June 24, 2003

Colonel Charles R. Alexander
District Engineer, Wilmington District
U. S. Army Corps of Engineers
P. O. Box 1890
Wilmington, NC 28402-1890

Attention: Mr. Hugh Heine, Environmental Resources Section

Dear Colonel Alexander:

In accordance with our Scope of Work for FY 2003, the U. S. Fish and Wildlife Service is pleased to provide this Planning Aid Letter (PAL) for the Neuse River Basin Study (NRBS). This study is being pursued in the General Investigation Program of the U. S. Army Corps of Engineers (Corps) and is being conducted in response to a resolution adopted by the U.S. House of Representative on July 23, 1997. This resolution requested that the Secretary of the Army review the report of the Chief of Engineers (House Document 175, 89th Congress) and other pertinent reports to determine whether modifications were advisable to the report recommendations regarding flood control, environmental protection, restoration, and related purposes. The purpose of the feasibility study is to identify a number of watershed projects that can be initiated under the Continuing Authority Program (CAP), primarily Section 206 of the Water Resources Development Act of 1996, as amended. This letter contains early scoping comments and does not constitute the report of the Department of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d).

Study Area

The Neuse River Basin (NRB) is the third largest basin in North Carolina and is one of only three basins located entirely within the state. The NRB covers 6,192 square miles. The basin contains 3,443 miles of stream and river channels (Powell 1999). The river originates in the Piedmont northwest of Durham in Person and Orange Counties. The major tributaries include the Eno, Flat, Little, and Trent Rivers and well as Crabtree, Swift, and Contentnea Creeks. The NRB can be divided into 14 subbasins (North Carolina Department of Environment and Natural Resources [hereafter NCDENR] 2001, p. 15) which vary in size. These subbasins which are designated from 01 to 14 form a convenient framework, e.g., Subbasin 01, to discuss the different areas of the Neuse River watershed and will be referenced in this report. There are 17 counties which comprise most of the NRB (NCDENR 2001, Figure 2). While the basin may contain smaller sections of other counties, these 17 counties, listed in Appendix 1, form the basis for this study.

The upper 22 miles of the river's mainstem is impounded behind the Falls of the Neuse Reservoir Dam that creates a large multi-use reservoir northeast of Raleigh. Below the dam the river flows about 185 miles southeasterly past the cities of Raleigh (Wake County), Smithfield (Johnston County), Goldsboro (Wayne County), and Kinston (Lenoir County) until it reaches the tidal waters near the Town of Street's Ferry (Craven County), upstream from New Bern (Craven County). Below Street's Ferry the river broadens dramatically and changes into a tidal estuary that eventually flows into Pamlico Sound.

Much of the land area in the basin is used for agriculture or commercial forestry. Urban development in the upper basin is concentrated around Raleigh, Durham (Durham County), and Cary (Wake County) and around Goldsboro, Kinston, and New Bern in the lower basin.

Significant Fish and Wildlife Resources in the Study Area

The Neuse River originates in the Piedmont region and flows through both the upper and lower coastal plains. Kellison et al. (1998) give a broad overview of the wildlife associated with major alluvial floodplains in the South. They note that these floodplains provide some of the most important fish and wildlife habitats in the region. The high fertility supports high forest productivity which in turn produces more high-quality food and browse than is found on poorer sites. The extensiveness and denseness of unbroken floodplain forests are as important as the habitat itself. A comprehensive report on the fishes of the NRB was prepared in the early 1960s (Bayless and Smith 1962).

On the coastal plain, broad, flat areas adjacent to the Neuse River represent major alluvial floodplains that, unless altered by man, are invariably forested (Kellison et al. 1998), and are referred to as bottomland hardwoods (BLH) (Kellison et al. 1998, p. 300). While many of these floodplain areas in the NRB have been developed, it is likely that these areas once contained, and could be restored to, BLH. Excellent reviews of the physical and biological characteristics of BLH are available (Wharton et al. 1982, Harris et al. 1984, Sharitz and Mitsch 1993, Kellison et al. 1998). Boaters on the Neuse River report (Powell 1999) an "amazing amount of wildlife" such as wood ducks (*Aix sponsa*) and other waterfowl, blue heron (*Ardea herodias*), belted kingfisher (*Megaceryle alcyon*), deer (*Odocoileus virginianus*), wild turkeys (*Meleagris gallopavo*), muskrats (*Ondatra zibethicus*), and beaver (*Castor canadensis*). Red shouldered hawks (*Buteo lineatus*) nest in the bottomland forests along the Neuse.

