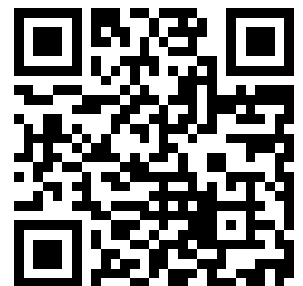

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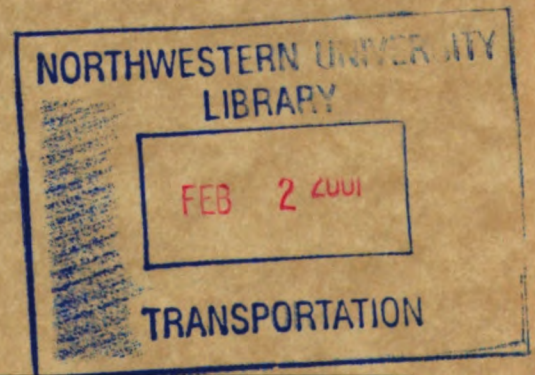
ENVIRONMENTAL IMPACT STATEMENT

RANDLEMAN LAKE

GUILFORD AND RANDOLPH COUNTIES

NORTH CAROLINA

December 2000





**FINAL ENVIRONMENTAL IMPACT STATEMENT
RANDLEMAN LAKE
GUILFORD AND RANDOLPH COUNTIES, NORTH CAROLINA**

The responsible lead agency is the U.S. Army Engineer District, Wilmington, North Carolina.

Abstract: The Piedmont Triad Regional Water Authority (PTRWA) has applied for a permit from the U.S. Army Corps of Engineers (USACE) pursuant to Section 404 of the Clean Water Act to discharge dredged or fill material into waters of the United States, including wetlands. The PTRWA has proposed to place fill material in the Deep River approximately 2 miles upstream from the town of Randleman in Randolph County, North Carolina, in order to construct Randleman Dam and Lake. At a normal pool elevation of 682 feet above mean sea level (m.s.l.), the proposed reservoir would inundate approximately 3,000 acres and would provide an **estimated** safe yield of 48.0 million gallons per day (mgd) of raw water for the PTRWA member governments, which include Randolph County and the municipalities of Greensboro, High Point, Jamestown, Archdale, and Randleman. The project would also include a buffer area approximately 200 feet wide **around the perimeter of the lake** that would involve **approximately 3,000** additional acres. The project would impact approximately 121 acres of Section 404 jurisdictional wetlands and inundate 28 miles of free-flowing streams.

In compliance with its responsibility under the National Environmental Policy Act (NEPA) of 1969, the Wilmington District, Corps of Engineers, has determined that the issuance of a permit for the proposed water supply project under Section 404 of the Clean Water Act would constitute a major Federal action significantly affecting the quality of the human environment. Therefore, this Final Environmental Impact Statement (FEIS) has been prepared in accordance with the requirements of NEPA (40 CFR 1500-1508) and USACE regulations (33 CFR 325, Appendix B), examining project alternatives and impacts related to air, hydrology, water quality, soils, plant communities, wetlands, fish and wildlife, **endangered and threatened species**, cultural resources, transportation, energy, and social and economic conditions. The FEIS contains no designation of an alternative preferred by the USACE. The decision on the Army Section 404 permit application will be made with full consideration of the public interest after the comment period on the FEIS and the Section 404 public notice has concluded.

A Draft Environmental Impact Statement (DEIS) was filed with the U.S. Environmental Protection Agency (USEPA) and appeared in the Federal Register on July 11, 1997. The public comment period was scheduled to end on August 26, 1997, but was extended several weeks at the request of USEPA. All comments received were considered during the preparation of this FEIS. Extensive additional work, including data collection, analyses, and modeling, have since been conducted to address issues raised by coordination of the DEIS. These issues relate primarily to aspects of potential water quality in the proposed lake, including contaminants and nutrient enrichment. The USEPA and the North Carolina Department of Environment and Natural Resources have been closely involved in this work.

**THE OFFICIAL CLOSING DATE
FOR THE RECEIPT OF COMMENTS
IS 30 DAYS FROM THE DATE
THAT THE NOTICE OF AVAILABILITY OF THIS FINAL EIS
APPEARS IN THE FEDERAL REGISTER.**

**FINAL ENVIRONMENTAL IMPACT STATEMENT
RANDLEMAN LAKE
GUILFORD AND RANDOLPH COUNTIES, NORTH CAROLINA**

If you would like further information on the FEIS, please contact:

**U.S. Army Corps of Engineers
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Requests for information on permit actions should be addressed to:

**U.S. Army Corps of Engineers
Post Office Box 1890
Wilmington, North Carolina 28402-1890
ATTENTION: Mr. David Franklin, CESA-W-RG
Telephone (910) 251-4952**

NOTES: Changes between the Draft and Final EIS are indicated in bold type.

