailed floodplain buffer conservation plan.

3. The NCDOT will monitor the river channel and banks at sites upstream, at the construction site, and downstream to determine changes in habitat resulting from activities at these sites. If any problems with regard to stream stability are detected during the monitoring, the NCDOT will attempt to correct the problems. This monitoring will also help evaluate the impacts of construction on habitat in the Dan River.

4. An inspection of the erosion-control devices will be conducted on a daily basis by the NCDOT's Construction Project Inspector, positioned in the Division Office in which the project occurs. Also, the NCDOT's Roadside Environmental Unit has Area Field Operations Engineers who will perform compliance inspections of the erosion-control devices a minimum of twice a month during the life of the project. In addition to these levels of inspection, an environmental specialist with the NCDOT's Office of Natural Environment's Biological Surveys Unit will perform periodic site inspections of the erosion-control devices at the construction site. This person will also be making qualitative assessments of the Dan River habitat at the construction site. These visits will be unannounced and, whenever possible, directly in relationship to rain events.

5. The NCDOT's Project Development and Environmental Analysis Branch and the Service will be invited to the preconstruction conference to discuss with the contractor the provisions of this Opinion. Prior to construction, the contractor will be required to give notification of the construction initiation date to the Service, NCWRC, and the Tennessee Valley Authority.

II. STATUS OF THE SPECIES

A. Species Description

The James spinymussel was listed as an endangered species on July 22, 1988 (53 FR 27693). Critical habitat is not designated for this species. This mussel was formerly believed to be endemic to the James River basin in Virginia. In October 2000, the NCDOT and Service biologists discovered the James spinymussel in the Dan River in Stokes County, North Carolina, and in August 2001, NCDOT biologists found it in the Mayo River in Rockingham County, North Carolina. Prior to its decline in Virginia, the

species apparently lived throughout the James River above Richmond, in the Rivanna River, and in ecologically suitable areas in all of the major upstream tributaries. There are historic records of collections from several locations on the main stem of the James River and nine sites on tributaries. Much of the species' decline has occurred since the mid-1960s, and the James spinymussel appears to be extirpated from 90 percent of its historic range in the James River basin.

The Service completed a recovery plan for the James spinymussel in 1990 (Service 1990). The primary recovery actions identified in the plan are to:

1. Collect basic data needed for the protection of *P. collina* populations, including population and habitat surveys and the identification of threats to the species' survival;

2. Preserve *P. collina* populations and occupied habitats;

3. Conduct life history studies and identify the species' ecological requirements;

4. Determine the feasibility of reestablishing populations within the species' historic range and, if feasible, introduce the species into such areas in the James River drainage;

5. Periodically monitor existing populations and all introduced populations; and

6. Evaluate the success of recovery activities and make revisions as necessary.

Studies have been conducted to address several of these recovery actions. An extensive survey to monitor known locations and search for new occurrences of the James spinymussel was conducted from 1998 through 2001. Additional work also has been conducted to determine the species' fish host and identify the ecological requirements of the species.

B. Life History

The James spinymussel was discovered in the Calfpasture River (in the James River basin) by T. A. Conrad and was originally described as *Unio collinus* (Conrad 1837). Various workers have subsequently placed this species in a number of different genera (see Service 1990 for synonyms). Turgeon et al. (1988) placed the James spinymussel in the genus *Pleurobema*. The taxonomic history of this species is described fully in Clarke and Neves (1984).

The James spinymussel is a small mussel that reaches a maximum size of about 70 millimeters (mm). The shells of small individuals (<40 mm) are subrhomboid in shape, with an obliquely subtruncated posterior with widely spaced concentric striations. The periostracum (outside layer of shell) is shiny and straw yellow, with prominent growth rests. Faint brownish rays are rarely present. One to three short, but prominent,

spines are occasionally present on each valve. With age, the shell becomes more ovate, or even arcuate; the periostracum becomes brownish to black; and any spines that were once present are lost. Beaks are typically eroded and only slightly elevated above the hinge line, if elevated at all. The nacre (inner shell) is white, with occasional bluish suffusions. The foot and mantle of live specimens are light orange in color (Service 1990).

Like the majority of all freshwater mussel species, the reproductive strategy of the James spinymussel involves a larval stage (glochidium) that becomes a temporary obligatory parasite on a fish. The James spinymussel is a short-term brooder, usually releasing its glochidia in the early summer. Many mussel species have specific fish hosts that must be present in order to complete their life cycle. Based on laboratory infestation experiments, Hove (1990) identified seven fish species, all in the family Cyprinidae (minnows), as potential fish hosts for the James spinymussel. All of these species have been recorded in the Dan River basin (Rohde et al. 2001).

Suitable habitat generally is described as runs with moderate current, with sand, gravel, and cobble substrata (Clarke and Neves 1984). Individuals from the Dan River population have been found in a variety of substrates, from silt/sand to sand, gravel, cobble, bedrock crevices, and sand surrounded by boulders, with a variety of flow patterns, from slack pools to runs with moderate to swift currents.

In the South Fork Mayo River in Virginia, suitable James spinymussel habitat included shallow riffle, run, slack, and pool (50 to 70 percent <61 centimeters), with abundant sand/gravel bars present (Petty 2002). The number of individuals observed was greater in slack water, low-energy areas with sand/gravel bars present. The low-energy areas were predominantly silt, sand, cobble, and gravel. The banks of the South Fork Mayo River were very stable.

C. Status and Distribution

James River Basin - The recovery plan for the James spinymussel described its historic distribution as widespread in the James River drainage. By 1990, surveys indicated that this species had experienced an apparent reduction in range of about 90 percent, with the majority of the decline occurring since the mid-1960s. Surveys were conducted near historic locations, and additional searches were conducted in areas with suitable habitat. Of the 28 locations listed in the recovery plan (historic and present), ten streams were found to have James spinymussels present.

