



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

February 23, 2006

Colonel John Pulliam
District Engineer, Wilmington District
U.S. Army Corps of Engineers
Post Office Box 1890
Wilmington, North Carolina 28402-1890

Attn: Jean Manuele

Dear Ms. Manuele:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed Dempsey E. Benton Water Treatment Plant (Project) located in Wake County, North Carolina and its effects on the dwarf wedgemussel (*Alasmidonta heterodon*, DWM) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 United States Code [U.S.C.] § 1531 *et seq.*) (Act). Your June 20, 2005 request for formal consultation was received on June 21, 2005.

This biological opinion is based on information provided in the June 2005 biological assessment (BA) (ENTRIX, 2005), the June 2005 Draft Environmental Assessment (DEA) (ARCADIS, 2005), telephone conversations, field investigations and other sources of information. A complete administrative record of this consultation is on file at this office.

Consultation History

The Service, through the informal consultation process, has met with representatives from the City of Raleigh (City) and their consultants at Arcadis G&M and Entrix, Inc. regularly since the scoping process was initiated in 2001. Biologists and other representatives with the North Carolina Wildlife Resources Commission (WRC), the North Carolina Natural Heritage Program (NHP) and the North Carolina Division of Water Quality (DWQ) have also been involved in the informal consultation process because of their expertise with the DWM and aquatic resources, in general. Table 1 includes a more detailed history of the consultation process for the proposed project and is adapted here from section 1.2 of the BA.

Table 1. Consultation History, adapted from Table 1-2 of the BA.

Consultation/Scoping Action	Date
Identification of scoping team and compilation of existing Swift Creek flow, biological and water quality data	October 2001
Field visits with agencies	October 2001
Issue Draft Study Plan for Swift Creek Instream Flow Study for review	November 2001
Scoping meeting, technical meeting regarding methods to address mussel habitat, site visit with agencies	November 2001
Consultants compiled comments and recommendations	December 2001 – January 2002
Issue Final Study Plan for Swift Creek Instream Flow Study for review and approval	February 2002
Selected appropriate study reaches	April 2002
Selected and developed habitat suitability criteria in consultation with scoping team	August 2002
Consultants accomplished field work, modeling, and results interpretation modeling	June 2002 – March 2003
Consultants issued Draft Swift Creek Instream Flow Study Report for review and comment	April 2003
Modeling results meeting	July 2003
Development of additional minimum flow alternatives, additional modeling and analyses	August 2003 – February 2004
Swift Creek Instream Flow Study Technical Meeting to review results of additional modeling	March 2004
Development of modified Index C analyses	March 2004
Swift Creek Instream Flow Study Technical Meeting to review modified Index C results	April 2004
Technical meeting to discuss mussel habitat impact analysis and interpretation	August 2004
Project application for Section 404 authorization; U.S. Army Corps of Engineers (USACE) coordination	September – October 2004
Scoping meeting held to reach concurrence on content and scope of BA	October 2004
Refined mussel habitat impact analysis; additional consultation with Service	December – January 2005
Consultation with Service about Refined Mussel Habitat Impact Analysis	January 2005
Issuance of Draft BA for review and comment	February 2005
City provided a response to resource agency review of Draft BA and submittal of Revised Draft BA	May 2005
City provided a response to resource agency review of Revised Draft BA and issuance of Final BA	June 2005
Service received letter from USACE and final BA requesting the initiation of formal consultation	June 21, 2005
Service provided the USACE with a letter stating the BA is complete	July 21, 2005

Table 1. Consultation History, adapted from Table 1-2 of the BA.

Consultation/Scoping Action	Date
and that a BO will be provided by November 3, 2005	

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The proposed Dempsey E. Benton Water Treatment Plant Project will be located on an impounded section of Swift Creek known as Lake Benson. Lake Benson is located south of Garner in Wake County, North Carolina. Swift Creek flows in a general northwest to southeast direction from its headwaters between Apex and Cary in Wake County to its confluence with Middle Creek and then shortly downstream, into the Neuse River near Smithfield in Johnston County, North Carolina.

The Project consists of the construction of a new 20 million-gallons-per-day (mgd) water treatment plant and associated ancillary facilities. The proposed Project water withdrawal would average 14-mgd. This Project represents reactivation of Lakes Wheeler and Benson as a water supply source. The lakes were formerly used as a water supply source from 1953 to 1987. The proposed Project would provide the dependability and reliability of a second water supply source for the City of Raleigh and assist in meeting the post-2010 water supply needs of the area. In addition to the City of Raleigh, the service area for the Project would include the Towns of Garner and Rolesville (Figure 1). Although Rolesville is located within the City's service area, no new water lines are planned there in association with the Project, and most of the water supplied to Rolesville would come from the City's existing E.M. Johnson Water Treatment Plant.

Specific elements of the Project would include the following:

- The new water treatment plant (WTP) would be constructed on a 55-acre site near the intersection of Highway 50 and Buffalo Road. The site, which is predominately forested, is bordered by Swift Creek to the south and Mahlers Creek to the east and includes an existing wastewater pumping station for the Town of Garner. The new facility would consist of the main WTP, a chemical bulk-storage facility, finished water storage via a 5 million gallon composite tank, a containment pond for emergency finished water overflow, and a finished water pump station.
- Upgrades and retrofits at the existing raw water pump station adjacent to the Lake Benson Dam would be used to deliver water to the new WTP. The existing antiquated intakes on the upstream side of the dam would be replaced with new intake screens. The existing raw water pump station would be upgraded and retrofitted to house new raw water pumps, existing pump dry wells would be converted into wet wells, motorized controls on the intake control gates would be added, and chemical pretreatment facilities would be constructed. The pretreated water would be pumped under Highway 50 to the proposed WTP via new 36 to 48-inch-diameter water mains.

- A new minimum flow release structure would be constructed in the spillway at Lake Benson Dam near the existing raw water pump station. Also at that location, a work/maintenance platform will be cantilevered over the spillway to allow access to the new valve assembly. The minimum release valve assembly would allow the City to accurately provide minimum flows in Swift Creek as specified in the tiered minimum release schedule.
- At the Lake Wheeler Dam site, the existing water-control tower in the lake would be upgraded. The existing manual, water-level-control valves in the tower would be replaced with a motorized, remotely operated system. Motor and computerized controls would be added to the top of the existing water control tower and covered with a small shed-like structure. A new, 100 foot long concrete foot-bridge would be placed over the lake, from the top of the dam to the tower, to facilitate access. A six inch diameter pipe at Lake Wheeler Dam would provide for continuous release of controlled downstream flows, which would be monitored by a weir and flow meter that would be added to the dam outfall.
- A new 24 inch diameter outfall would be constructed to discharge filter backwash effluent, a treated by-product of the WTP filtration process, to Lake Benson. The discharge point would be located in the narrow, north-reaching arm of Lake Benson just upstream of Buffalo Road. This discharge would represent a new National Pollutant Discharge Elimination System (NPDES) discharge, and would be permitted in accordance with applicable NPDES requirements.
- A second, intermittent discharge would be regulated by the NPDES permitting process. The discharge from an emergency overflow of the finished water clearwell at the WTP site would be routed to a one million gallon capacity, containment pond. The finished water contained in the pond following an emergency overflow event would either be allowed to naturally dechlorinate or be chemically dechlorinated. Once dechlorinated, the discharge would be manually released to Mahler's Creek via sheet flow over grassy terrain.
- New water transmission mains would be constructed to inject water treated at the WTP into the City's existing distribution system. A new 3.6-mile-long, 48-inch-diameter finished water transmission main would be constructed within the existing City of Raleigh water line easement corridor extending from the Lake Benson raw water pump station to north of the US 70 intersection at Mechanical Boulevard. Just north of the US 70 intersection, the finished water transmission main would split into a 36 inch and a 30 inch water main. The 36-inch main would extend approximately 6.7 miles, co-locating within existing roadway easements along Garner Road, Creech Road, Sanderford Road, Rock Quarry Road, and Martin Luther King Jr. Boulevard. The 30 inch transmission main would continue approximately 3.5 miles within the existing City of Raleigh water line easement to an interconnect with an existing 30 inch main at the E.B. Bain Re-Pumping Facility. A 16 inch water main would follow Lake Benson Road from the WTP site to an interconnect with an existing main at Atchison Street.

Table 1-1 of the BA includes a list of federally threatened and endangered species and federal species of concern that could occur within the project area. Of those species that are federally protected (threatened or endangered), the Service, during a meeting on

October 19, 2004, concurred that the Project will have no effect on the Tar River spiny mussel (*Elliptio steinstansana*), bald eagle (*Haliaeetus leucocephalus*), red-cockaded woodpecker (*Picoides borealis*) and Michaux's sumac (*Rhus michauxii*). The DWM is federally listed as an endangered species, and a population of the species is known to occur in Swift Creek downstream of Lake Benson. Implementation of the proposed project has the potential to affect the DWM.

Conservation Measures

The City of Raleigh, in consultation with the Service, has agreed to incorporate the following conservation measures into the Project to minimize adverse impacts to DWM, as described in the BA.

Construction Related Effects

- The City agrees to develop site specific Erosion and Sedimentation Control (ESC) Plans for each major activity associated with Project construction. Plans will be approved by Division of Land Resources (DLR) and DLR staff will conduct inspections weekly or after every 0.5 inch rainfall event.
- The site specific ESC Plans will include the following elements to minimize erosion:
 - To the maximum extent possible, fit the development to existing site conditions;
 - Minimization of the extent and duration of bare soil exposure;
 - Protection of disturbed areas from storm water runoff;
 - Stabilization of areas of disturbed soil;
 - Minimization of run-off velocities;
 - Use of traps, barriers, basins or other measures to keep sediments onsite;
 - Inspection and maintenance of control measures; and
 - Restoration / revegetation of the site as soon as practical.