Forested alluvial floodplains are important to many birds as breeding, wintering, and migrating stop-over habitat (Kellison et al. 1998, p. 314). These forests provide food and cover for wildlife throughout the year. Seasonal flooding produces shallow, warm water areas where many kinds of water life spawn and feed (Harris et al. 1984, p. 7). Flooded BLHs are nurseries for many fish species. The web page of the North Carolina Division of Parks and Recreation (http://ils.unc.edu/parkproject/visit/clne) notes that the Cliffs of the Neuse State Park (Wayne County) has 420 plant species, an abundant and diverse animal life, and wetland and aquatic habitats for reptiles and amphibians.

Four areas having significant biological diversity (NCDENR 2001, pp. 24-25) are:

1 Headwater rivers in Subbasin 01 which include the upper Flat River, Little River, and the Eno River;

2. Middle portion of the Little River in Johnston County (Subbasin 06);

3. Middle portion of the Neuse River which contains many species not found in tributaries; and,

4. Better tributaries of the Trent River in Subbasin 11, especially Island Creek.

Rare and Protected Species in the Study Area

The NRB also provides habitat for many threatened or endangered species, listed under Federal and/or State legislation. While many terrestrial plants and animals would benefit from higher quality riparian areas and improved water quality, the most direct beneficiaries would be aquatic species, especially fish and mussels within the basin. The NCDWQ reports that several rare or unusual invertebrate species were collected during recent surveys (NCDENR 2001, pp. 25-26), including mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), beetles (Coleoptera), dragonflies/damselflies (Odonata), midges Chironomidae), and snails (Gastropods). Two species of rare crayfish (Cambaridae) were found in the NRB (NCDENR 2001, p. 26).

The eight mussels (Pelecypoda) listed as either Federally endangered or a Federal Species of Concern (FSC) in the 17 counties that comprise most of the Neuse River Basin are given in Appendix 2. Both the dwarf wedge mussel (*Alasmidonta heterodon*) and the Tar spinymussel (*Elliptio steinstansana*) are listed as endangered reflecting an assessment that the species is in danger of extinction throughout all or a significant portion of its range. The greatest mussel diversity within the NRB occurs in the Flat River in the northern part of the basin and the Little Rivers in Johnston County (NCDENR 2001, p. 26). The dwarf wedge mussel occurs mainly near the fall line with the best populations occurring in the Johnston County portion of the Little River. The Atlantic pigtoe (*Fusconaia masoni*), a FSC, occurs in the Little River of Johnston County and the Flat River in Person and Durham Counties. The yellow lance (*Elliptio lanceolata*), a FSC, also occurs mainly near in fall line in the watershed of Middle, Swift, and Mill Creeks. The yellow lampmussel (*Lampsilis cariosa*), a FSC, is found in the Flat, Little, Eno, and Little Rivers.

The Neuse River waterdog (*Necturus lewisi*), an amphibian with a state status of “Special Concern” occurs in the NRB. The species inhabits rivers and large streams within the Neuse and Tar River drainages. On a global scale this species is considered very rare or local throughout its range, or found locally in a restricted area.

North Carolina is home to nearly 200 native species of freshwater fish. Of these, approximately 21% are designated endangered, threatened, or special concern within the state (LeGrand et al. 2001). Based on data of the NCDENR and Menhinick (1991), 97 species of fish are known from the NRB. Six species of fish are listed as either Federally endangered or a FSC in the 17 counties that comprise most of the Neuse River Basin (Appendix 3). The shortnose sturgeon (*Acipenser brevirostrum*), the single Federally endangered fish within the basin, is a bottom dwelling, anadromous fish that moves from the ocean and estuaries into freshwater between February and May and spawns from April through June. Threats to the species include overfishing and degradation of its habitat by erosion, siltation, toxic pollution, and dams that interfere with upstream migration to spawning areas. The species is under the jurisdiction of the National Marine Fisheries Service.

The five State fish species of special concern within the NRB are the least brook lamprey (*Lampetra aepyptera*), Atlantic sturgeon (*Acipenser oxyrhynchus*), bridle shiner (*Notropis bifrenatus*), the Neuse River population of the Carolina madtom (*Notropis furiosus*), and the eastern Piedmont population of the Carolina darter (*Etheostoma collis lepidinion*) (NCDENR 2001, pp. 29). The least brook lamprey, a nonparasitic fish occurs in warm, mostly slow, sandy, slightly acidic, and small creeks. The species is listed as State threatened and has a State rank of S2 indicating that it is imperiled in North Carolina because of rarity or because of some factor(s) making it vulnerable to extirpation. Within the basin it is currently found in Wake and Franklin Counties. The Atlantic sturgeon is considered rare in the State. The NCDENR conducted fish community assessment in several watersheds of the NRB in 2000 (NCDENR 2001, pp. 26-29). One Carolina darter was collected in Smith Creek (Granville County) and three bridle shiners, also a FSC, were collected from Batchelor Creek (Craven County).