More recent surveys, conducted from 1998 through 2007, have found 19 streams with locations occupied by the James spinymussel. Mill Creek, listed in the recovery plan as a historic record near Millboro, was found to be occupied in the survey from 1998 through 2007. The current distribution of the James spinymussel in the James River basin includes the following streams: South Fork Potts Creek, Craig Creek, Johns Creek, Dicks Creek, Patterson Creek, Catawba Creek, and Cowpasture River (all within the upper James River tributaries, west of the Blue Ridge Mountains); Mechums River, Moormans

River, Wards Creek, Rocky Run, Buck Mountain Creek, Upper North Fork Rivanna River, Welsh Run, Swift Run, and Ivy Creek (all within the Rivanna River system); and Mill Creek (Calfpasture/Maury River system), Pedlar River, and Hardware River (middle James River system).

Although seven more streams had occupied habitat in the 1998 through 2001 survey period than in 1990, densities of the James spinymussel at all sites were low, with fewer than ten individuals observed at any site. Some sites yielded only relict shells. Craig Creek, considered a stronghold for the species in the late 1980s, had reduced numbers in the more recent survey even though habitat in this stream remains in good condition.

The current distribution of the James spinymussel indicates that the populations are still in decline from the historic distribution (McGregor and Baisden 2002). The best populations of the species are in the Rivanna River system (Wards Creek, Rocky Run, Buck Mountain Creek, and North Fork Rivanna River), Johns Creek (upper James), upper Potts Creek (West Virginia), and Mill Creek (Maury River system).

Since 2002, an interagency team led by the Virginia Department of Game and Inland Fisheries (VDGIF) has been conducting James spinymussel surveys in the same general locations surveyed by McGregor and Baisden (2002). Based on data from these surveys, Mr. Brian Watson (VDGIF) concluded that the James spinymussel population in the James River basin is declining, especially in the upper Rivanna River watershed near Charlottesville, Virginia. With the exception of Johns Creek (Craig County), populations in the James River basin are of such low densities that they are considered to be highly unstable. This decline is primarily a result of siltation and the hydrological alteration of waterways (from development).

Additional occurrences have been documented in the Cowpasture (Bath County) and Hardware (Albemarle County) Rivers and Welsh Run (Greene County) in the upper Rivanna River basin since 2002. However, James spinymussel populations have not been found in Potts Creeks (Craig and Alleghany Counties) since the early 1990s (Brian Watson, VDGIF, personal communication, 2008); Catawba and Patterson Creeks (tributaries to Craig Creek in Botetourt County) since 2002; or the Moormans River (Albemarle County) since the late 1980s. It is believed that populations in Mechums River (Albemarle County) and Wards and Ivy Creeks (Albemarle County) have either been extirpated or are near extirpation (Watson, personal communication, 2008). During the most recent Potts Creek survey in 2007, no James spinymussels were found (Petty and Neves 2007). The James spinymussel was historically found in the Calfpasture River (Rockbridge County) but was not found by McGregor and Baisden (2002) and has not been found by Watson.

Major threats to mussels in the James River include agricultural practices, sedimentation, point-source pollutants from industries, sewage, nonpoint-source runoff, and critically low densities. Perhaps the largest combined threat is low densities and isolation. Most of the occupied sites have very low densities and are isolated from each other. This greatly

increases the chances that a single catastrophic event could eliminate one of these individual occurrences.

Dan/Mayo Rivers, Roanoke Basin - The October 2000 discovery of the James spinymussel in the Dan River in North Carolina greatly expanded the range of this species. Current survey data for the Dan and Mayo Rivers indicate that about 36 RM and 8 RM are occupied in the Dan and Mayo Rivers in North Carolina, respectively, and about 15 RM are occupied in the South Fork Mayo River in Virginia.

The species occupies the Mayo River in North Carolina from the North Carolina/Virginia border to about 1.5 miles downstream of NC 770 in northwest Rockingham County, North Carolina. Below this point in the Mayo River, roughly 3 miles are not occupied by the James spinymussel, likely due to point-source discharge (Stoneville Wastewater Treatment Plant), sand/gravel mining (Stoneville Sand Mine), and an impoundment (Avalon Dam). The James spinymussel has been found in a short reach (~0.5 mile) of the Mayo River between the Avalon Dam and the Mayo Dam. Further surveys are needed below the Mayo Dam.

In Virginia, surveys conducted in 2002 found the James spinymussel in the South Fork Mayo River but not in the Dan River. Based on physical habitat appearance, it is also likely that the James spinymussel occurred in the Smith River (another large tributary to the Dan River) at some point. Similar sources of habitat degradation as described above are evident in the Smith River as well.

Threats to the Species in the Dan River - The cumulative effects of several factors, including sedimentation, point and nonpoint 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 (Service 1990).

Siltation - Siltation resulting from the improper control of erosion for various land uses, including agricultural, silvicultural, and development activities, has been recognized as a major contributing factor to the degradation of mussel populations (according to the BA). Siltation has been documented to be extremely detrimental to mussel populations; it degrades substrate and water quality, increasing potential exposure to other pollutants and directly smothering mussels (Service 1990). Sediment accumulations of less than 1 inch have been shown to cause high mortality in most mussel species (Ellis 1936).

The soils in the Dan River basin are subject to high erosion rates. Soil erosion rates as great as 21 tons/acre/year have been documented for cultivated cropland in the Upper Dan River (according to the BA). 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.