Minimum Flows

- The City will implement a tiered, minimum flow release schedule that will achieve a no greater than ten percent reduction in safe yield, as regulated by the statutes of the NC 1995 Dam Safety Rules. Minimum flow releases for Tier 1, Tier 2 and Tier 3 will not exceed 3.0 cubic-feet-per-second (cfs), 2.0 cfs and 1.0 cfs, respectively.
- The City will notify the Service whenever Tier 3 minimum flow releases (1.0 cfs) from Lake Benson Dam are maintained for in excess of seven consecutive days.
- The City will place a maximum threshold on the base withdrawal rate of the Project and limit the frequency of maximum withdrawal rate operation.
 - The base withdrawal rate for the Project is 14 mgd; however, the City will occasionally increase withdrawals to 20 mgd in order for the City's E.M. Johnson WTP to be taken off line to aid maintenance activities at that facility. These short term increases in withdrawal rates at the Lake Benson Dam will be limited to high flow periods when both Lake Wheeler and Lake Benson are full and the total stream flow at Lake Benson Dam is greater than 40 cfs;

therefore, a minimum flow of nine cfs would still flow over the Lake Benson Dam during these increased withdrawal periods.

- The City will operate Lake Benson Dam in a manner that avoids or effectively minimizes rapid reductions in downstream flow.
 - The Project will not induce rapid changes in downstream flows or stream stage. By controlling and managing minimum flow releases at Lake Benson Dam, mussel habitat will be protected against potentially more rapid, natural decreases in flow which would reduce wetted stream area and possibly strand DWM on dry ground or in very shallow water.

Water Quality

- The City will construct a new water intake structure at Lake Benson Dam to aid minor adjustments in the depth of water withdrawals from the reservoir to make sure that the water withdrawn has appropriate temperature and dissolved oxygen (DO) levels for downstream releases to Swift Creek.
 - A new minimum flow release structure will be installed to control the rate of downstream releases to Swift Creek. The new structure will incorporate an aerating nozzle or other turbulent flow feature to make sure that adequate aeration of downstream discharges.
- The City will decommission Indian Creek Overlook and Mill Run Mobile Home Park Waste Water Treatment Plants (WWTP). Both WWTP facilities have recently been cited for non-compliance and their effluent currently discharges into Swift Creek. The wastewater that is now discharged by these facilities into Swift Creek will be rerouted to the City's Neuse River WWTP, substantially reducing the existing load of potential harmful pollutants and improving water quality in Swift Creek.

Land Acquisition

- The City will purchase two greenway corridors in the Swift Creek watershed that are important for water quality and riparian corridor protection. These lands include the following:
 - Steep Hill Creek Corridor, a 300 foot buffer along 7.23 miles of Steep Hill Creek (which drains into Lake Benson) encompassing 516 acres.
 - Lake Wheeler/Lake Benson Corridor, a 300 foot buffer along 4.06 miles of Swift Creek between Lake Wheeler and Lake Benson encompassing 346 acres.

Watershed Protection Measures

- The City has played an important role in the development of new watershed protection measures for the lower Swift Creek watershed in Wake County. These measures will offset the overland pollutants that would originate from new development in the Swift Creek watershed in Wake County. In addition, Johnston County recently expanded the boundaries of its Environmentally Sensitive Area Overlay District in order to protect portions of the lower Swift Creek watershed that occur in Johnston County.

- Wake County, in coordination with the Service and the NC Department of Transportation (NCDOT), has prepared a final draft Resource Conservation Overlay District II (RCOD-II) ordinance for the proposed watershed protection area (see Figure 6-3 in the BA).
 - The RCOD-II increases stream buffers from 50 feet to 100 feet for all perennial streams within the proposed area, as identified by the 1999 Wake County Surface Water Survey Mapping Project. This will protect about 250,000 linear feet of stream channel and 1,032 acres of land adjacent to streams. Restrictions on allowable activities within the 100 foot stream buffer are outlined in Table 2 of the final draft RCOD-II Ordinance.
 - The RCOD-II Ordinance re-codifies Wake County's existing stormwater ordinances as follows:
 - Peak stormwater runoff (one year storm event) leaving any site post-development must be less than ten percent over pre-development conditions.
 - Impervious surfaces in residential districts with no stormwater controls can not occupy more than 15 percent of the total parcel size. Maximum impervious surface coverage for residential districts with stormwater controls must be no greater than 30 percent.
 - New development must not exceed a nitrogen export-loading rate of 3.6 pounds-per-acre-per-year (lbs/ac/yr) unless excess nitrogen loading is offset by a one-time payment to the NC Ecosystem Enhancement Program (EEP). The maximum nitrogen load from residential development must not exceed six lbs/ac/yr.
- The Town of Garner, in coordination with the Service and the NCDOT agreed to continue the use of their current stream buffer standards as outlined in Section 7.2.D. of their Unified Development Ordinance (UDO).
 - According to the UDO, this Watershed Conservation Buffer is required to be an undisturbed buffer, the width of which includes the 100 year floodplain plus an additional 50 feet on streams listed in Section 7.2.D of the UDO. These requirements will provide enhanced protections for a total of about 1,050 acres within the proposed watershed protection area. The Town does not allow development within the 100 year floodplain (319 acres of the total protected acreage). About 73 miles of perennial and intermittent stream channel are already protected by the 50 foot stream buffer requirements, per the Neuse River Buffer Rules, which would encompass about 731 acres of the total protected acreage within the proposed watershed protection area.
 - The Town of Garner Development Standards for Stormwater Management limits the nitrogen export for new development to 3.6 lbs/ac/yr.
 - Residential developers have the option of making a one-time payment to the EEP for nitrogen loading rates in excess of 3.6 lbs/ac/yr but loading rates may not exceed six lbs/ac/yr.
 - New single-family detached residential development is limited to 30 percent impervious surfaces.
 - New multi-family detached residential development is limited to 50 percent impervious surfaces.

- New non-residential development is limited to 50 percent, though up to 70 percent is allowed with treatment consistent with the Neuse River Nitrogen Rules.
- Johnston County, in coordination with the Service and the NCDOT, has developed protective measures within an Environmentally Sensitive Area Overlay District.
 - Johnston County has agreed to expand the boundaries of its existing Environmentally Sensitive Area Overlay District (District) as defined in its Land Development Code. The expanded boundary will include those portions of the Swift Creek watershed protected by the original District as well as the Little Creek watershed (see Figure 6-3 in the BA).
 - The Environmentally Sensitive Area Ordinance requires a 100 foot buffer on the main stem of little creek from its confluence with Swift Creek to the crossing of the proposed Clayton Bypass.
 - No development (residential or non-residential structures) is allowed within special flood hazard areas within the District
- Johnston County has agreed to modify its Stormwater Management Ordinance to reduce allowable total nitrogen loads from new development within the existing and proposed District.
 - Nitrogen loading contributed by new development must be limited to 3.6 lb/acre/year. Developers of commercial property within the District will have the option of offsetting the nitrogen loading from commercial development by using additional Best Management Practices or by paying into the EEP. When using the offset payment, the total nitrogen loading from a development must not exceed eight lb/acre/year. Residential development may not use the EEP offset option, but must limit nitrogen loading to 3.6 lbs/acre/year.
- Johnston County has agreed to apply impervious surface limitations to the District.
 - Impervious surfaces will be limited to 12 percent for residential development and 50 percent for commercial development.
 - These limits could be increased to 30 and 80 percent, respectively, if payments are made to the Land Dedication Fund or if there is a direct dedication of land, as described in the Johnston County Stormwater Design Manual.

Environmental Monitoring

Stream Flow Gauging

- The City will cooperate with the U.S. Geological Survey (USGS) to provide matching and/or other required funding to sponsor and establish a USGS flow gauging station at an appropriate location on Swift Creek downstream of Lake Benson Dam. The specific details of the flow gauging station (e.g., monitoring details, flow data availability and storage, etc.) will be determined with the USGS in consultation with the Service and the NC Division of Water Resources (DWR).

Mussel Surveys

- The City will fund and / or perform periodic surveys of the Swift Creek mussel and DWM population downstream of Lake Benson Dam.
 - A baseline mussel survey in Swift Creek and Mahler's Creek will be performed following completion of this consultation, but prior to project construction.
 - Additional mussel surveys will be conducted within the Swift Creek watershed downstream of Lake Benson after the project is implemented. Four surveys will be conducted over a period of 20 years (one survey every five years).
 - Mussel survey plans will be coordinated with the Service, WRC and NHP. Staff from these agencies will be invited to participate in the surveys and any data collected from those surveys will be shared with the same agencies.
 - The protocols for these surveys will be developed in consultation with the Service, WRC and NHP.

Water Quality Data Collection

- The City will set up a water quality monitoring station at or near the USGS stream flow gauging station to monitor for temperature, dissolved oxygen, turbidity, pH, and total suspended solids via grab samples on a monthly basis.
- The City will monitor water quality at the raw water intake at Lake Benson Dam on a weekly basis.
- The City will develop and coordinate the details of its water quality monitoring plan with the Service and DWQ.

A complete discussion of the City's mitigation package and conservation measures can be found in Chapter 6 of the BA and in the DEA (Arcadis, 2005).

The action area includes the proposed Project construction footprint in the vicinity of the Lake Benson Dam and the lower Swift Creek watershed including about 15 miles of Swift Creek downstream from the dam at Lake Benson to its confluence with Middle Creek (Figure 2).

STATUS OF THE SPECIES

Species/critical habitat description

The DWM was federally-listed as endangered on March 14, 1990. At one time, this species was recorded from 70 localities in 15 major drainages ranging from North Carolina to New Brunswick, Canada. Currently, there are more than 85 documented locations for DWM (Appendix A). Of these, about 18 are known or are believed to be reproducing populations. At least 31 of these sites are based on less than five individuals or solely on spent shells. The only known occurrence in New Brunswick, Canada (Petticodiac River) appears to be historic. The Swift Creek and Middle Creek DWM populations are the southernmost population of this species. There is no critical habitat designated for this species in North Carolina.