Fish and Wildlife Problems in the Neuse River Basin

Congressional asked the Corps to address three broad problems, or needs, within the basin, i.e., flooding, environmental protection, and restoration. In many ways these problems are interrelated and actions taken for one goal would benefit other goals. In the planning stage, the NRBS the Corps should consider the following problems facing fish and wildlife resources.

Flooding Can Be Harmful to Fish and Wildlife Resources - Many areas within the NRB are prone to flooding. Flood damage is often related to clearing floodplains for agricultural production or constructing home, businesses, and infrastructure. This process not only increases the risk to human life and property, but eliminates valuable fish and wildlife habitat. Protecting existing riparian areas within floodplains and restoring such areas where inappropriate development has occurred are recognized ways to reduce flood damage. Within the NRB the Service recognizes three concerns associated with fish and wildlife resources:

1. The loss of natural riparian vegetative communities along with the fragmentation and degradation of other areas;

2. The decline in water quality, e.g., low dissolved oxygen and increased sedimentation, due to point and non-point source runoff into waterways of all sizes, including ephemeral streams; and,

3. The loss of hydrologic connective for aquatic organisms along the waterways due to dams

The Loss and Fragmentation of Natural Riparian Areas - A landscape in which isolated patches of natural areas are separated by developed areas is detrimental to plant and animal communities. Animals of limited mobility and plants of limited dispersal ability may become reproductively isolated from other members of their species. The theory of island biogeography has provided a basis for the idea that plants and animals in subdivided units of a larger area are more susceptible to inbreeding and accidental extinction from infrequent, natural catastrophes. One major, long-term impact of habitat fragmentation is the inability of healthy individuals in one area to migrate and repopulate a nearby area of suitable habitat in which members of the species have been eliminated due to short-term, adverse conditions. By increasing inbreeding and restricting recolonization of nearby suitable habitat, fragmentation can lead to the gradual extirpation of a species from a large area in which the total acreage of all habitat blocks has declined by only a small amount.

Approximately one-third of North American freshwater fish species (Williams et al. 1989) qualify for classification as “endangered,” “threatened,” or “special concern” at the Federal level, and habitat loss is a primary cause. In North Carolina, 21% of freshwater fishes are designated as endangered, threatened, or of special concern at the state level (LeGrand et al. 2001).

Federally endangered and threatened species are particularly affected by secondary and cumulative impacts associated with urban development due to their sensitivity to habitat alterations. A high proportion of listed species occurs within rapidly developing areas of the state. Some have lost major reaches of their habitats within the past few decades and others are in danger of being extirpated from entire river basins.

Many native species of aquatic organisms have become highly imperiled as a result of land-based and near-water development. Approximately 72% of North American freshwater mussel species qualify for classification as “endangered,” “threatened,” or “special concern” at the Federal level (Williams et al. 1993), and habitat loss is a primary culprit. North Carolina is home to more than 60 species of freshwater mussels. Unfortunately, 50% of these species are designated as endangered, threatened, or special concern within the State. As an example, the Carolina Elktoe (*Alasmidonta robusta*), a mussel known only from a tributary of the Catawba River in Mecklenburg County has apparently been extirpated from the state, and is probably extinct.

A recent report (NCDENR 2002) summarizes the functions of forested riparian zones. Natural forested areas within the NRB help to:

1. Reduce pollutants and filter runoff;
2. Improve air quality and lower ozone levels;
3. Maintain stable water flows;
4. Sustain natural channel morphology;
5. Maintain water and air temperature by providing shade;
6. Stabilize stream banks;
7. Provide most of the organic carbon and nutrients to support the aquatic food web;
8. Provide sources of large woody debris for the stream channel;
9. Reduce the severity of floods;
10. Facilitate the exchange of groundwater and surface water; and,
11. Provide critical wildlife habitat

Decline in Water Quality - The decline in freshwater species is a direct reflection of declining quality in the streams and rivers of North Carolina (NCDENR 2002). Development along the Neuse has damaged or eliminated the natural riparian buffers which naturally filter runoff from uplands. Nonpoint runoff from both urban (stormwater and suspended sediments) and rural, agricultural areas is the main contributor to water quality degradation (NCDENR 2001, p. 17). Swift Creek has elevated turbidity from development in south Raleigh and rapidly urbanizing Johnston County. The Neuse River mainstem shows a spike in nitrate-nitrite-nitrogen below Raleigh which declines with distance downstream (NCDENR 2001, p. 17). Contentnea Creek has experienced high nutrient concentrations and these high levels caused elevated nutrients at Neuse River sites downstream. Contentnea and Little Contentnea Creeks may have low summer dissolved oxygen (DO) concentrations (NCDENR 2001, p. 19). The NCDENR (2001, p. 24) lists 13 sites within six subbasins of the Neuse with declining water quality based on sampling of benthic macroinvertebrates.