Mining Operations - Negative 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 protracted (>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 in-stream mines occur within or upstream of habitat that is currently believed to be occupied by the James spinymussel. Without historic distribution data for the James spinymussel 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 the species in the drainage. However, it is apparent that habitat in the extraction sites is of poor quality for mussels, and it is highly unlikely that recruitment of the James spinymussel into these areas could be successful in the foreseeable future. The extent of "poor-quality habitat" occurs for considerable distances upstream and downstream (including tributaries) of these extraction sites.

Deforestation - The proposed Godfrey Lumber Wood Chip Mill site near the Dan River in Pine Hall, Stokes County, could potentially threaten the James spinymussel population(s) in the Dan and Mayo Rivers. The proposed operation is a high-capacity chip mill (300,000 tons of chips per year). Although the proposed site is located several miles downstream of the Dan River population, the lumber for this type of operation comes from an area within a 75- to 100-mile radius of the site. This would encompass the watersheds of the Dan and Mayo Rivers, where the James spinymussel occurs.

Wide forested buffers have been identified as critical in maintaining stream type (Llhardt et al. 2000), water temperature control (according to the BA), food resources (Palik et al. 2000), and in-stream habitat (Semilitsch 1998) for aquatic resources. Deforestation of large magnitude in the Dan and Mayo River watersheds would be expected to have significant impacts on the James spinymussel.

Sewage Treatment Effluent - Sewage treatment effluent significantly affects the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that the recovery of mussel populations might not occur for up to 2 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 James spinymussel from the North River in Virginia. Based on field observations, the municipal wastewater treatment plant (Stokes County/Danbury Wastewater Treatment Plant, NPDES # NC0082384) located in Danbury appears to contribute to a reduction in mussel fauna, including the James spinymussel, in the Dan River (John Fridell, Service, personal observation, 2002). However, this discharge is not the limiting factor in the downstream distribution of the James spinymussel in the Dan River. In numerous other streams in North Carolina, mussel populations have been observed to disappear entirely immediately below the point of effluent discharge. The very low volume of discharge at

this site and the large size of the Dan River may be the reason the discharge does not totally eliminate the mussel fauna below the discharge.

Impoundments - The impact of impoundments on freshwater mussels has been well-documented (Service 1992, Neves 1993). The construction of dams transforms lotic habitats into lentic habitats, which results in changes within 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 (according to the BA). As mentioned earlier, a small impoundment (Jessups Mill, located on the river just above SR 1432), may be restricting the distribution of this species in the river. Numerous small impoundments occur on the Dan River downstream of the James spinymussel range in the river. Again, without historic data on the distribution of the James spinymussel in the Dan River, it is difficult to determine if the construction of these impoundments had any impact on the species.

Exotic Species - The introduction of the exotic Asian clam (*Corbicula fluminea*) has 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 that still support surviving populations of the James spinymussel. Concern has been raised over competitive interactions for space, food, and oxygen with this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987, Alderman 1997). The Asian clam is common to abundant within the Dan River.

III. ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the Act, when considering the "effects of the action" on federally listed species, we are required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all federal, state, or private actions and other activities in the action area (50 CFR 402.02), including federal actions in the area that have already undergone section 7 consultation, and the impacts of state or private actions that are contemporaneous with the consultation in process. The environmental baseline for this Opinion considers all projects approved prior to the initiation of formal consultation with the Service.

Since the discovery of the James spinymussel in the Dan River in October 2000, an extensive survey of the Dan River subbasin was conducted by biologists with the NCDOT, NCWRC, and Service (380 man-hours to date). The majority of the survey efforts in North Carolina have been concentrated in Stokes, Rockingham, and Caswell Counties. In addition to the main stem of the Dan River, the James spinymussel was also discovered in the Mayo River, a tributary to the Dan River, at approximately RM 109 in northwest Rockingham County. The James spinymussel has not been found in any other tributaries to the river. In fact, the majority of the tributaries in the Dan River drainage appear to be devoid of mussel fauna.

Based on available survey data, the known range of the James spinymussel is about 36 RM. It extends from below the North Carolina/Virginia border, near the first bridge crossing in North Carolina (Flippin Road, SR 1416) in northwest Stokes County, down to at least SR 1695 (Dodgetown Road), below the town of Danbury in central Stokes County.

In the upper part of the established range (the reach between SR 1416 [Flippin Road] and SR 1432 [Collinstown Road]), the James spinymussel 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/hour) in this reach compared to the reach immediately below the dam (0.43/hour), it is very likely that the dam may be a factor influencing the distribution of this species in this section of the river. Below Jessups Mill, the James spinymussel appears to be fairly evenly distributed in the river until it becomes very patchy below Danbury. It appears to be most abundant (based on CPUE) in the stretch between NC 704 and NC 89 (Table 2).

Because the James spinymussel was discovered only recently in the Dan River basin, further research is needed to determine its present and historic distribution throughout the drainage. Based on the current distribution in the Dan and Mayo Rivers, a reasonable assumption can be made that the James spinymussel historically occurred as one large contiguous population from at least the current upper limits within these two rivers downstream to the confluence of the two rivers. A number of factors, such as point-source and nonpoint-source discharge, in-stream sand/gravel mining, and the loss of riparian buffers, have likely contributed to the elimination of the James spinymussel from the lower reaches of its historic range in these two rivers, creating two smaller subpopulations. There are approximately 25 RM separating the downstream extent of the James spinymussel in the Dan and Mayo Rivers, with at least four in-stream mining operations and one small impoundment (Mayo Dam) occurring in this reach. Thus, it is very likely that the Dan River and Mayo River subpopulations are functionally isolated from each other.

Table 2. Catch Per Unit Effort for the James Spinymussel (JSM) in the Dan River.

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

*River miles and CPUEs are calculated for combined occupied reaches; unoccupied reaches are not factored into the total.