The DWM is the only North American freshwater mussel that has two lateral teeth on its right valve and only one lateral tooth on its left valve. The outer shell is often dark with a greenish cast, though it may be faintly rayed in younger, lighter animals. The anterior end is rounded while the posterior end is lengthened and angular, giving this mussel its characteristic "wedge-shape". The DWM rarely exceeds 1.5 inches long.

Life history, Population dynamics, Status and distribution

The DWM has been found in substrates including firm sand, clay banks, muddy sand, and mixed sand, gravel and cobble. In the southern portion of its range, it is often found buried under logs or root mats in shallow water (Service, 1993). In the northern portion of its range, the dwarf wedgemussel has been found in firm substrates of mixed sand, silt, gravel, cobble, or embedded in clay banks in water depths of a few inches to greater than 20 feet (Fichtel and Smith, 1995; Gabriel, 1995; Gabriel, 1996; Nedeau, et al. 2003).

The reproductive cycle of freshwater mussels appears to be similar for nearly all species. During the spawning period, sperm is discharged by males into the water column, and taken in by females during siphoning. Eggs are fertilized in the gills, which serve as marsupia for larval development to mature glochidia. Upon release into the water column, mature glochidia attach to the buccal cavities, gills and fins of appropriate host fish to encyst and eventually drop off onto the substrate as juvenile mussels.

The DWM is considered to be a long-term brooder. In Virginia, this species spawns in late summer, and becomes gravid in September with glochidia maturing in November (Michaelson, 1993). Michaelson (1993) estimated that DWM release glochidia in North Carolina in April. McLain and Ross (2005) measured the most glochidia during April and May in the Mill River in MA. Host fish for this species include the tessellated darter (*Etheostoma olmstedi*), Johnny darter (*E. nigrum*), and mottled sculpin (*Cottus bairdi*) (Michaelson and Neves 1995).

Human activity has significantly degraded DWM habitat causing a general decline in populations and a reduction in distribution of the species (Michaelson, 1993; Service, 1993). Primary factors responsible for the decline of the DWM include: 1) impoundment of river systems, 2) pollution, 3) alteration of riverbanks, and 4) siltation (Service, 1993).

Damming and channelization of rivers throughout the DWM's range have resulted in the elimination of some of its formerly-occupied habitat. In general, dams and river channelization activities result in the loss or alteration of mussel habitat (Watters, 2001). Immediately upstream of a dam, conditions such as heavy silt deposition, low current and low oxygen levels are not conducive to the maintenance of DWM populations. Immediately downstream of these dams, remaining habitat is subject to daily water level and temperature fluctuations and scour, conditions stressful or intolerable to sensitive DWM.

Domestic and industrial pollution was the primary cause for mussel extirpation at many historic sites. Mussels are known to be sensitive to the adverse effects of heavy metals

and pesticides, and to high levels of nutrients and chlorine. Mussel die-offs have been attributed to chemical spills, agricultural waste run-off and low DO levels (Havlik and Marking, 1987). Some pollutants indirectly impact the mussels; for example, nitrogen and phosphorus cause organic enrichment, and in extreme cases, oxygen depletion.

Siltation, generated by road construction, agriculture, forestry activities, and removal of streambank vegetation, is considered to be an important factor in the decline of many freshwater mussel species, including the DWM. Sediment loads in rivers and streams during periods of high discharge may be abrasive to mollusk shells. Erosion of the outer shell allows acids to reach and corrode underlying shell layers (Harman, 1974). Irritation and clogging of gills and other feeding structures in mussels occurs when suspended sediments are siphoned from the water column (Loar et al., 1980), affecting the mussel's normal activity or even causing death.

Because freshwater mussels are relatively sedentary and cannot move quickly or for long distances, they cannot easily escape when silt is deposited over their habitat. Ellis (1936) found that mussels could not survive in substrate on which silt accumulated to depths over 0.2 – 1.0. He observed dying mussels with large quantities of silt in their gills and mantle cavities and attributed their deaths to interference with feeding and to suffocation. In addition, Ellis determined that siltation from soil erosion reduced light penetration, altered heat exchange in the water, and allowed organic and toxic substances to be carried to the bottom where they were retained for long periods of time. This resulted in further oxygen depletion and possible absorption of these toxicants by mussels (Harman, 1974).

A further probable adverse effect on many mussel species is the impact of sedimentation or pollution on host fish species. Some fish species are vulnerable to changes in light, turbidity and pollutants. Any water quality degradation that affects host fish species may affect mussels.

Most of the DWM populations are small and geographically isolated from each other (Service, 1993). This isolation restricts exchange of genetic material among populations, and reduces genetic variability within populations (Service, 1993). Strayer (1994) conducted a rangewide assessment of the DWM (examining thirteen rivers and streams from New Hampshire to North Carolina. Strayer concluded that all 13 populations of the DWM are vulnerable to loss because of their small range, low population densities, linear ranges, or some combination of the three factors. However, for all but one of the populations studied (Aquia Creek, VA), densities determined by Strayer were large enough so that he did not expect them to be affected by problems such as inbreeding or demographic stochasticity. Nevertheless, Strayer felt that these populations demonstrated lower fertilization rates than other freshwater mussel species, even though there was evidence of reproduction at most sites.

Although not within the action area, surveys for DWM were performed in the upper portions of the Swift and Middle Creek watersheds (i.e., Wake County) in June and July 2004 (CZR, 2004). The survey was performed on behalf of the Cities of Cary, Apex, Holly Springs, and Morrisville, NC. Nineteen sites were sampled in Swift Creek and its

tributaries upstream of Lake Wheeler, totaling 31.5 person-hours of sampling effort. A total of 203 mussels, consisting primarily of *Elliptio* spp., were collected in upper Swift Creek and its tributaries. However, no DWM were collected in either the upper Swift Creek or upper Middle Creek watersheds (CZR, 2004). Based on the surveys and data described above, it appears that DWM in Swift Creek are restricted to the area downstream of Lake Benson in general, and the area near or downstream of the Wake-Johnston County boundary in particular.

Analysis of the species/critical habitat likely to be affected

The proposed construction, maintenance, operations and conservation measures for the proposed Project have the potential to adversely affect DWM. Potential impacts to DWM and its habitat may result from sedimentation and chemical spills during Project construction and reduced flows that will result from Project operations. These effects are expected to occur far into the future. Project related sedimentation could cause the burial of juvenile and adult mussels. Project related chemical spills or toxic substances could injure or kill all life stages of DWM. Project related flows will be less than what naturally occurs in Swift Creek and may, at certain times of the year, reduce available habitat for DWM and their host fish species. During extremely low flows, DWMs and their host fish may be physically separated by dry areas which would prevent glochidia from attaching to host fish species. The effects of the proposed action on DWM will be considered further in the remaining sections of this opinion.

ENVIRONMENTAL BASELINE

The environmental baseline is a summary of the status and health of the species and/or its habitat in the area affected by the proposed action. As defined in 50 Code of Federal Regulations [CFR] 402.02, "action" means all activities or programs of any kind that are 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 resulting from the federal action 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.

Description of the Action Area

The action area includes the proposed Project construction footprint in the vicinity of the Lake Benson Dam and the lower Swift Creek basin including about 15 miles of Swift Creek downstream from the dam at Lake Benson to its confluence with Middle Creek (Figure 2). The water treatment plant will occupy about 55 acres of land immediately downstream of the Lake Benson Dam. Swift Creek is within the Upper Neuse River Basin (USGS Hydrologic Unit Code 03020201) and drains parts of southern Wake and western Johnston counties. Not including the Middle Creek basin, the drainage area of Swift Creek is 157 square miles. Due to the presence of various rare species of fish and mussels, Swift Creek is considered a nationally Significant Natural Heritage Area by the NHP.

Status of the species within the Action Area

The DWM was first documented in Swift Creek in 1991 downstream of Lake Benson in Wake and Johnston counties. To date, no DWM have been found upstream of Lake Benson. The WRC and various other state and independent biologists conducted surveys in Swift Creek in 1991, 1992, 1994, 1996, 1997, 1998, 2002 and 2003. The results of those surveys indicate that the catch per unit of effort (CPUE) has never been high and has varied from year to year with no distinguishable trend, similar to results at other DWM locations in the Neuse River Basin. CPUE calculations are based solely on qualitative informal mussel sampling and are simply a means of standardizing data. Data should not be used to make inferences about the mussel population due to unproven assumptions that the samples are representative of the population and due to unknown variances. It is difficult to estimate population size or relative abundance based on qualitative sampling data (Strayer and Smith 2003). In 1991, 0.5 DWM/hr (two DWM total) were found in Swift Creek. Surveyors found one DWM/hr (three DWM) in 1992, four DWM/hr (two DWM) in 1994, three DWM (CPUE unknown) in 1996, 1.3 DWM/hr (11 DWM) in 1997, 1.3 DWM/hr (four DWM) in 1998, 0.86 DWM/hr (three DWM) in 2002 and 0.0088 DWM/hr (one DWM) in 2003. Based on available survey data, the DWM population in Swift Creek appears to be small. The 2003 Project related survey resulted in a very low number of mussels per unit effort (0.0088 DWM/hr) with only one DWM.