The NCDENR (2001, p. 21) notes that studies in the Neuse River Estuary (Subbasin 10) indicate that the fauna of the lower Neuse River is controlled by periods of very low DO, or hypoxia, during the summer months. Algal blooms in which nutrient rich water produces a large amount of algae are a major cause of low DO. When the algae die, the bacterial decomposition requires DO. The number of algal blooms has increased over time in Subbasin 10, often accompanied by extreme swings in DO. Summer algal blooms (especially dinoflagellates) have been a common and chronic problem in Subbasin 10 for many years with the most severe blooms occurring during the 1990-1995 period.

Nonpoint runoff contributes to water quality degradation in the Falls of the Neuse Reservoir Watershed (Subbasin 01) (NCDENR, 2001, p. 17). Point source dischargers also contribute to severe water quality problems near Durham, especially in Ellerbe and Knap of Reeds Creeks. In Subbasin 02, Falls Lake to southern Johnston County, nonpoint runoff contributes to water quality degradation (NCDENR, 2001, p. 17).

Loss of Hydrologic Connective along the Waterways Due to Dams - A major concern along North Carolina rivers is the blockage of movement of aquatic organisms by dams. Dams may block some fish, especially anadromous fish, from portions of their historic habitat. Restoration of access to historic habitats and removing dams as barrier to upstream-downstream moving of aquatic organisms would have significant benefits to fish and wildlife resources.

A closely related concern is the effort to control flood damage using structural measures, e.g., dikes and levees, to separate water within major channels from their historic floodplains. Seasonal flooding produces shallow, warm water areas where many kinds of water life spawn and feed (Harris et al. 1984, p. 7). Flooded BLHs are nurseries for many fish species. The nonstructural approach, such as elevating or relocating houses and businesses, retains this link. Harris et al. (1984, p. 14) note that when a BLH forest is drained, channelized, dike, and cleared, it can no longer perform the same functions in the landscape. Important functions of an interconnected river-floodplain ecosystem include water control and purification, groundwater recharges, soil enrichment, erosion control, and support for downstream fishing industries (Harris et al. 1984, p. 14).

Resource Opportunities and Service Recommendations for Planning Objectives

The present study presents an opportunity to address the major problems cited in the Congressional Resolution. Tibbetts (1999) present a broad overview of efforts to reduce flood damage in North Carolina. He notes that communities could diminish their risk of flood damage by purchasing wetlands and open spaces along waterways to protect these areas from development. Local governments could also improve stormwater drainage systems, enact special building standards in flood-prone areas, and direct public facilities and infrastructure away from floodplains. The best tool for reducing flood damage is the development of comprehensive plans and ordinances to limit new development in flood-prone areas. Such efforts can lead directly to fulfilling the two other objects of the present study, environmental protection and restoration. Limiting development within floodplains protects natural fish and wildlife habitats. Land previously impacted could be purchased and restored to natural riparian areas. Efforts to protect and restore riparian habitats would also enhance water quality. The Service believes this effort should be addressed in six major areas which are considered below. Much of the following discussion is based on a guidance memorandum produced in 2002 to address and mitigate secondary and cumulative impacts to aquatic and terrestrial wildlife resources and water quality (NCDENR 2002).

1. Riparian Buffers - The NRBS should seek to determine where natural, riparian vegetative communities have been lost and reestablish these communities. Wide, contiguous riparian buffers have greater and more flexible potential than other options to maintain biological integrity (Horner et al. 1999) and could ameliorate many ecological issues related to land use and environmental quality (Naiman et al. 1993). As expansion of developed areas continues into the watershed, wildlife habitats can change, become fragmented, and even disappear. Riparian buffers provide travel corridors and habitat areas for wildlife displaced by development.

Native forested buffers should be established and maintained along each side of perennial and intermittent streams at a minimum of 100 feet and 50 feet, respectively. Furthermore, buffers should also be established on ephemeral streams due to the important functions that they provide as headwater streams (Alexander et al. 2000; Peterson et al. 2001). Buffers should be measured horizontally from the edge of the stream bank (Knutson and Naef 1997), which may result in wider buffers on higher gradients, and must be provided over the entire stream length, including headwater streams. If development occurs within these designated buffers, a minimum of 30% of such development area should be left as greenspace which would include buffers and wetlands. These greenspaces should have connections to natural resources in the area.