In addition, Figures and Tables have been consolidated to enable the reader to locate them more easily. They now appear after the main text in Sections 10 and 11, respectively.

Appendices printed with the DEIS in 1997 (Appendix A, B, and C) are unchanged and are not being reprinted. New appendices (Appendix D, E, F, and G) are included in new Appendix Volume II.

**FINAL ENVIRONMENTAL IMPACT STATEMENT
RANDLEMAN LAKE
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**FINAL
ENVIRONMENTAL IMPACT STATEMENT
RANDLEMAN LAKE**

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APPENDIX A. Water Quality and Quantity Studies to Support Randleman Lake Environmental Impact Statement (1990) and Water Supply Alternatives Assessment (1991), Black & Veatch.

APPENDIX B. Certificate for Interbasin Transfer and Eminent Domain (1992), NCEMC.

APPENDIX C. Biological Assessment for Randleman Lake, Randolph and Guilford Counties, North Carolina (1993), J. Carter & Associates.

APPENDIX VOLUME II – Developed for the Final EIS

APPENDIX D. **Section 1: Letters of Comment.**
Section 2: Summary of DEIS Comments and Responses.
Section 3: Agency Letters and Other Documentation.

APPENDIX E. **Mitigation Plan.**

APPENDIX F. **Additional Water Quality Evaluations, 1997 – 1999.**

APPENDIX G. **Water Quality and Predictive Modeling Studies on the Proposed Randleman Reservoir, High Point, North Carolina (1995), Brezonik.**

ACRONYMS USED IN THIS REPORT

BOD ₅	five-day biochemical oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
COD	chemical oxygen demand
CWSW	Critical Water Supply Watershed
DNAPL	dense non-aqueous phase liquid
EIS	Environmental Impact Statement
GPCD	gallons per capita per day
I/I	infiltration/inflow
MCL	Maximum Contaminant Level (established by USEPA)
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MOA	Memorandum of Agreement
mL	milliliter
m.s.l.	mean sea level
NCAC	North Carolina Administrative Code
NCDCR	North Carolina Department of Cultural Resources
NCDEHNR	North Carolina Department of Environment, Health, and Natural Resources
NCDEM	North Carolina Division of Environmental Management
NCDENR	North Carolina Department of Environment and Natural Resources (formerly NCDEHNR)
NCNRC	North Carolina Department of Natural Resources and Community Development
NCDOT	North Carolina Department of Transportation
NCDSHW	North Carolina Division of Solid and Hazardous Waste
NCDSWM	North Carolina Division of Solid Waste Management
NCDWM	North Carolina Division of Waste Management (formerly NCDSWM)
NCDWQ	North Carolina Division of Water Quality (formerly NCDEM)
NCDWR	North Carolina Division of Water Resources
NCEMC	North Carolina Environmental Management Commission
NCGS	North Carolina General Statute
NCWRC	North Carolina Wildlife Resources Commission
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
ppb	parts per billion
PTRWA	Piedmont Triad Regional Water Authority
RCC	roller-compacted concrete
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan (approved under the Clean Air Act)
SVOC	semi-volatile organic compound

ACRONYMS USED IN THIS REPORT (Continued)

SY₂₀	20-year safe yield
SY₅₀	50-year safe yield
TCLP	Toxicity Characteristic Leaching Procedure
TRI	Toxics Release Inventory
ug/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
USWRC	U.S. Water Resources Council
VOC	volatile organic compound
WRF	water reclamation facility
WTP	water treatment plant
WWTP	wastewater treatment plant

**FINAL
ENVIRONMENTAL IMPACT STATEMENT**

**RANDLEMAN LAKE
GUILFORD AND RANDOLPH COUNTIES, NORTH CAROLINA**

1.0 SUMMARY

1.1 PROPOSED ACTION

The Piedmont Triad Regional Water Authority (PTRWA) proposes to construct Randleman Dam and Lake in Randolph and Guilford Counties, North Carolina. This would require the placement of fill material to construct the dam on the Deep River approximately 2 miles upstream from the Town of Randleman. The project would include the establishment of a 3,000-acre reservoir and the preservation of a 3,000-acre buffer zone consisting of a strip approximately 200 feet wide around the reservoir. Project construction would result in the loss of 121 acres of wetlands and the inundation of 28 miles of free-flowing streams. This Final Environmental Impact Statement (FEIS) has been prepared to evaluate an application by the PTRWA for a permit pursuant to Section 404 of the Clean Water Act to discharge dredged or fill material into waters of the United States, including wetlands.