Little Creek, a tributary of Swift Creek, was surveyed in 2003 and a total of 0.044 mussels/hr (a total of two DWM) were recorded. The only DWM records from Little Creek were collected in association with NCDOT project surveys for the Clayton Bypass. Surveys were conducted in White Oak Creek, a tributary to Swift Creek about ten miles downstream of the Lake Benson dam, in 1992 and only one mussel/hr (one DWM) was reported. The WRC has no other DWM records from White Oak Creek. While not a part of the action area, a mussel survey was conducted in 1992 in Middle Creek, a nearby stream to Swift Creek and a tributary to Swift Creek near its confluence, and resulted in 0.38 DWM/hr (three DWM). According to the opinions of professional biologists knowledgeable of mussel fauna in Wake and Johnston counties, Swift and Little Creek DWM populations are in decline and Middle and White Oak Creek DWM populations are potentially extirpated (A. Rodgers, WRC, pers. comm., 2005).

The NCDOT and its contractors sampled Swift Creek and four of its tributaries (Little Creek, White Oak Creek, and Copper Branch, and Middle Creek) in 2003 (NCDOT, 2005b) (Table 2). A total of 36 sites were sampled in Swift Creek and 114 person-hours of sampling effort were expended. The sample sites in Swift Creek encompassed the area from Lake Benson Dam to nearly its confluence with Middle Creek, and were concentrated near the Wake-Johnston County boundary. Seven sites were sampled in Little Creek upstream of the SR 1562 bridge in Johnston County, expending about 45 person-hours of sampling effort. Seven sites in White Oak Creek (67 person-hours), and a single site in Copper Branch (12 person-hours) were also sampled during the NCDOT surveys. Despite collections of relatively large numbers of mussels, primarily *Elliptio* spp., at all sites, only three DWM were collected. Two DWM were collected in Little

Creek, which joins Swift Creek about 13 stream miles downstream of the Wake-Johnston County boundary. Only one, older DWM individual was collected in Swift Creek, about two miles downstream of the Wake-Johnston County line near the State Highway 42 bridge crossing, during this effort.

Table 2. NCDOT DWM Surveys for the Clayton Bypass.

Stream	Number of Sites	Survey Hours	Number of DWMs
Little Creek	7	45	2
White Oak Creek	7	67	0
Copper Branch	1	12	0
Swift Creek*	36	114	1

An asterisk (*) indicates that the stream is within the action area.

Factors affecting the species within the Action Area

The Project area is located just southeast of the City of Raleigh. Suburban growth from Raleigh and the smaller towns of Garner and Clayton is expanding and encroaching into the Swift Creek watershed. Both Garner and Clayton have plans to expand infrastructure such as roads, water lines and sewer lines into the watershed. Residential development, such as single family homes and apartment complexes, and associated shopping centers and other commercial development continue to occur in the watershed. While a portion of the watershed remains forested, much of the undeveloped land is currently in agriculture.

Lawn and agricultural chemicals and road run-off including sediment and petroleum products may further degrade water quality. However, riparian vegetation generally appears to be maintained along the streambank. The Neuse River Basin Buffer Rules, enacted in 1998, protect fifty feet of buffer on each side of perennial streams in the Neuse Basin. Additional buffer protections have been adopted by Wake and Johnston counties and the Town of Garner, and are further described in the Conservation Measures section of this document and Chapter 5 of the BA. However, continual development and the lack of conservation measures will negatively impact the aquatic resources of the Swift Creek watershed, including DWM.

EFFECTS OF THE ACTION

Direct and Indirect Effects

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. Under section 7, 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 Biological Opinion. Indirect effects are defined as those that are caused by the proposed action and are later in time, but still reasonably certain to occur (50 CFR §402.02). The BA includes a complete discussion of the direct and indirect effects of the Project on DWM. However, we believe that those effects described as indirect, such as impacts to flows and water quality, may be more

appropriately considered to be direct effects as they would be part of the normal operation of the Project.

Land Clearing and Disturbance and Sedimentation

Section 5.1 of the BA indicates that land clearing and disturbance activities associated with the construction of the water treatment plant will permanently alter about 55 acres of natural areas, including the dredge and fill of about 0.26 acres of jurisdictional forested wetland. The Lake Wheeler and Lake Benson Dam and pump station upgrades and retrofit areas and the new discharge structure at Lake Benson will, for the most part, occupy areas previously disturbed by the original water withdrawal facilities. The new finished water transmission main will impact about 1.42 acres of jurisdictional wetlands at two locations and cross 15 perennial streams and could increase turbidity and sedimentation in tributaries to Swift Creek. About 15 linear feet of stream banks and stream bottoms will be impacted at each stream crossing and impacts will not exceed the 40 foot wide easement corridor. These effects should be short-term in duration since all disturbed areas will be restored to their natural condition as quickly as possible after the transmission main is installed. The implementation of ESC best management practices (BMPs) should minimize potential impacts. Additional precautions will be taken to minimize direct impacts to water resources that could result from possible construction-related spills of toxic or harmful materials and to control their runoff in the event of a spill. These and other protective measures are further described in section 5.1 of the BA.

Flows

As stated in the BA, instream flow is a major determinant of habitat availability for aquatic species such as DWM. Through scoping with the Service and an interagency group, the potential effects of water withdrawals for the Dempsey E. Benton WTP and the associated changes to the hydrology and aquatic habitat of Swift Creek were identified, and the methods for quantifying these potential effects were agreed upon (ENTRIX, 2001; 2002). The Swift Creek Instream Flow Study (ENTRIX, 2003) and subsequent technical analyses provide the basis for analyzing the effects for water withdrawals on Swift Creek.

As described in the BA (ENTRIX, 2005), a simulated pre-impoundment hydrologic record was assumed to represent the environmental baseline and was used as the basis for evaluation of the proposed action, per request of the agencies involved in the scoping of the Swift Creek Instream Flow Study. This pre-impoundment hydrologic record is referred to hereafter as the “baseline” condition. The hydrologic time series representing the proposed action, or “with Project” condition, was developed with the use of a spreadsheet-based reservoir operations model. This model simulated 60-years of flows in Swift Creek that would result from implementation of the proposed operation of Lakes Wheeler and Benson, the Dempsey E. Benton WTP withdrawals, and the tiered, minimum flow release schedule.

A review of the 500 cfs scale hydrographs presented in Appendix D of the BA indicates that WTP operations will have a slight effect on the high flow regime in Swift Creek. The 10 cfs scale hydrographs, however, indicate that WTP operations will increase the

frequency and duration of stream discharges that are less than 10 cfs, relative to the baseline condition. Project related water withdrawals will considerably increase the amount of time that stream flows in Swift Creek are less than 10 cfs relative to the baseline condition. The median annual frequency of flow events less than 10 cfs is similar for the baseline and with Project conditions (i.e., 7 vs. 9 events, respectively); however, the median annual duration of time spent at flows less than 10 cfs is 56 days under the baseline condition, but 170.5 days under the with Project condition.

There will be little change in the total duration of flows less than 3 cfs between the baseline condition and with Project operation flows. However, the distribution and exceedence of flows less than three cfs will vary.

A comparison of the frequency and duration of flows less than three cfs for each year for a 60-year period of record under the baseline and with Project conditions indicates that in 32 of 60 years there would be no substantial change in the frequency and duration of flows less than three cfs; in 13 of 60 years the frequency and duration of flows less than three cfs relative to the baseline condition would increase; and in 15 of 60 years the with Project condition would reduce the frequency and duration of flows less than three cfs relative to the baseline condition.

The with Project condition will decrease the frequency and reduce the duration of the lowest stream discharges (i.e., flows less than two cfs) relative to the baseline condition. Additionally, the implementation of a minimum flow release under the with Project condition will prevent the occurrence of the lowest, naturally-occurring summer and fall stream discharges (i.e., flows that approached zero cfs in some instances) that occurred in some years under the baseline condition. Low flows often concentrate pollutants which can affect feeding, breeding and overall health of DWM. In addition, reduced flows may expose DWM, making them more vulnerable to predators and dehydration.

Habitat

Dwarf wedgemussel experts familiar with Swift Creek identified two types of habitat important to the survival of the DWM: Shallow Fast Coarse (SFC) and Deep Stream Margin Roots (DSMR). Shallow Fast Coarse habitats are determined largely by the distribution of coarse sand, gravel, and cobble within the stream channel and are limited to riffles and shallow runs of Swift Creek. These areas are typically separated by long stretches of run and pool habitat. Deep Stream Margin Roots habitat includes areas with stable banks and root mats over appropriate sediments.

As described in the BA and supporting technical analyses, two-dimensional (2-D) habitat modeling results were used to identify "patches" of suitable SFC and DSMR habitats and to determine how the area, spatial location, and quality of these patches change with flow.

Mussels are relatively sessile organisms, and depending on the species have a limited range of mobility and cannot rapidly change their physical position in a stream or move in response to changes in the spatial distribution of suitable habitats (Layzer and

Madison, 1995). Consequently, many mussel species tend to occur primarily in stable habitats that persist throughout the year at a range of stream flows. The extent of mussel habitat is therefore constrained by the availability of that habitat during the lowest flow periods of the year, often represented as the July, August, September, and October (JASO) period. Though suitable mussel habitat patches might occur at higher stream flows, those habitat patches that do not overlap with the habitat patches provided at stream flows corresponding to typical JASO low flows could not be used effectively, and as such would not constitute “effective” habitat. In other words, suitable mussel habitat is limited to those portions of the stream that stay wet during the lowest flow periods of the year.

The simulated flow data for Swift Creek were used to help interpret the habitat data and determine how frequently various flow-habitat thresholds might occur. The analysis of DWM habitat effects focused on Swift Creek Reaches 2 and 3, as represented by study Sites 2 and 3, because these portions of Swift Creek include the most suitable habitat for DWM. Table 3 summarizes the changes in the JASO flow regimes between the baseline and with Project conditions.

Table 3. Summary of Flows Occurring During the Summer-Fall Period (JASO) in Swift Creek at Sites 2 and 3.