In distinguishing between perennial, intermittent, and ephemeral streams, delineations should be conducted according to U. S. Army Corps of Engineers or North Carolina Division of Water Quality methodologies. This information can be found at http://h2o.enr.state.nc.us/ncwetlans/strmfrm.html (accessed May 2002). U. S. Geological Survey (USGS) maps underestimate the extent of streams. Recent research has shown that USGS maps can underestimate total stream lengths in the Piedmont of North Carolina by 25% (Gregory et al. in press). The Corps could assist local government in upgrading the classification of streams within their jurisdiction.

2. Utility Infrastructure - Sewer lines, water lines, and other utility infrastructure should be kept out of riparian buffer areas (Knutson and Naef 1997; and references therein). All utility crossings should be kept to a minimum, which includes careful routing design and the combination of utility crossings into the same right-of-way (provided there is not a safety issue). Discontinuous buffer segments can impair riparian functions disproportionate to the relative occurrence of the breaks in the buffer (May and Homer 2000; Van Sickle 2000), and multiple crossings can result in cumulative impacts. The directional bore (installation of utilities beneath the riverbed and thus avoiding impacts to the stream and buffer) stream crossing method should be used for utility crossings wherever practicable, and the open cut stream crossing method should only be used when the water level is low and stream flow is minimal. Manholes or similar access structures should not be allowed within buffer areas. Stream crossings should be near perpendicular (75^{o} to 105^{o}) to stream flow and should be monitored at least every three months for maintenance needs during the first 24 months of the project and then annually thereafter. Sewer lines associated with crossing areas should be maintained and operated at all times to prevent the discharge to land or surface waters. There should be a minimum setback of 50-100 feet on all streams, lakes, and wetlands for these structures. In circumstances where minimum setbacks cannot be attained, sewer lines should be constructed of ductile iron or other substance of equal durability. Pesticides (including insecticides and herbicides) should not be used for maintenance of rights-of-way within 100 feet of perennial streams and 50 feet of intermittent streams, or within floodplains and wetlands associated with these streams.

Force mains should be used to the greatest extent practicable. Gravity sewer lines should be installed to follow along the outside of the 100-year floodplain contour unless topographic features, existing development, or other conditions restrict this technique. Public and private sewer lines adjacent to streams should parallel streams and be sited as far as practicable from stream and tributary corridors (Knutson and Naef 1997; and references therein). To maintain the integrity of riparian buffers or the full extent of the 100-year floodplain, sewer lines should be sited with a minimum 200-foot buffer around perennial streams and a 100-foot buffer for intermittent streams. No new sewer lines or structures should be installed or constructed in the 100-year floodplain or within 50 feet of wetlands associated with a 100-year floodplain (Knutson and Naef 1997; and references therein).

Septic tanks, lift stations, wastewater treatment plants, sand filters, and other pretreatment systems should not be located in areas subject to frequent flooding (areas inundated at a 10-year or less frequency) unless designed and installed to be watertight and to remain operable during a 10-year storm. Mechanical or electrical components of treatment systems should be above the 100-year flood level or otherwise protected against a 100-year flood (As per rule 15A NCAC 18A .1950 - Location of Sanitary Sewage Systems).

Only aerial crossings elevated sufficiently to reduce the risk of flood damage or directional boring stream crossings should be allowed. The placement of these crossings should be limited to major stream or creek confluences. All water lines and utilities should follow roads or meet the requirements associated with sewer line placements (Killebrew 1993; Knutson and Naef 1997; and references therein).

Where practicable, all permanent roadway crossings of streams and associated wetlands should require bridges to eliminate the need for fill and culverts. If culverts must be used, the culvert should be designed to allow passage of aquatic organisms. Generally, this means that the culvert or pipe invert is buried at least one foot below the natural streambed. If multiple cells are required, the second and/or third cells should be placed so that their bottoms are at stream bankfull stage. This will allow sufficient water depth in the culvert or pipe during normal flows to accommodate movements of aquatic organisms. If culverts are long and sufficient slope exists, baffle systems should be used to trap gravel and provide resting areas for fish and other aquatic organisms. If multiple pipes or cells are used, at least one pipe or box should be designed to remain dry during normal flows to allow for wildlife passage. In addition, culverts or pipes should be situated so that no channel realignment or widening is required. Widening the stream channel at the inlet or outlet of structures usually causes a decrease in water velocity causing sediment deposition that will require future maintenance. Riprap should not be placed on the streambed.