The distribution of the James spinymussel in the action area (Stokes County) totals roughly 36 RM. The mussel is rare in the upper portion of its range above Jessups Mill and patchily distributed in the lower portions of this range downriver of Danbury. While it is most abundant in the approximately 7 RM between NC 704 and NC 89, the James spinymussel is fairly evenly distributed for the majority of the river between Jessups Mill and Danbury.

IV. EFFECTS OF THE ACTION

Under section 7(a)(2) of the Act, "effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this Opinion. Should the effects of the federal action result in a situation that would jeopardize the continued existence of the species, we may propose reasonable and prudent alternatives that the federal agency can take to avoid a violation of section 7(a)(2). The discussion that follows is our evaluation of the anticipated direct and indirect effects of replacing Bridge No. 60. Indirect effects are those caused by the proposed action that occur later in time but that are still reasonably certain to occur (50 CFR 402.02).

A. Factors to be Considered

Proximity of the Action - James spinymussel individuals have been observed in the vicinity of the proposed bridge replacement and both upstream and downstream of the project area in 2001, 2006, and 2007. Although measures to avoid and minimize impacts to the Dan River and the James spinymussel are included in the project plans, implementation of this project will result in unavoidable impacts to the river habitat and to individual mussels.

Timing - Construction will begin in late summer or early fall of 2008 and will continue for about 1 year. Demolition will occur during the low-flow period in late summer.

Nature of the Effect - Suitable in-stream habitat at the construction site will be affected for the duration of the construction and demolition and likely for some period after completion of the project. Portions of the habitat may be impacted permanently. A small portion of the riparian area at the site will be cleared for equipment access and may result in temporary increases in water temperature until reforestation can occur.

Disturbance Duration, Frequency, and Intensity - The majority of the disturbance to the riverbed will occur in separate blocks of time that will be short in duration. Initially, riverbed disturbance will occur as temporary work bridges are placed in the river. Riparian vegetation removal will be conducted and stabilized through erosion-control measures and a combination of hardened work pads and immediate seeding and mulching.

B. Analyses of Effects of the Action

Potential Beneficial Effects - The construction and demolition of the existing bridge will have some temporary negative impacts but also will have long-term beneficial effects. Specifically, the NCDOT has described the following beneficial effects that could occur as a result of this project:

1. *Reduction of direct storm-water runoff.* Storm water from the existing bridge enters the river directly from the bridge deck. The new bridge will collect and direct storm water to a vegetated buffer area that will filter the runoff before it enters the river. Additionally, storm water coming off of roadways in these locations will not be directly discharged into any water body; rather, it will be directed over a grass swale.

2. *Removal of bents in the main river channel.* The existing structure has bents in the main channel of the river. These bents trap debris during high flows and can change the hydraulics in the immediate vicinity of the structure. These factors, either singly or in combination, can cause scour and deposition, both of which can negatively impact aquatic habitat. Project B-4281 will be constructed with no bents in the main channel.

Direct Impacts - Actions that may result in direct impacts include the construction of temporary work bridges for construction of the new structure and demolition of the existing structure, land clearing for access, potential toxic spills, the removal of temporary structures after construction, and the demolition and removal of the existing bridge structure. All of these activities have the potential to kill or injure mussels, either by crushing them, poisoning them with the release of some toxic substance, or causing siltation that may suffocate them. These actions may result in direct harm to individuals or negative changes in currently suitable habitat.

Substrate Disturbance and/or Habitat Loss - The construction of this bridge will not result in the placement of permanent piers or bents in the river. However, temporary work bridges will be constructed as work platforms for building the new bridge and for the demolition and removal of the existing structure. It is anticipated that this structure will create minimal permanent change in the river channel. The work bridges will have a foundation of a precast concrete mass or an A-frame of steel and will not be anchored to the riverbed. They will be fabricated off-site and moved into place by a crane. Girders and decking will be added to provide a platform for the equipment. This foundation will allow water to flow relatively freely, and the structures can be removed from the channel during high flows if needed. About 800 square feet (ft^2) of the streambed will be temporarily impacted by the construction of the temporary work bridges. There will be 125 ft^2 of permanent impacts due to the armoring of the bank, where the bent will be closest to the river, in order to prevent scouring. There will also be 1,300 ft^2 of temporary impacts associated with the removal of the existing bents.

The unavoidable effects of bridge construction are expected to adversely affect existing James spinymussel individuals in the Dan River immediately downstream of the project area, but these effects are anticipated to be temporary and sublethal. The NCDOT is proposing to remove individuals from the impact sites and relocate them (see the "Conservation Measures" section of this Opinion). Effects caused by bridge construction are not likely to prevent the recolonization of the James spinymussel into the action area in the future.

Sedimentation and/or Siltation Impacts - Because of the topography and the erodable nature of the soils in the project area, project construction has the potential to result in sedimentation in the Dan River. To minimize the potential for sedimentation, the NCDOT has developed specific erosion-control measures for this project that are designed to protect environmentally sensitive areas. If sediment inputs from construction occur, they should be of short duration.

Indirect Impacts - Indirect effects are defined as those that are caused by the proposed action and are later in time but are still reasonably certain to occur (50 CFR 402.02). Indirect effects to the James spinymussel may include permanent changes in channel substrate or stability that adversely affect the availability of suitable habitat in the vicinity of the bridge. Additional indirect effects could result from infrastructure improvements and any resulting improvements to levels of service, better accommodation of merging and exiting traffic, or reductions in travel times that could have land development impacts outside the project area. Careful implementation of project plans, including the work bridges, should reduce permanent impacts to the Dan River habitat. Given that this project involves the replacement of an existing structure in the same location, it is unlikely that the new structure would increase accessibility to the adjacent land or result in changes in the type or volume of traffic using the structure.