		Typical JASO Flows (between 25 th and 75 th percentile) ¹	Low JASO Flows (between 75 th and 90 th percentile) ²	Lowest JASO Flows (less than the 90% percentile) ³
Site 2	Baseline	5.8 – 35.7 cfs	1.8 – 5.8 cfs	0.0 – 1.8 cfs
	With Project	3.9 – 15.1 cfs	2.6 – 3.9 cfs	0.8 – 2.6 cfs
Site 3	Baseline	8.3 – 50.9 cfs	2.5 – 8.3 cfs	0.0 – 2.5 cfs
	With Project	6.4 – 33.8 cfs	3.5 – 6.4 cfs	0.8 – 3.5 cfs

¹ Flows in this range occur 50% of the time during JASO months

² Flows in this range occur 15% of the time, and flows less than these values occur only 10% of the time during JASO months

³ Flows in this range occur only 10% of the time during JASO months

The most obvious and substantial change in the Swift Creek flow regime due to Project operations during the JASO period is the reduction in the middle 50% of flows. Though this constitutes a substantial change in stream flows, the change was determined to be outside the range of flows within which DSMR and SFC effective habitat is particularly sensitive to changes in flow. Example levels of DSMR and SFC habitat corresponding to the flow ranges in Table 3 are presented in Tables 4 and 5, respectively.

Table 4. Summary of Approximate DSMR Habitat Patch Area¹ Occurring During the Summer-Fall Period (JASO) in Swift Creek at Site 2 for the Flows Shown in Table 3.

	Habitat Provided at Typical Summer Flows and occurring 50% of the time during JASO Flows	Habitat Provided at Low Summer Flows and occurring 15% of the time during JASO Flows	Habitat provided at Lowest Summer Flows and occurring 10% of the time during JASO Flows ²
Baseline	619 – 1,292	240 - 619	<170 - 240
With Project	515 - 854	373 - 515	~170 – 373

¹ Habitat area expressed in units of ft²/1,000 ft of stream

² Some numbers in this column are listed as < or ~ because the lowest simulated flows were 1 cfs and 0.5 cfs at Sites 2 and 3, respectively. The amount of habitat at near zero flow is expected to be very low or zero.

Table 5. Summary of Approximate SFC Habitat Patch Area¹ Occurring During Summer-Fall Period (JASO) in Swift Creek at Site 3 for the Flows Shown in Table 3.

	Habitat Provided at Typical Summer Flows and occurring 50% of the time during JASO Flows	Habitat Provided at Low Summer Flows and occurring 15% of the time during JASO Flows	Habitat provided at Lowest Summer Flows and occurring 10% of the time during JASO Flows ²
Baseline	883 – 1,206	433 - 972	<164- 433
With Project	826 – 1,206	542 - 826	~240 - 542

¹ Habitat area expressed in units of ft²/1,000 ft of stream

² Some numbers in this column are listed as < or ~ because the lowest simulated flows were 1 cfs and 0.5 cfs at Sites 2 and 3, respectively. The amount of habitat at near zero flow is expected to be very low or zero.

As shown in Tables 4 and 5, the range of habitats that would be provided under the baseline and Project condition during the common summer flows (those occurring 50% of the time) overlaps considerably. Although the typical JASO flows would change substantially, the spatial change in DSMR and SFC habitat patches and effective DWM habitat are not particularly sensitive to changes in flow in this range. Many of the habitat patches that disappear in the range of the typical (middle 50%) baseline JASO flows would either still persist at the typical Project JASO flows or would not persist in some years or months even under the baseline flows, simply due to the occurrence of natural low flow events.

At lower and less frequent summer-fall flows (flows occurring 15% of the time during JASO months) the difference between the baseline and the Project condition is less pronounced. Though the baseline flows would be greater part of the time, they would also fall lower than the Project flows, which would remain about 1 cfs higher than the baseline flows. The DSMR and SFC habitat values mimic this relationship. For low summer-fall flows occurring about 15% of the time, the DSMR and SFC habitat values would be similar between the two flow regime conditions, and the Project flows would prevent DSMR and SFC habitat values from falling as low as they would under the baseline condition. Finally, at the lowest summer-fall flows (flows occurring about ten percent of the time during JASO months), the Project condition would provide slightly higher flows, and thereby prevent the occurrence of the lowest flows and habitat events observed under the baseline condition.

In summary, in some years, or for some percentage of time in any given year, the baseline flows would maintain somewhat higher levels of effective DWM habitat than the Project flow condition. In other years the amount of DWM effective habitat would be similar between Project and baseline conditions. Less frequently, during critically low-flow periods, the tiered minimum flows provided by the Project would provide protection against the lowest observed flows in Swift Creek, and may provide more protection for critical levels of effective DWM habitats, which are lost at flows less than 1-2 cfs. While Project flows will result in more frequent dewatering of some of the persistent DWM habitats, they will also provide some enhanced protection for those critical, low-flow habitats that would otherwise be dewatered during the most extreme drought periods.

Naturally occurring, prolonged periods of drought may result in various lethal and non-lethal effects on mussels. Under extreme drought conditions, mussels may face increased water temperatures and reduced dissolved oxygen concentrations (hypoxia, or eventually anoxia), increased predation, and emersion or stranding (Johnson et al., 2001). A survey of mussel assemblages was conducted in a number of streams in the Flint River Basin of southwestern Georgia prior to and following a significant drought period (Johnson et al., 2001; Golladay et al., 2005). Sites that ceased flowing during the drought had significant declines in the abundance of stable and endangered species of mussels and in taxa richness. However, sites that maintained some flow during the drought had increases in stable species of mussels and no change in special concern or endangered species through the drought. Mortality of mussels at sites that ceased flowing was associated with reductions in dissolved oxygen concentration, which was highly correlated with water velocity. These results suggest that the value of guaranteed minimum flows in Swift Creek during prolonged periods of drought may be significant for the protection of DWM and other mussels.

The tessellated darter is believed to be the host fish species for DWM in Swift Creek. According to the BA, this species is generalized in its use of stream habitats. Tessellated darters are abundant in Swift Creek where they have been observed using a wide range of habitats including sand-gravel riffles, sandy runs, woody debris in runs and pools, and the margins of shallow pools. It is important that DWM and tessellated darters be in close contact between March and May when glochidia are released in order for them to encyst successfully. Since the DWM are sessile organisms, this is most likely to occur in the SFC or DSMR habitats. Based on the Instream Flow Study (Appendix A of the BA), post Project conditions in Swift Creek during that time of the year will range from a ten percent increase in habitat to an about five percent decrease in habitat. In general, it appears that during the spawning, attachment, encystment, and settling process of DWM reproduction, the Project flow condition would not result in a substantial change in availability of DSMR and SFC habitats over that of the baseline condition. The ecology of tessellated darters, their abundance in Swift Creek, and the habitat versus flow relationships indicate that tessellated darter habitat, contact with DWM during appropriate seasons, and the general host species relationship would not be limited under the Project flow condition.

Water Quality

The Project will result in one new permanent discharge to Lake Benson and two intermittent discharges to Mahler's Creek and Swift Creek.

Filter Backwash

About two to four mgd of treated effluent from the filter backwash process will be discharged into Lake Benson after it is clarified, dechlorinated and disinfected via UV disinfection in order to augment the water supply for drinking water and downstream flows. The DWQ has indicated that this discharge will be subject to NPDES permit conditions and compliance monitoring will make sure that the required NPDES standards are met. No effects to water quality of Lake Benson or Swift Creek or to DWM are expected.

Emergency Treated Water Overflow

Emergency overflows of finished water clearwell may be intermittently discharged to Mahler's Creek, a tributary to Swift Creek. These overflows will only occur in the event of emergencies such as power failure or temporary loss of systems integration. The discharge of finished water will be routed to a one million gallon containment pond on the WTP site. The finished water will be contained in the holding pond to allow natural dechlorination or it will be chemically dechlorinated. The DWQ has indicated that this discharge will be subjected to limits for flow; total suspended solids, pH and total residual chlorine, and that whole effluent toxicity monitoring will be required.

Storm Water Discharges

Storm water discharges may affect water quality and the DWM in Swift Creek during both construction and operation of the proposed Project. Potential impacts resulting from storm water will be minimized by the maintenance of vegetated buffers and the implementation of the erosion and sedimentation control measures.

Nutrients

Project related contributions of nutrients (nitrogen and phosphorus) to Lake Benson and Swift Creek may affect water quality and therefore, DWM in Swift Creek. Since the portion of Swift Creek below Lake Benson is classified as a Nutrient Sensitive Water and has been targeted for development of nutrient management strategies, a total maximum daily load (TMDL) has been developed for the Neuse River Basin, and restrictions on total nitrogen loads have been imposed on many discharges. The DWQ will likely require monitoring of nutrient contributions (total nitrogen, ammonia nitrogen, and total phosphorous) in Project discharges on a monthly basis. The use of treatment additives that may contribute nutrients will be minimized or eliminated in order to reduce impacts to water quality in Swift Creek.

The withdrawal of water from Lake Benson/Swift Creek and the associated tiered, minimum flow regime will increase the frequency and duration of low-flow events in Swift Creek which may affect water temperatures and DO levels and could reduce the assimilative capacity of the stream and concentrate pollutants discharged to Swift Creek via point source discharges.

Seven NPDES-permitted point source discharges occur in the Swift Creek watershed and contribute various forms of phosphorous and nitrogen, biological oxygen demand, residual chlorine, and fecal coliform bacteria that reduce water quality and potentially harm DWM, especially at low flows. If discharges in excess of permitted levels occur concurrently with lower than normal stream flows resulting from Project operations, the water quality in Swift Creek could be negatively affected.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological 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. Authorization of the proposed Project would not significantly affect growth rate, final land use patterns, or development densities in the Swift Creek watershed, as these are determined, or have been determined, by separate planning and political processes (ARCADIS, 2005). However, it is also correct to state that the additional increment of water supply that would be contributed by the Project is a necessary factor in achieving a normal rate of growth. Such growth, and the associated urbanization and development, could result in cumulative effects to Swift Creek water quality and aquatic habitats, including DWM habitat.