3. Floodplain Development - Local governments should prohibit commercial or residential development within the 100-year floodplain. Undeveloped floodplains strongly influence aquatic systems, support a combination of riparian and upland vegetation used by aquatic and terrestrial wildlife, supply a rich source of food to aquatic communities (Junk et al. 1989), and provide an important sediment trapping function (Palik et al. 2000). The filling of floodplains increases the potential for flooding of adjacent properties and interferes with the natural hydrologic process of the waterways. It also disrupts the continuity of migration corridors for wildlife. As noted, developers should set aside a portion of the land to be developed as greenspace and concentrate these areas along the streams and rivers. Site practices for infill and brownfield development have been issued by the U. S. Environmental Protection Agency (EPA) (http://www.epa.gov; accessed May 2002) and the Center for Watershed Protection (http://www.cwp.org/; accessed May 2002). Floodplain maps may need to be updated to reflect development in the watershed. Floodplain remapping studies in Charlotte showed that buildout conditions would result in a floodplain width change from an average of 429 feet to 611 feet (http://www.co.mecklenburg.nc.us/coeng/storm/floodinfo/floodmaps.htm; accessed May 2002).

The removal of large trees at the edges of construction corridors should be avoided. Efforts should be made to maintain a closed canopy over streams to reduce water temperatures. Disturbed areas should be re-seeded with seed mixtures that are beneficial to wildlife. Native, annual small grains appropriate for the season are preferred and recommended (See http://www.esb.enr.state.nc. us/wetplant/wetland_plants.htm, and http://www.co.mecklenburg.nc.us/coeng/Storm/services/vegetation/vegetation.htm). Where feasible, woody debris and logs from corridor clearing should be used to establish brush piles and downed logs adjacent to the cleared right-of-way to improve habitat for wildlife. Corridor areas should be allowed to revegetate into a brush/scrub habitat that would maximize benefits to wildlife. For land adjacent to residential areas, a native shrub/grass option is also beneficial.

Maintenance should focus on trimming trees, instead of tree removal in areas within 200 feet of streams, floodplains, and associated wetlands (Knutson and Naef 1997; and references therein). To minimize impacts to nesting wildlife, corridor maintenance should be minimal, and mowing should be prohibited between April 1 and October 1. A maintenance schedule should be established that incorporates only a portion of the area - one third of the area, for example - each year instead of the entire project every three or four years. Insecticides and herbicides should not be used within 200 feet of streams, floodplains, and associated wetlands (Knutson and Naef 1997; and references therein) except when needed to protect native flora and fauna from exotics and when using appropriately labeled products, such as biopesticides (http://www.epa.gov/pesticides/biopesticides/; accessed May 2002).

4. Restrict Impervious Surfaces - Multiple studies have shown that stream degradation occurs at approximately 10% coverage by impervious surfaces (Schueler 1994; Arnold and Gibbons 1996; Doll et al. 2000; Mallin et al. 2000; May and Homer 2000; Stewart et al. 2000; Paul and Meyer 2001). The Wake County Watershed Management Plan Task Force performed a correlation analysis of impervious surfaces to watershed classification based on water quality data, and they found that watersheds of unimpaired streams averaged 8% imperviousness, impacted streams averaged 11%, and degraded streams averaged 24% (http://projects.ch2m.comlWakeCounty/; accessed May 2002). Water quality would be improved by limiting impervious surfaces to less than 10% of the watershed (Schueler 1994; Arnold and Gibbons 1996; Doll et al. 2000; Mallin et al. 2000; May and Homer 2000; Stewart et al. 2000; Paul and Meyer 2001). The construction of roadways and other impervious surfaces in new neighborhoods can produce short-term direct impacts as well as long-term cumulative effects.

Local government should provide sufficient open space to effectively reduce impervious surfaces so that pre-development hydrographic conditions are maintained. To achieve no net change in the hydrology of the watershed, building codes can specify the installation of grassed swales in place of curb and gutter and on-site stormwater management (i.e., bio-retention areas or other attenuation measures) to prevent direct discharges of stormwater into streams. These designs often cost less to install (Kwon 2000) and significantly reduce environmental impacts from residential development. Information regarding financing stormwater management can be found at < http://www.stormwaterfinance.urbancenter.iupui.edu/ >(accessed May 2002).