Interrelated and Interdependent Actions - An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification

(Service and National Marine Fisheries Service [NMFS] 1998). An interdependent activity is an activity that has no independent utility apart from the action under consultation (Service and NMFS 1998). A determination of whether other activities are interrelated to, or interdependent with, the proposed action under consultation is made by applying a "but for" test. That is, it must be determined that the other activity under question would not occur "but for" the proposed action under consultation (Service and NMFS 1998). There are no other projects planned that would satisfy the "but for" test; therefore, there are no interrelated or interdependent actions that should be considered in this Opinion.

V. Cumulative Effects

Action Area

Cumulative effects include the combined effects of any future state, local, or private actions that are reasonably certain to occur within the action area covered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The only potential private action we are currently aware of that may occur and produce significant cumulative impacts would be the proposed Godfrey Lumber Wood Chip Mill site near the Dan River in Pine Hall, Stokes County, North Carolina. This proposed operation would have the potential to significantly impact the Dan River subbasin and the James spinymussel. However, controversies over these types of facilities and subsequent moratoriums on their construction in North Carolina have decreased the likelihood that new facilities will be built. Given the uncertainty of this action, the Service will not address potential wood chip mills further in this Opinion. We are not aware of any other future state, local, or private actions that are reasonably certain to occur within the action area that would not be subject to section 7 review. Therefore, cumulative effects, as defined by the Act, will not occur and will not be addressed further in this Opinion.

The proposed project involves the replacement of the existing structure slightly to the north, using a portion of the existing approach on the western side. The new structure is not intended, or expected to increase accessibility to the adjacent land 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 James spinymussel's habitat and the individual mussels at this site is fairly small compared to the extensive amount of occupied habitat in the Dan River (about 36 RM). According to the Stokes County website (http://www.co.stokes.nc.us/), no new projects are planned within the action area. According to the NCDOT's Division 9 TIP planning (http://www.ncdot.org/planning/development/TIP/Trans/division9map), no new projects are scheduled in the proposed action area.

Cumulative Impacts of Incidental Take Anticipated by the Service in Previously Issued Biological Opinions

In reaching a decision of whether the implementation of activities outlined in the BA is likely to jeopardize the continued existence of the James spinymussel, the Service must factor into its analysis previous biological opinions issued involving the species, especially those opinions where incidental take was presented as the amount (square footage) of habitat lost. Only one biological opinion has been issued by the Service in North Carolina (for bridge replacement projects B-2639 and B-3045, in Stokes County). The amount of take associated with those two projects was not to exceed 1,600 ft^2 of combined permanent and temporary impacts. All other previously issued Service biological opinions involving the James spinymussel were rendered for activities in the James River drainage in Virginia. All of those opinions were nonjeopardy, and the amount of take was assessed to be "minimal."

VI. CONCLUSION

After reviewing the current status of the James spinymussel; the environmental baseline for the action area; the effects of bridge construction and demolition; measures identified in the NCDOT's BA to help minimize the potential impacts of the proposed project and assist in the protection, management, and recovery of the species; previously issued Service nonjeopardy biological opinions that allow various levels of incidental take; any potential interrelated and interdependent actions associated with the proposed action; and any potential cumulative effects, it is the Service's biological opinion that implementing this project is not likely to jeopardize the continued existence of the James spinymussel. Critical habitat does not occur in the action area; therefore, none will be adversely affected or destroyed by implementing this project.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant to section 4(d) of the Act prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, such as breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not for the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the Act, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Amount of Take Anticipated

The Service anticipates that incidental take of the James spinymussel may occur as a result of construction of the subject bridge. During construction, individual mussels may be crushed, harmed by siltation or other water quality degradation, or dislocated because of physical changes in their habitat.

About 800 ft^2 of the streambed will be temporarily impacted by the construction of the temporary work bridges. There will be 125 ft^2 of permanent impacts due to the armoring of the bank where the bent will be closest to the river, in order to prevent scouring. There will also be 1,300 ft^2 of temporary impacts associated with the removal of the bents.

Within the "footprint" of the proposed project, a total of 2,225 ft^2 of streambed (125 ft^2 permanent and 2,100 ft^2 temporary) will be impacted by construction equipment or structures placed in the river (temporary work bridges, bents, etc.). Downstream impacts (sedimentation), if any, are expected to occur within 100 feet downstream of the construction site. Accordingly, to minimize the potential for mortality of the James spinymussel, all mussels will be relocated from the river from a distance 100 feet downstream and 50 feet upstream of the project "footprint." Because there are no reliable data on the number of James spinymussels buried in the substrate compared to those on the surface (and even those on the surface are difficult to detect), it is not possible to base the amount of incidental take on numbers of individual mussels. Rather, the amount of incidental take will be exceeded if the project "footprint" exceeds 2,225 ft^2 or if downstream impacts are occurring more than 100 feet downstream or 50 feet upstream from the "footprint." If incidental take is exceeded, all work should stop, and the Service should be contacted immediately.

EFFECT OF THE TAKE

In this Opinion the Service has determined that this level of take is not likely to result in jeopardy to the James spinymussel or the destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the James spinymussel. These nondiscretionary measures include, but are not limited to, the terms and conditions outlined in this Opinion.

1. Construction and demolition activities will be implemented consistent with measures developed to protect the James spinymussel, including those designed to maintain, improve, or enhance its habitat.

2. The NCDOT will remove James spinymussels from the impact site and relocate them to suitable locations upstream of the impacted areas according to the procedures in the approved relocation plan and under the direct supervision of an individual (or individuals) who has appropriate state permit(s) for conducting surveys for and handling live James spinymussels.

3. The NCDOT will assess the river channel and banks at sites upstream, at the construction site, and downstream to determine changes in habitat resulting from activities at these sites and evaluate its potential for future use as a relocation site.