1.2 PURPOSE AND NEED

The applicant's purpose and need is to develop a safe and dependable water supply for North Carolina's Piedmont Triad region that will satisfy the projected water demand for a planning period of approximately 50 years*. Based upon expected regional growth and increases in water demand, water shortages are predicted to occur shortly after the turn of the century. While water conservation may reduce the rate of demand increase, continued regional growth is expected to lead to more severe shortages in the future. Randleman Lake would satisfy the applicant's purpose and need by increasing the water supply for PTRWA member governments from the projected 2050 safe yield of 60.2 million gallons per day (mgd) to 108.2 mgd. The assurance of an adequate water supply is important for the continued economic growth of the region.

1.3 ALTERNATIVES

Seven alternatives to the proposed action were evaluated. These included the following:

- Alternative A - Upper Deep River Lake
- Alternative B - Altamahaw Lake
- Alternative C - Benaja Lake and Polecat Creek Lake
- Alternative D - Purchasing Water from Other Municipalities
- Alternative E - Development of Groundwater Wells
- Alternative F - Combination of Benaja Lake and Groundwater Wells
- Alternative G - No Action

* Reports in the Appendices may indicate a different planning period. The planning period referenced in the FEIS text takes precedence over that presented in the Appendices.

Alternatives D, E, and G were eliminated from detailed evaluation due to serious deficiencies which made them unacceptable (described in Chapter 3.0 Alternatives). Alternatives A, B, C, and F, which all include reservoirs, were analyzed in greater detail. The proposed project and the four reservoir alternatives are compared in Table 1, which addresses their yields, adequacy to meet 50-year needs, project costs, physical characteristics, and major environmental impacts. The locations of the reservoir alternatives appear on Figure 1. The locations of groundwater well fields were not defined but were anticipated to be in the Haw River basin.

1.4 MAJOR CONCLUSIONS

The proposed project and the four reservoir alternatives are each capable of providing a long-term water supply for PTRWA member governments. However, only Randleman Lake, Altamahaw Lake, and the Combination Alternative (Benaja Lake plus Groundwater Wells) would have a safe yield expected to be sufficient to fully satisfy the stated purpose and need of providing a 50-year water supply. The safe yield of Upper Deep River Lake or Benaja Lake-Polecat Creek Lake is expected to be sufficient to satisfy water demand for about 40 years.

The Randleman Lake project would be the least expensive alternative by a substantial margin. It would cost about \$29 million less than the next cheapest alternative and about \$52 million less than the most expensive alternative. The alternatives, ranked in order of increasing estimated costs, are Randleman Lake (\$140 million), Altamahaw Lake (\$169 million), Benaja Lake-Polecat Creek Lake (\$178 million), the Combination of Benaja Lake and Groundwater Wells (\$187 million), and Upper Deep River Lake (\$192 million).

All the reservoir alternatives represent large projects which would result in the acquisition of thousands of acres of land. Project land requirements would be smallest for Upper Deep River Lake (4,880 acres) followed, in ascending order, by Randleman Lake (6,000 acres), Altamahaw Lake (7,280 acres), Benaja Lake-Polecat Creek Lake (9,960 acres), and the Combination of Benaja Lake and Groundwater Wells (7,660 acres for reservoir plus land use controls or purchase of approximately 48,000 acres for well fields). Some of the adverse impacts of these alternatives are reflections of project size, such that alternatives with larger land requirements produce greater adverse effects. In this respect, the larger projects would change current land uses over larger areas and would be more destructive of plant communities and their associated wildlife inhabitants and habitat. When evaluated on this basis, the most environmentally acceptable alternatives are Upper Deep River Lake and Randleman Lake.

Other types of impacts are more related to environmental characteristics and the level of existing development of the project location than to project size. Such impacts include the numbers of residences affected, the numbers of stream miles inundated, the numbers of roadways requiring modifications, the amounts of interbasin water transfer, and the acreages of wetlands affected. The range of such impacts for project alternatives would include land acquisition of 59 (for the Combination Alternative plus well fields still to be found) to 254 tracts, loss of 7 to 41 residences, modification of 5 to 15 roadways, inundation of 14 to 28 miles of free-flowing streams, and interbasin transfer of 3.8 mgd to 30.5 mgd of water. All alternatives would reduce downstream average flows. While some impacts may be insignificant for a particular alternative, collectively the impacts would be significant for every alternative. As Table 1 indicates, no project alternative would be clearly superior in minimizing all categories of environmental impacts.