Many of these recommendations have been applied in Maryland to protect the Chesapeake Bay from water quality degradation (Maryland Department of the Environment 2000). Suggested examples to accomplish the <10% impervious goal are using conventional designs at a level of <10% imperviousness or using conservation clusters with higher densities, with dedicated open space and other stormwater control measures to mimic the hydrograph consistent with an impervious coverage of less than 10%. Reduction of road widths is one method to reduce overall impervious surface coverage. The N. C. Department of Transportation (NCDOT) has issued road guidelines that allow for the reduction in street widths when compared to standard secondary road guidelines. This material can be found at http://www.doh.dot.state.nc.us/operations/tnd.pdf (accessed May 2002). In addition, there are site planning practices that, when incorporated with the above mentioned road building guidelines, can further reduce the amount of impervious surfaces within a site. Some of these measures are contained in the document Better Site Design (Center for Watershed Protection; http://www.cwp.org/; accessed May 2002).

5. Erosion and Sedimentation Control - The NRBS should determine where water quality standards have been degraded. Based on this information, efforts should be undertaken to prevent any further decline and then work to improve the ability of these waters to support the biological productivity of a more natural assemblage of aquatic organisms. The Corps should assist municipalities in incorporating the elements listed below into their erosion and sediment control plans. Sediment is considered the most important cause of water pollution in the United States (Waters 1995) and construction is considered the most damaging phase of the development cycle to aquatic resources (Brown and Caraco 2000).

a. Minimize clearing and grading and only perform these operations in the context of an overall stream protection strategy;

b. Protect waterways by preventing clearing adjacent to waterways and stabilize drainage ways;

c. Phase construction for larger construction sites (~25 acres) to reduce the time and area that disturbed soils are exposed;

d. Stabilize soils as rapidly as possible (<2 weeks) by establishing a grass or mulch cover;

e. Protect steep slopes and avoid clearing or grading existing steep slopes as much as possible;

f. Establish appropriate perimeter controls at the edge of construction sites to retain or filter concentrated runoff from relatively short distances before it leaves the site;

g. Employ advanced settling devices that contain design features which include greater wet or dry storage volume, perforated risers, better internal geometry, use of baffles, skimmers and other outlet devices, gentler side-slopes, and multiple cell construction;

h. Implement a program to certified contractors so that trained and experienced personnel are on-site; and,

i. Sedimentation impacts should be minimized by regular inspection of erosion control measures and sediment control devices should be maintained in effective condition at all times. Erosion and sediment controls should be reassessed after storms. The incorrect installation of erosion control structures and those not properly maintained can result in sedimentation impacts to nearby streams and wetlands.

6. Improve Waterborne Movement Along Waterways - The present study could also improve habitat connectivity for aquatic organisms by removing barriers to waterborne movement, e.g., removing dams. Removal of the Quaker Neck Dam in 1998 provided anadromous fishes such as the striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*) with 127 river kilometers (79 miles) of additional spawning habitat between Goldsboro and Raleigh. Since that time, information from electro-fishing, radio-telemetry, and egg/larval sampling has shown that both species are taking advantage of the restored habitat. The extent to which migratory fishes use the upstream habitat depends on spring flows, which are affected by rainfall and operation of the Falls of the Neuse Dam. With relatively high spring flows in 2003, substantial numbers of American shad and striped bass migrated to the base of Milburnie Dam. Electro-fishing catch rates were higher in the section of the river below Milburnie Dam than in any of the sections further downstream. Radio-telemetry studies and observations of spawning activity have shown that American shad primarily spawn at relatively shallow sites, often containing larger substrates such as gravel, cobble, and bedrock. This type of habitat (relatively high-gradient, with rocky riffle sections) is found almost exclusively upstream of Smithfield but is not very common in reaches now accessible to anadromous fishes. Additional habitat of this type would be found upstream of Milburnie Dam. Resident migratory fish are also likely to benefit by removal of Milburnie Dam as several species aggregate below the dam during the spring spawning season. The Service requests that the Corps use their Neuse River Model to evaluate what effect the removal of Milburnie Dam would have on (1) flooding, (2)wetlands, and (3) the Corp's ability to manage Falls Lake.