Moderate land development has been occurring and is expected to continue in the Swift Creek watershed for the reasonably foreseeable future (ARCADIS, 2005; NCDOT, 1998). The upper Swift Creek watershed is largely urban, moderately to highly developed, and drains to Lakes Wheeler and Benson, though many non-urban areas, which are largely protected from future development, surround the two lakes (ARCADIS, 2005). The lower Swift Creek watershed is largely rural, and has the greatest development potential, but is also considerably controlled from rapid and uncontrolled development by recent land use planning efforts, growth caps, and new ordinance development (ARCADIS, 2005). The lower Swift watershed also drains directly to the lower Swift Creek section that contains the Swift Creek DWM population. The potential effects of cumulative development in the Swift Creek watershed on the DWM population would be least from the upper watershed and most pronounced in portions of the Swift Creek watershed located downstream of Lake Benson.

The lower Swift Creek watershed is predicted to transition from low and medium density residential areas to higher density land use categories (NCDOT, 2004a). The Little Creek watershed, a tributary to Swift Creek, is predicted to change from rural and agricultural areas to low density residential land uses. Though a number of growth and watershed protection measures and storm water and buffer ordinances are already in place, the level of nutrient yield to Swift Creek would increase in some areas. In other areas of the lower Swift Creek watershed, the conversion of farmland and agricultural use would result in nutrient yield reductions in the Little Creek watershed.

Despite protective measures such as stream buffers, impervious surface limitations and stormwater runoff controls, additional residential, commercial and industrial development in the lower Swift Creek watershed will likely have negative effects on the water quality and aquatic life found in Swift Creek (NCDOT, 2004b). Increasing buffer widths is a watershed protection tool that has been shown to substantially reduce increased pollutant yields associated with development. Increased buffer widths could contribute significantly to the protection of DWM in terms of water quality protection, but would also have other benefits such as stream shading, thermal regime control, bank stabilization, and other ecological functions important to DWM and DWM habitat.

CONCLUSION

After reviewing the current status of the DWM, the environmental baseline for the action area, the effects of the Project and the cumulative effects, it is the Service's biological opinion that the Project is not likely to jeopardize the continued existence of the dwarf wedgemussel. No critical habitat has been designated for this species; therefore, none will be affected.

The non-jeopardy determination is based on the fact the Project will provide more stable low flows and guarantee that Swift Creek flows will not be reduced to less than 1.0 cfs. In addition, the change in effective DWM habitat will be relatively small. The Project also includes measures to protect water quality from existing waste water discharges and local governments have passed ordinances to control indirect and cumulative impacts. The conservation measures included in the project proposal should also ensure that the species will not be jeopardized.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant to section 4(d) of the Act prohibit the take 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 to 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, including 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 which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the USACE so that they may become binding conditions of any grant or permit issued to the City of Raleigh, as appropriate, for the exemption in section 7(o)(2) to apply. The USACE has a continuing duty to regulate the activity covered by this Incidental Take

Statement. If the USACE (1) fails to assume and implement the terms and conditions or (2) fails to require the City of Raleigh to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the USACE or the City of Raleigh must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR §402.14(I)(3)].

AMOUNT OR EXTENT OF TAKE

Incidental Take is not anticipated to occur during Project construction since the Project includes protective ESC Plans and measures to minimize negative construction related impacts to Swift Creek and its tributaries.

The Service anticipates that incidental take of DWM in association with operation of the Project throughout the action area will be difficult to determine. Adequate data are not available to determine the specific number of DWM that may be taken. Additionally, incidental take will likely be difficult to detect and monitor. The best available data do not give precise population counts and detecting a significant change in the population may take years or decades. A substantial portion of the DWM population may occur below the surface of the substrate at any given time, precluding exact mussel counts. Although spent shells may be collected, attributing the cause of mortality may be difficult. Glochidia and juvenile mussels are extremely difficult to sample, therefore it is difficult to document take of either of these life stages. However, the level of incidental take of the DWM can be defined by the loss of all DWMs that may be harmed, harassed or killed under normal project operations (Tier 1, Tier 2 or Tier 3 water withdrawals) within the Action Area (the 15 miles of Swift Creek downstream from the Lake Benson Dam). It is anticipated that incidental take associated with this Project would be most likely to occur in those situations where Project related withdrawals would reduce flows to a level that would de-water effective habitat that would not otherwise be de-watered and that these situations would be most likely to occur at flows less than 1.0 cfs. Therefore, incidental take will be exceeded only if Project related water withdrawals reduce flows within the Action Area to less than 1.0 cfs.

Incidental take, due to Project operations may be in the form of harm, harassment and mortality. DWMs may be harmed, harassed or killed as a result of the increased concentration of harmful chemicals and other toxic substances. DWMs may also be harmed, harassed or killed due to increased exposure causing the potential for desiccation and/or predation. In addition, during periods of low flows, DWM glochidia may die as a result of being separated from host fish species during the critical time period for encystment in those fish. These forms of take may occur repeatedly, but for short durations, throughout the life of the project.

The amount of take anticipated is based on the specific Project operating procedures described in the BA and this biological opinion. Operation of the Project in a different manner may increase the level of harm to DWM through additional adverse habitat

conditions. Therefore, any such changes in Project operation would require reinitiation of consultation.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service has determined that the level of anticipated take is not likely to result in jeopardy to the DWM. Since critical habitat has not been designated for this species, the proposed Project will not result in 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 further minimize impacts of incidental take of DWM:

1. The USACE/City must provide in stream flows that are protective of the DWM, including tiered minimum flow release schedule with corresponding reductions in water withdrawal rates, and must monitor and report minimum release flows. The USACE/City must place a maximum threshold on the base withdrawal rate of the Project and limit the frequency of maximum withdrawal rate operation.
2. The USACE/City must design and construct intake, outlet, and minimum flow release structures at the Lake Benson Dam to accurately control the release rate of instantaneous minimum flows and ensure that that water released is of suitable water quality for the DWM and meets North Carolina water quality standards.
3. The USACE/City must fund and perform periodic surveys of Swift Creek mussel and DMW populations downstream of Lake Benson Dam to provide information useful for evaluation and management of the Swift Creek DWM population.
4. The USACE/City must fund and establish a flow gauging station on Swift Creek downstream of the Lake Benson Dam, preferably in cooperation with the U.S. Geological Survey. This flow monitoring station must include monitoring for temperature and dissolved oxygen and the data will be used to assess impacts to DWM.
5. The USACE/City must provide for monitoring of water quality, biological indices, and general stream condition in Swift Creek by adding three stations in Swift Creek to the City's Sampling and Monitoring Program (City of Raleigh, 2005).
6. The USACE/City must decommission Indian Creek Overlook and Mill Run Mobile Home Park WWTPs in order to improve the quality of DWM habitat in Swift Creek.
7. The USACE/City must pursue riparian corridor protection for the Steep Hill Creek and Lake Wheeler to Lake Benson corridors for water quality protection within the Swift Creek watershed. The target acreage for these two tracts is approximately 862 acres. These additional buffers on Swift Creek will protect the watershed from additional pollutant runoff and therefore provide some protection of water quality in DWM habitat downstream.
8. The USACE/City must implement a Public Service Announcement (PSA) plan to encourage water conservation, especially during periods of low rainfall. The resulting reduced water usage is designed to reduce the duration of low flow conditions in DWM habitat.

9. The USACE/City must adopt additional measures to conserve water usage within the City's service area.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the USACE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. The terms and conditions associated with the reasonable and prudent measures articulated in this biological opinion will minimize the level of incidental take identified for the DWM.

The following terms and conditions implement reasonable and prudent measure No. 1.

- The USACE/City must place the maximum threshold on the base withdrawal rate of the Project at 14 mgd (22 cfs) with occasional withdrawals up to 20 mgd (31 cfs) in order to facilitate maintenance activities at the City's E. M. Johnson WTP or other emergency operations. The 20-mgd withdrawal rate will be limited to short-term increases in withdrawal rates during periods of higher flows, such that an instantaneous minimum flow release of at least 9 cfs is maintained from Lake Benson Dam for the duration of the increased withdrawal. A 9 cfs instantaneous minimum flow will be maintained at all times when withdrawals exceed 14 mgd.
- The USACE/City must implement a tiered minimum flow release and corresponding water supply withdrawal reductions during periods of low inflow to Lakes Benson and Wheeler. The instantaneous minimum flows and associated withdrawal reductions must be determined according to available reservoir storage, as described in Table 6 below. The tiered minimum flow release would make sure that those areas of persistent DWM habitat that occur now under baseline flow conditions would remain largely wetted and suitable throughout the year.

Table 6. Swift Creek Instantaneous Minimum Release Schedule.

Remaining Available Storage	Minimum Flow Release (cfs)	Reductions in Water Supply Withdrawal*
60% or more	3.0	0%
60% to 30%	2.0	10%
< 30%	1.0	an additional 10% (20% total)

*Water withdrawal reductions based on the average daily withdrawal for the 60 day period immediately prior to the first reduction in the minimum flow release. Reductions must be accomplished within two weeks of the reduction in the minimum flow release.

- The USACE/City must monitor and report on the above-required minimum flow releases, including the 9 cfs required flow and the instantaneous minimum flows made under the tiered minimum flow release schedule. The USACE/City must make releases from the Lake Benson Dam by establishing instrumentation and controls (orifice, weir, or other structure designed for calibrating, adjusting, and

controlling minimum flows) to provide the minimum flows. The release structure will be calibrated and adjusted at a frequency that will provide for accurate operation, at least once per year and preferably prior to a period during which tiered minimum flows are anticipated to begin. The USACE/City must provide the Service with reports documenting the daily minimum flow releases and calibration data, and records of such data will be kept available on site. These reports must be submitted twice per year for the first two years of Project operations and annually thereafter.