4. The NCDOT will protect riparian buffers along the Dan River or its major tributaries through acquisition or perpetual conservation easements.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described previously and outline required reporting and/or monitoring requirements. These terms and conditions are nondiscretionary and apply to the Dan River.

1. A Service biologist will be present at the preconstruction meeting to explain permit conditions and discuss any questions the contractor has regarding implementation of this project.

2. The NCDOT will ensure that a qualified aquatic biologist is present at critical times to monitor certain phases of construction, including, but not limited to, initial clearing for construction, when the temporary work bridges are installed, when drilled shaft work begins, when demolition begins, and when the temporary work bridges are removed.

3. All appropriate NCDOT BMPs for bridge maintenance, construction, and demolition will be followed or exceeded for this project.

4. Construction will be accomplished in a manner that prohibits wet concrete from contacting water as it enters or flows in the river.

5. Upon completion of the project, the existing approach fill will be removed to natural grade, and the area will be planted with native grasses and/or tree species as appropriate.

6. Activities in the floodplain will be limited to those absolutely necessary to construct the proposed bridge and remove the existing bridge. Areas used for borrow or construction by-products will not be located in wetlands or the 100-year floodplain.

7. All construction equipment should be refueled outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater) and be protected with secondary containment. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 feet from all water bodies (whichever distance is greater), preferably at an upland site.

8. Riparian vegetation will be maintained to the maximum extent possible, especially large trees.

9. If riparian areas are disturbed, they will be revegetated with native species as soon as possible.

10. Bridge demolition will occur during low flow (typically late summer).

11. The NCDOT will implement the mussel relocation procedures in accordance with the approved mussel relocation plan (see Appendix A). The plan details appropriate methods for the collection, tagging and recapture, and handling and transportation of individuals as well as appropriate monitoring protocols.

12. The NCDOT will provide a report to the Service for each monitoring period outlined in the relocation plan.

13. The NCDOT will monitor turbidity levels throughout the life of the project to ensure that the area of authorized take is not exceeded.

14. An individual qualified to assess James spinymussel habitat will conduct a visual assessment of the project area 2 years after project completion to determine the suitability of the habitat for reintroduction of this species.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The following conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Pursue funding and partnership opportunities to complete any additional research, inventory, and monitoring work in order to better understand the distribution and autecology of the James spinymussel in the Dan River.

2. Where opportunities exist, work with landowners, the general public, and other agencies to promote education and information about endangered mussels and their conservation.

3. Pursue additional buffers and conservation opportunities along the main stem of the Dan River and its tributaries, either individually or in concert with other conservation organizations. One potential area for restoration that would benefit the health of the Dan River and James spinymussel is the agricultural field located along the southwest bank, immediately upstream of the project site (right ascending bank).

4. Explore opportunities to work with local and state water quality officials in order to minimize or eliminate wastewater and storm-water discharges into the Dan River.

5. Consult with the Service on projects affecting aquatic habitat in the Dan River drainage, regardless of funding source, to ensure compliance with all provisions of the Act.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION/CLOSING STATEMENT

This concludes formal consultation on the actions outlined in the FHWA's BA dated December 7, 2007, and request for formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion, or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease, pending reinitiation. Consultation should also be reinitiated if new biological information comes to light that invalidates the assumptions made regarding the biology or distribution of the James spinymussel in the Dan River in North Carolina.

If there are any questions regarding this Opinion, please contact Mr. Troy Wilson of our staff at 828/258-3939, Ext. 226, or me, Ext. 223. We have assigned our Log Number 4-2-04-122 to this consultation; please refer to this number in any future correspondence concerning this matter.

Sincerely,

Brian P. Cole
Field Supervisor

Enclosures

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Field Supervisor, FWS, Raleigh Field Office, Raleigh, NC (Attention: Mr. Gary Jordan)

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APPENDIX A

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 the 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

successfully used during previously mussel tagging activities in North Carolina (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, Super Glue or a similar quick dry epoxy (the "gel" type of quick drying epoxy appears to work well on wet shells). 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 mussels 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 2 years at the following intervals: 1 month, 3 month, 6 month, 1 year and 2 years following relocation (adjustments to this schedule may be made, but should be coordinated with, and approved by the Service). It is preferable that the staff conducting the monitoring include biologists who were involved with the salvage and relocation work. Mussels observed at the surface should be taken from the substrate and recorded and placed back into the squares they were taken from. All tagged mussels should be collected, measured and returned to the 1-m^2 square it was collected from. Any untagged mussels should be processed and tagged as before and placed back into the square. 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.

Data collected during monitoring activities should include names of individuals involved in monitoring surveys, general weather conditions, general water conditions (temperature, clarity, and depth) tagged and untagged mussels located, location of tagged mussels recovered (e.g., inside relocation area or approximate distance from relocation site), and any changes in habitat conditions at the relocation site should be noted).

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APPENDIX B

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.

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), about .25 miles west of the intersection of Pitzer Road and Dodgetown Road (Figure 1). The mitigation area is about 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.