Scope and Level of Future FWCA Coordination

The natural connection between North Carolina rivers and their historic floodplains serves not only to enhance fish and wildlife resources, but also serves to improve water quality and mitigate flooding, the Service recommends that Corps planning for the Neuse River Basin focus on a limited number of objective measures. This PAL does not suggest that the Corps implement these conservation measures on its own. Recommended measures will certainly require a coordinated effort between state and local governments as well as private organizations and individuals. With limited resources available within the Corps' CAP, the best approach may be to provide technical and financial assistance to city and county governments. Such assistance may be in the form of model laws, ordinances, or zoning procedures. We urge the Corps to develop partnerships with local governments and non-governmental organizations to both plan and implement the conservation measures discussed above. Actions the Corps could undertake include:

1. Assisting local governments to conduct workshops for developers and landowners on conserving riparian buffers and improving water quality;

2. Assisting local governments in developing model ordinances and zoning plans which address the conservation measures discussed;

3. Assisting local governments in updating floodplain maps and developing plans for the phased relocation of threatened homes and businesses out of the 100-year floodplain and restoring these areas as natural riparian buffers;

4. Working with the U. S. Natural Resources Conservation Service and the North Carolina Cooperative Extension Service on efforts underway to control nitrogen runoff from agricultural field by establishing wetland systems within drainage canals, a form of controlled drainage;

5. Providing financial assistance to local governments, perhaps in the form of a small grant program, to design and implement utility infrastructure;

6. Providing a portion of the funds needed to purchase and manage conservation easements in the most important areas of the NRB;

7. Working with the NCDOT and/or The Center for Transportation and the Environment (http://www.itre.ncsu.edu/cte/) to enhance their ongoing efforts to avoid and minimize the adverse environmental impacts of road and utility construction near sensitive waterways within the NRB; and

8. Providing technical and financial assistance for the removal of dams, specifically the use of the Neuse River Model to determine the feasibility of removing Milburnie Dam

If this work proceeds to the feasibility stage, the Service is prepared to provide a more comprehensive FWCA report. This report would focus on discussions of the fish and wildlife resources likely to occur in the project area and their habitat requirements. Measures to maintain and improve these habitats would be considered along with additional information the Corps might provide on the scope and funding available.

The Service appreciates the opportunity to provide these comments early in your planning effort. Please advise us of any action taken by the Wilmington Corps District. If you have questions regarding this PAL, please contact Howard Hall at 919-856-4520, ext. 27 or by e-mail at < howard_hall@fws.gov >.

Sincerely,

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Appendix 1. Counties that comprise most of the Neuse River Basin, listed approximately from upstream (northwest) to downstream (southeast). Source: Figure 2, North Carolina Department of Environment and Natural Resources. 2001. Basinwide Assessment Report - Neuse River Basin.

Person

Orange

Granville

Durham

Franklin

Wake

Nash

Johnston

Wilson

Wayne

Greene

Lenoir

Pitt

Craven

Jones

Pamlico

Carteret

Appendix 2. Federally listed mussels in the 17 counties that comprise most of the Neuse River Basin (Figure 2, North Carolina Department of Environment and Natural Resources. 2001. Basinwide Assessment Report - Neuse River Basin). Endangered refers to a taxon "in danger of extinction throughout all or a significant portion of its range." A Federal species of concern (FSC) is a taxon that may or may not be listed in the future (formerly C2 candidate species or species under consideration for listing for which there is insufficient information to support listing). Additional information on the species that occur in each county and details of habitat requirements for endangered species may be obtained on the Raleigh Field Office web page < http://www.nc-es.fws.gov/es/cntylist/>.

Species	Status
Atlantic pigtoe (*Fusconaia masoni*)	FSC
Brook floater (*Alasmidonta heterodon*)	FSC
Dwarf wedge mussel (*Alasmidonta heterodon*)	Endangered
Green floater (*Lasmigona subviridus*)	FSC
Savanna lilliput (*Toxolasma pullus*)	FSC
Tar spinymussel (*Elliptio steinstansana*)	Endangered
Yellow lampmussel (*Lampsilis cariosa*)	FSC
Yellow lance (*Elliptio lanceolata*)	FSC

Appendix 3. Federally listed fish in the 17 counties that comprise most of the Neuse River Basin (Figure 2, North Carolina Department of Environment and Natural Resources. 2001. Basinwide Assessment Report - Neuse River Basin). Endangered refers to a taxon "in danger of extinction throughout all or a significant portion of its range." A Federal species of concern (FSC) is a taxon that may or may not be listed in the future (formerly C2 candidate species or species under consideration for listing for which there is insufficient information to support listing). Additional information on the species that occur in each county and details of habitat requirements for endangered species may be obtained on the Raleigh Field Office web page < http://www.nc-es.fws.gov/es/cntylist/>. The shortnose sturgeon is under the jurisdiction of the National Marine Fisheries Service.

Species	Status
Bridle shiner (*Notropis bifrenatus*)	FSC
Carolina darter (*Etheostoma collis lepidinion*)	FSC
"Carolina" redhorse (*Moxostoma* sp.)	FSC
"Neuse" madtom (*Noturus furiosus*) population 1	FSC
Pinewoods shiner (*Lythrurus matutinus*)	FSC
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered

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