- The USACE/City must provide via facsimile prompt notification to the Service's Raleigh Field Office (919-856-4556, or then current facsimile number) whenever Tier 3 (1.0 cfs) minimum flow releases from Lake Benson Dam are initiated. Re-notification of Tier 3 (1.0 cfs) minimum flow releases will not be required more than once in any thirty (30) day period, except in those instances where minimum flow releases are maintained at Tier 3 (1.0 cfs) for more than seven (7) consecutive days or more than seven (7) days within any thirty (30) consecutive day period.
- The USACE/City must include a listing all time periods when the projected operated at Tier 2 or Tier 3 and the duration of each Tier 2 or Tier 3 operation in an Annual Report submitted to the Service's Raleigh Field Office.
- The USACE/City must maintain flows in Swift Creek downstream of Lake Benson Dam during the construction of the Project. As practicable, construction activities would be performed outside of a low flow period, such that a continuous downstream flow would be maintained via flow over the top of Lake Benson Dam. If during construction it becomes necessary to reduce water levels at Lake Benson, such that flow over the crest of the dam ceases, a siphon, portable pump, or other suitable means will be used to maintain a continuous downstream flow to Swift Creek that is consistent with the tiered, instantaneous minimum flow regime. Within 120 days of obtaining all the necessary permits and approvals for Project construction and not less than 45 days prior to the planned initiation of project related withdrawals, the USACE/City must file with the Service's Raleigh Field Office, for review and approval, a Construction Period Flow Plan that addresses instantaneous minimum flow requirements during the construction period.

The following terms and conditions implement reasonable and prudent measure No. 2.

- The USACE/City must design the raw water intake structure from Lake Benson such that adjustments can be made, if necessary, to the depth at which water is withdrawn to make sure that appropriate levels of temperature and dissolved oxygen are maintained in the flows released to downstream. The minimum flow release structure must be operated and/or designed to make sure that North Carolina dissolved oxygen standards (currently 4.0 mg/L instantaneous and at least 5 mg/L) are met at all times.
- On a weekly basis during the period April to November, the USACE/City must monitor and record temperature and dissolved oxygen profile data in Lake Benson adjacent to the intake. Should dissolved oxygen conditions require, the

USACE/City will make adjustments to the intake depth to optimize dissolved oxygen levels.

- The USACE/City must continuously measure dissolved oxygen levels in the water released downstream of the Lake Benson Dam and must notify immediately, via facsimile, the Service's Raleigh Field Office (919-856-4556, or then current facsimile number) whenever the dissolved oxygen levels fall below 5 mg/L. Should monitoring and operational data indicate that further monitoring is unnecessary to meet North Carolina dissolved oxygen standards, the USACE/City may petition the Service to remove this monitoring requirement.

The following terms and conditions implement reasonable and prudent measure No. 3.

- The USACE/City must conduct DWM surveys in Swift Creek, the exact protocols and reporting requirements of which must be developed in coordination with Service, WRC and NHP biologists prior to project construction. All DWM surveys must be supervised by a qualified scientist with previous experience in mussel population assessment techniques and who possesses a degree in fisheries biology, aquatic ecology, or a related field. Additionally, the scientist must also hold the appropriate state and federal permits to conduct such surveys. The qualifications of the proposed DWM survey supervisor will be submitted to the Service's Raleigh Field Office for approval prior to the commencement of any survey.
- Because mussel surveys can only be conducted under certain situations, allowances should be made so that surveys can be conducted during suitable times of the year and under acceptable flow and water clarity conditions. The Service, WRC and NHP biologists must be notified at least one week prior to each survey and will be invited to assist with the surveys. The DWM surveys must be accomplished according to the following schedule:
 - (a) An initial baseline mussel survey must be conducted prior to initiation of Project construction. The level of effort expended for each survey must not exceed 250 person-hours.
 - (b) A follow-up mussel survey must occur within 12 months following initiation of Project operations, and subsequent surveys must be performed at five year intervals thereafter for a total of 20 years. The level of effort expended for each survey must not exceed 250 person-hours.
 - (c) Additional mussel surveys must be promptly performed whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 3 (1.0 cfs) for more than seven (7) consecutive days or more than fourteen (14) days within any thirty (30) consecutive day period. The level of effort for each survey must not exceed 40 person-hours, and no more than one low flow triggered mussel survey would occur in any year. Four (4) such low-flow mussel surveys will be conducted. Following the annual report that includes the fourth low-flow mussel survey results, the City and the Service will determine if further low-flow mussel surveys are warranted.

- The City must submit, to the Service's Raleigh Field Office, a complete report summarizing the results of each mussel survey. The report will be consistent with the protocols developed in consultation with the Service, WRC and NHP biologists, and will describe survey objectives, methods, level of effort, mussels found and identified, catch per unit effort, and other relevant findings or recommendations and should be submitted with the Annual Report for that particular year.
- Any spent DWM shells collected during the surveys must be sent to the NC Museum of Natural Sciences. [Note: the recovery of spent DWM shells does not imply that their mortality is a result of Project operations but rather is a means to correlate potential effects in assessing take.] If freshly-killed DWM are found in the project area, care must be taken in their handling to preserve biological material in the best possible condition (i.e., freezing). In conjunction with the preservation of any dead specimens, the finder has the responsibility to make sure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the Act. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to make sure that the terms and conditions are appropriate and effective. Upon locating a dead, injured, or sick specimen of an endangered or threatened species, prompt notification must be made to the Service's Raleigh Law Enforcement Office (919-856-4786, or then current phone number) or the Supervisor, Raleigh Field Office (919-856-4520, or then current phone number).
- Should monitoring results indicate that DWM or any other federally listed species are not present in Swift Creek, or if DWM population levels are stable or increasing, the USACE/City may petition the USFWS to remove all or part of the mussel survey requirements.

The following terms and conditions implement reasonable and prudent measure No. 4.

- The USACE/City must independently implement a gauging station or cooperatively fund a USGS gauging station to provide continuous monitoring (at least hourly interval) of stream flows in Swift Creek. The final location of the flow gauging station will be determined in consultation with the Service, USGS, WRC, and the DWR, but it is anticipated that the station will be located at either the North Carolina Highway 50 or Highway 42 bridge crossing.
- All flow and water quality data must be made readily available to the Service, WRC and NHP (e.g., via the USGS or other internet web site) on a daily basis.
- The gauging station must be operational before the start of Project operations (i.e., water supply withdrawals). If the gauging station is not installed and operational by the time Project water supply withdrawals begin, then USACE/City must conduct equivalent flow and water quality monitoring until such time as the gauging station is operational.
- Until constructed, the City must provide an annual update on the progress toward the gauging station installation. This update must be submitted to the Service as part of the Annual Report.

The following terms and condition implements reasonable and prudent measure No. 5.

- The USACE/City must provide for monitoring of water quality, biological monitoring, and general stream condition in Swift Creek by adding three stations in Swift Creek to the City's Sampling and Monitoring Program.
- One of the new sampling locations in Swift Creek will be set up immediately downstream of Lake Benson Dam. The other two locations will be selected in consultation with the Service and the DENR, but it is anticipated that the locations would include one station at the North Carolina Highway 42 bridge crossing and one additional site in Johnston County. Monthly water chemistry sampling and annual benthic macroinvertebrate sampling will be performed at each site, consistent with the City's Sampling and Monitoring Program.
- Consistent with the City's Sampling and Monitoring Program, the USACE/City must provide for field observations and photo-documentation of Swift Creek from the Lake Benson Dam to the confluence with Middle Creek once every two years to identify potential problem areas, or "hot spots" (e.g., sources of excessive sedimentation, illicit discharges, stream buffer violations, etc.).
- The USACE/City shall provide a summary of all water quality monitoring in an Annual Report submitted to the Service by February 28 of the following year.

The following terms and conditions implement reasonable and prudent measure No. 6.

- Upon approval of the Highway 50 Pump Station and prior to initiation of Project operations (i.e., water withdrawals), the City must secure all required permits and approvals for the decommissioning of the two private WWTPs (Indian Creek Overlook and Mill Run Mobile Home Park).
- Both WWTPs must be decommissioned and removed from service within 12 months of initiation of Project water withdrawals.

The following terms and conditions implement reasonable and prudent measure No. 7.

- The USACE/City must pursue protection of riparian areas within the Lake Wheeler to Lake Benson corridor. The corridor includes an approximate 300-foot-buffer along 4.1 miles of Swift Creek between Lake Wheeler and Lake Benson. Adjustments to areas of the corridor are allowable based on land availability, willingness of property owners to negotiate, and parcel boundaries. Protection mechanisms may include land acquisition, conservation easements, purchase by other third parties with protective covenants, and other means that provide protection against development and allow uses appropriate for buffers and green space. The USACE/City must make sure that such protection mechanisms are in place for at least 50% of the land contained within the Lake Wheeler to Lake Benson corridor within 12 months of initiation of Project water withdrawals. Beyond this time frame, the City, in conjunction with Wake County, must continue its efforts in good faith and to the best of its ability to pursue riparian protection for the remaining parcels.