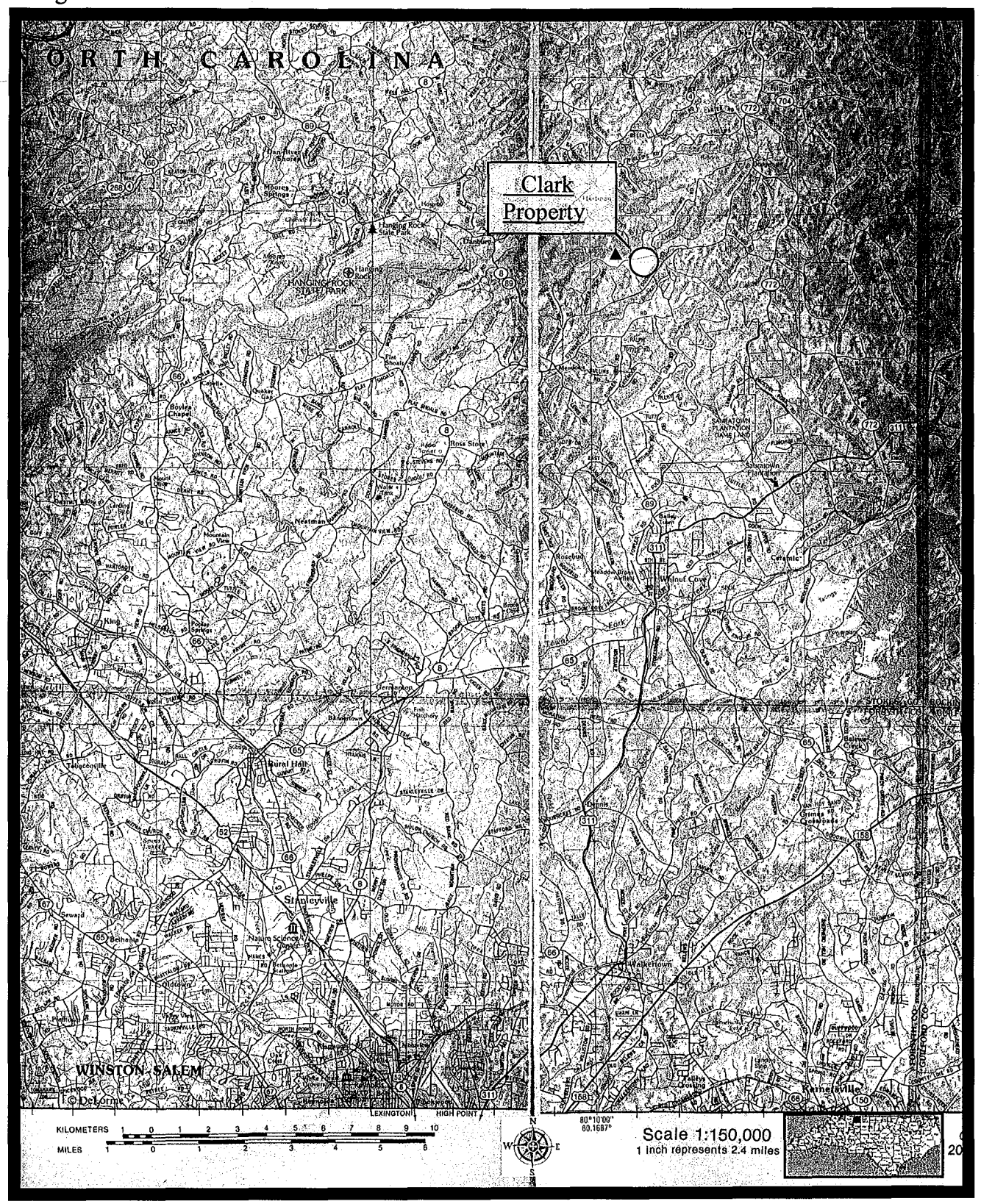
The purpose of this study is to establish a detailed Site mitigation plan for riparian buffer restoration. The objectives of this study are as follows:

- 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, roughly 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 about 45 inches per year (NRCS 1995).

Topography within the Site is nearly level at an elevation of about 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 about 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 about 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 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 about 10 percent of this map unit.

Figure 2. Topography

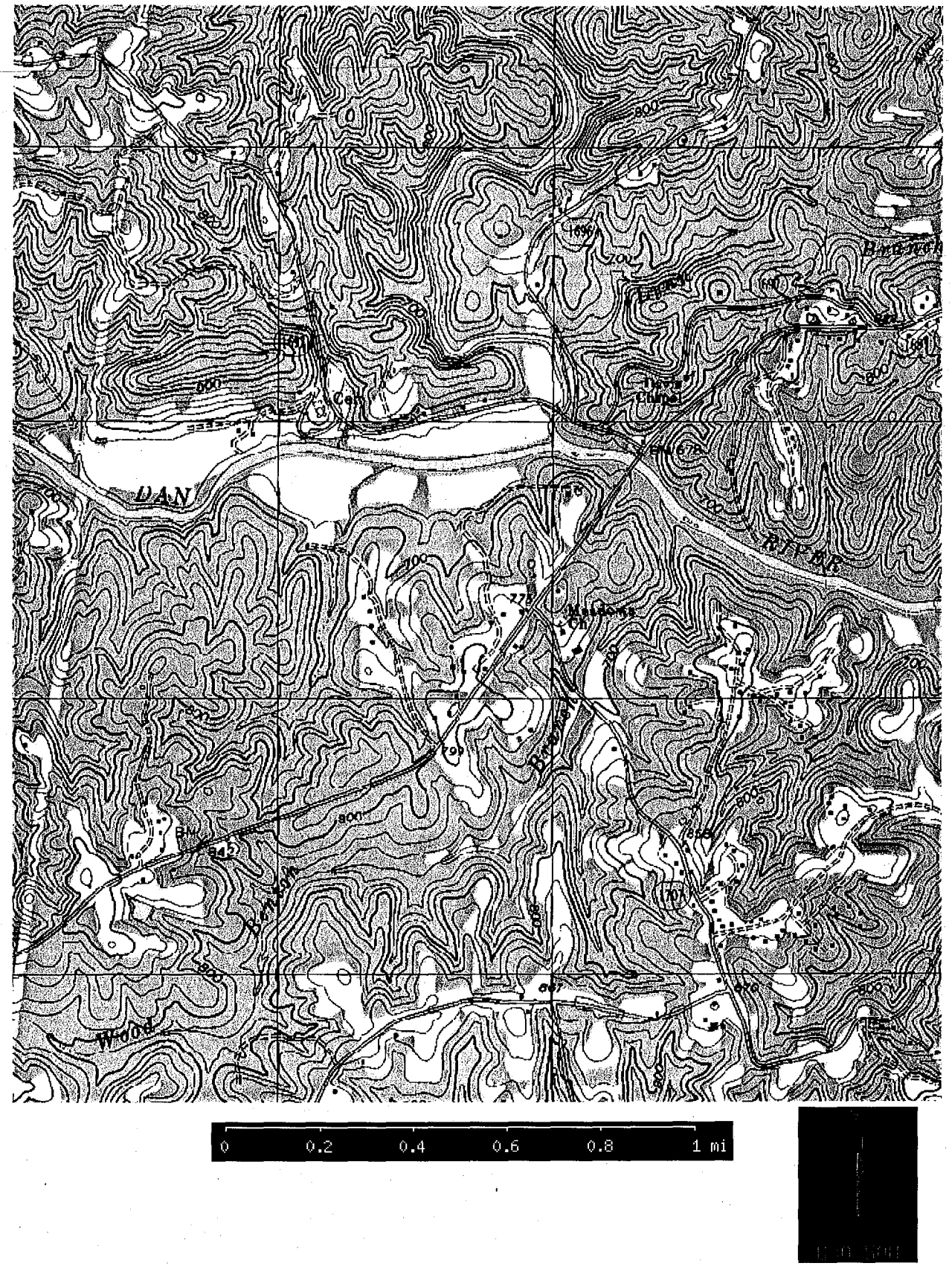
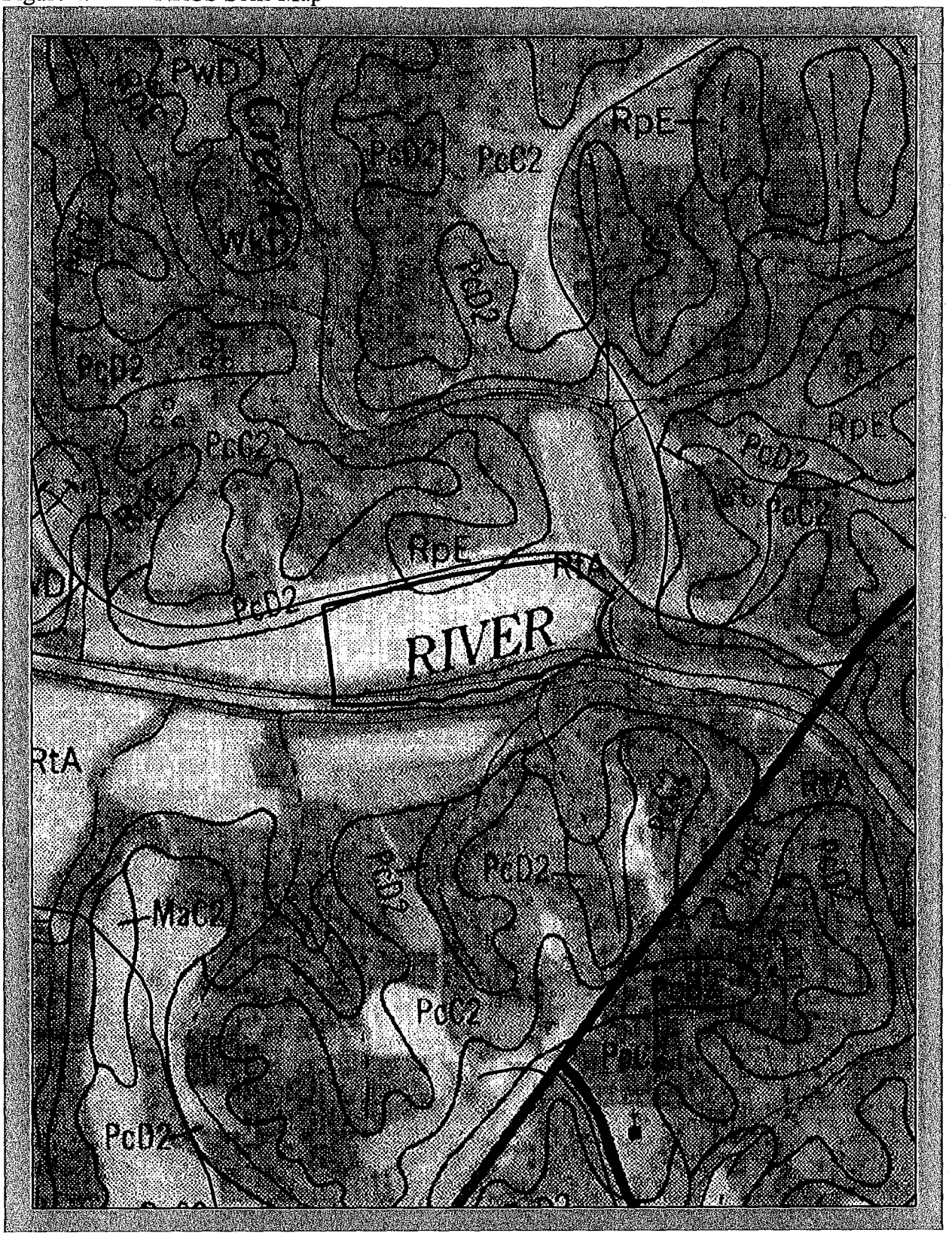


Figure 3. On-Site Land Use

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 (about 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 about 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), and 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, about 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).

Planting Plan

TABLE 2

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

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