- The USACE/City must pursue protection for the Steep Hill Creek corridor. The corridor includes an approximate 300-foot buffer along 7.2 miles of Steep Hill Creek for water quality protection. Adjustments to areas of the corridor are allowable based on land availability, willingness of property owners to negotiate, and parcel boundaries. Protection mechanisms may include land acquisition, conservation easements, purchase by other third parties with protective covenants, and other means that provide protection against development and allow uses appropriate for buffers and green space. Within 24 months of the initiation of Project water withdrawals, the City, in conjunction with the County, must have exercised all reasonable efforts to purchase or seek conservation easements for parcels within the Steep Hill Creek corridor. Beyond this time frame, the USACE/City, in conjunction with Wake County, must continue its efforts in good faith and to the best of its ability to pursue riparian protection for the remaining parcels.
- Lands within these corridors must be incorporated into the City and County Greenways Program as appropriate and allowable by their ownership, protection status, and conservation easement conditions. As such, these lands will be preserved to the extent possible in greenway corridors per the Wake County Consolidated Open Space Plan (Wake County, 2003).
- The USACE/City shall provide an update on the status of these land protection efforts in the Annual Report.

The following terms and conditions implement reasonable and prudent measure No. 8.

- The USACE/City must design water conservation PSAs in the form of television, radio and newspaper advertisements for implementation during periods of low flow in Swift Creek, as described below.
- Whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 2 (2.0 cfs) for more than fourteen (14) consecutive days or more than fourteen (14) days within any thirty (30) day period, the City must broadcast/publish two of the three forms of PSAs mentioned above. Whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 3 (1.0 cfs) for more than fourteen (14) consecutive days or more than fourteen (14) days within any thirty (30) day period, the City must broadcast/publish all three forms of PSAs mentioned above. All radio and television PSAs must be broadcast between the hours of 5:00 AM and 11:00 PM.

The following terms and conditions implement reasonable and prudent measure No. 9.

- The USACE/City must modify existing water conservation measures or adopt additional measures designed to reduce or minimize the need to operate the Project at the Tier 2 and Tier 3 levels.
- The USACE/City must require that any municipality obtaining finished water from the City's water treatment plants (e.g. Rolesville, Garner, Zebulon, etc.) adopt water conservation measures at least as stringent at those used by the City.

Reporting

With regards to the reporting requirements outlined in the Terms and Conditions above, the Service requests that the City consolidate the submittal of reports to the maximum extent possible. To summarize, an Annual Report (based on the calendar year) should be submitted to the USACE and the Service by February 28 of the following year. This report should contain the following information:

- low flow (Tier 2 and Tier 3) occurrences,
- water quality monitoring data,
- baseline and post project implementation DWM survey results,
- update on the completion of a gauging station (if applicable), and
- update on land acquisition in Lake Wheeler to Lake Benson and Steep Hill Creek corridors (if applicable).

The Construction Period Flow Plan should be provided to the USACE and the Service for review and approval prior to project construction. The DWM population monitoring protocols should be developed in consultation with the Service, WRC and NHP with enough time for the USACE/City to conduct a baseline survey prior to the initiation of project construction.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The Service believes that incidental take will not be exceeded if the USACE/City is in compliance with all of the reasonable and prudent measures outlined above. Operation of the project in a different manner than described may increase the level of harm to DWM through additional adverse habitat conditions. Therefore such changes in project operation or variances from the operating measures would require reinitiation of consultation and review of the reasonable and prudent measures provided. The federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

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. 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.

The Service recommends that the USACE/City implement the following conservation recommendations for the benefit of the DWM:

1. The City should aid additional research on the effects of flows and DO levels on DWM and their host fish species in order to more appropriately assess Project related impacts. The RPMs of this biological opinion may be revised based on the results of this research.

2. The City should develop educational programs to address DWM and other freshwater mussels and aquatic species and their conservation for the general public. Outreach materials and activities could include fact sheets and articles to be included in water bills and the City's annual water quality report, television programs for the local community television station and student activities to be presented at local schools or field trips to local natural areas.
3. The City should work cooperatively with the local governments in the upper Tar River Basin in Edgecombe, Franklin, Granville, Halifax, Nash, Person, Vance and Warren counties to aid projects that promote water quality and habitat protection for aquatic species, especially the dwarf wedgemussel.
4. The City should work cooperatively with the Service, WRC, NHP, DWQ, DWR and other agencies as part of a Swift Creek aquatic resources team to evaluate data collected through various project related monitoring efforts and ensure the optimum operation of the reservoir for the protection of the DWM, water quality and aquatic communities within Swift Creek.

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

REINITIATION NOTICE

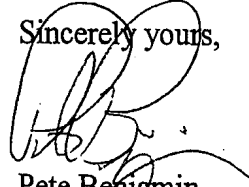
This concludes formal consultation on the actions outlined in the USACE's June 20, 2005 initiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary USACE's involvement or control over the action has been retained (or is authorized by law), and if:

1. the amount or extent of incidental take is exceeded;
2. new information reveals consequences of the USACE's action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;
3. the USACE's 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 designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, formal consultation must be reinitiated immediately.

The Service appreciates the opportunity to work with the USACE in fulfilling our mutual responsibilities under the Endangered Species Act. Please contact Dale Suiter of this office at (919) 856-4520 extension 18 if you have any questions or require additional information.

Sincerely yours,



Pete Benjamin
Ecological Services Supervisor
Raleigh Field Office

cc: USFWS Region 4 Office (Joe Johnston)
USFWS Region 5 Office (Susi vonOettingen)
NC DENR Office of Legislative Affairs (Melba McGee)
NC Natural Heritage Program (Sarah McRae)
NC Wildlife Resources Commission (Shari Bryant)
City of Raleigh (Dale Crisp)
✓ ARCADIS G&M (Mary Sadler)
ENTRIX, Inc. (Erik Dilts)

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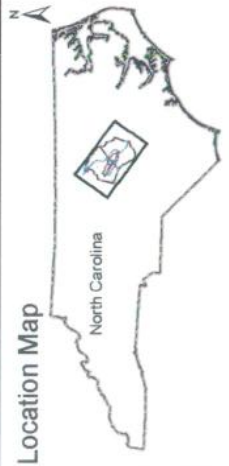
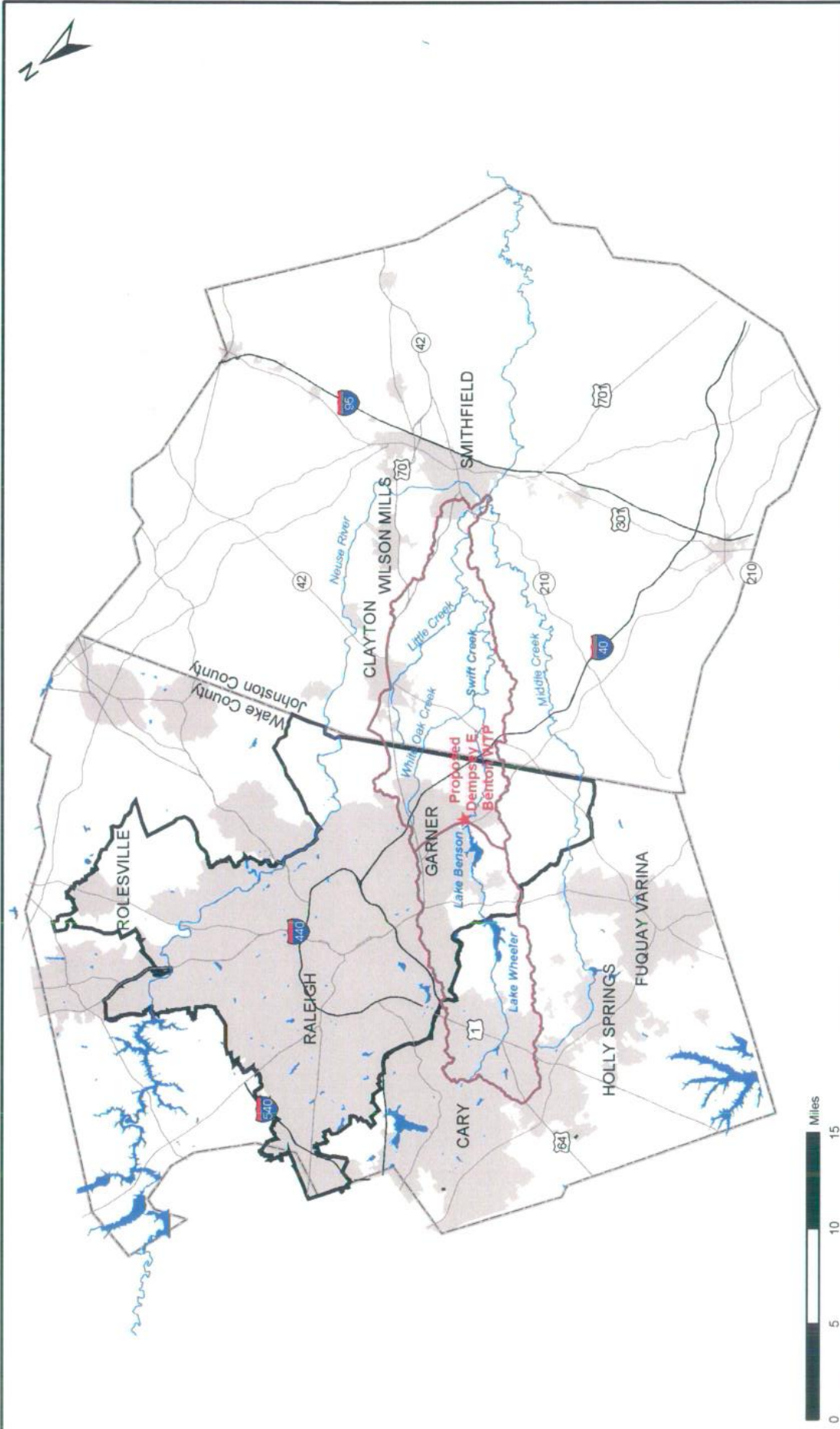
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Legend

- Project Service Area
- Action Area/Watershed Boundary
- Lakes
- Streams
- Major Roads
- Interstates
- City Limits
- County Boundaries

**DEMPSEY E. BENTON
WATER TREATMENT PLANT PROJECT**

PROJECT AREA

City of Raleigh, NC

Figure 1