A very important category of impacts with regard to consideration of the proposed project under Section 404 of the Clean Water Act is the amount of wetlands adversely affected. All project alternatives would involve wetland losses. The amount of unavoidable wetland loss for the Randleman Lake project has been determined through detailed, site-specific investigations to be 121 acres. This wetland amount has been mapped and certified by the U.S. Army Corps of Engineers (USACE). This level of detailed wetland definition was not available for the other project alternatives. Consequently, the comparative wetland impacts of the other alternatives were estimated from readily available data. The single factor generally considered to be the best indicator of potential wetland presence is the acreage of mapped hydric soils. Mapped hydric soils within the reservoir area of each project alternative total 7 acres for Upper Deep River Lake, 37 acres for Randleman Lake, 470 acres for Altamahaw Lake, 735 acres for Benaja Lake-Polecat Creek Lake, and 735 acres for the Combination Alternative. The acreage of mapped hydric soils is an imperfect indicator of jurisdictional wetlands, as is indicated by Randleman Lake's 37 acres of mapped hydric soils versus its 121 acres of Section 404 wetlands, but these data are sufficient to show that potential wetland impacts would be much lower for Upper Deep River Lake and Randleman Lake than for the other alternatives. To mitigate for unavoidable wetland losses associated with the proposed project, the PTRWA proposes to (1) restore **wetland functions within 121** acres of forest wetlands along major tributaries of the reservoir and (2) acquire for preservation approximately **608** acres of ancient cypress swamp along the Black River, a tributary of the Cape Fear River.

The construction of Randleman Lake or any of the reservoir alternatives would provide a water supply to sustain regional growth. All alternatives would result in increased streamflows downstream from the reservoir during low flows, which would improve water quality within these stream reaches during summer droughts.

Although all the reservoir alternatives could address long-term water supply needs of the Piedmont Triad, the PTRWA prefers the Randleman Lake project for the following reasons.

- it is expected to fully satisfy the project purpose and need by providing a safe, reliable water supply that is adequate to meet projected needs over approximately 50 years;
- it is estimated to be the least costly alternative by a substantial margin;
- it is located within the counties of member governments so that watershed protection and zoning controls can be effectively managed;
- its wetland impacts are judged to be in a range comparable to those of Upper Deep River Lake and substantially lower than those of all other alternatives; and
- its adverse impacts, while significant, are comparable to or lower than those of the other alternatives.

1.5 AREAS OF CONTROVERSY

Concerns have been raised regarding the water quality of Randleman Lake. Sources of potential problems include:

- the contamination of groundwater by toxic substances at the sites of the abandoned Seaboard Chemical Corporation and the closed High Point landfill, both of which are located along the Deep River adjacent to the proposed project,

- potential groundwater contamination from the Randleman town dump,
- direct discharge of effluent from the High Point Eastside Wastewater Treatment Plant (WWTP) into the upper end of the lake, which would increase the lake's nutrient level as well as the concentrations of several metals, including chromium, copper, lead, nickel and zinc,
- Infiltration/inflow (I/I) in the High Point wastewater collection system,
- the potential for overflows and bypasses at the Eastside WWTP,
- the potential high nutrient loadings from dairy farms and urban runoff, and
- the long retention time for water passing through the proposed lake.

These issues have been addressed through several analyses and modeling studies. Remedial investigations have been conducted at the former Seaboard Chemical Corporation and closed High Point landfill sites, and study findings are currently being evaluated. Additional monitoring is ongoing, and further remedial steps will be implemented, if required. For these two sites, the N.C. Division of Waste Management (NCDWM) has indicated that they remain confident that it is technically feasible and economically viable to achieve a drastic reduction in any pollutants leaving the site and accordingly minimize the potential of any pollutants from this site causing any violations of water quality in the lake (NCDENR, 1999d).

Potential impacts from the Randleman town dump will be minimized by removal of all buried waste and surface material and disposal off-site in conformance with NCDWM *Guidelines for Assessment and Cleanup* under the Inactive Hazardous Waste Sites Program.

The impact of nutrients from the High Point Eastside WWTP will be minimized by relocation of the Eastside WWTP discharge to a point approximately 1.5 miles downstream below Freeman Mill and imposition of a stringent effluent phosphorus limit of 0.5 milligrams per liter (mg/L) for the Eastside WWTP. Control of toxic chemicals, including metals, discharged from the Eastside WWTP will be by control measures under the City's industrial pretreatment program, and effluent limits, monitoring and enforcement procedures contained in the plant's National Pollutant Discharge Elimination System (NPDES) permit.

The City of High Point's I/I reduction program will enable the Eastside WWTP to operate within the hydraulic design capacity of the expanded plant and will reduce the potential for overflows from the wastewater collection system and treatment plant.

The potential for overflows and bypasses for the expanded Eastside WWTP will be reduced by providing a capacity to treat a peak flow of 3.0 times the design capacity of 26 mgd. The Eastside WWTP expansion facilities will also include measures to minimize the potential for treatment system failures, including redundant equipment, power supplies and treatment process units, as well as alarm systems to alert the operators of failure of critical equipment.

The potential nutrient loadings from dairy farms and urban runoff will be controlled by the

implementation of the Nutrient Management Strategy rules for the Randleman Lake watershed (15A NCAC 2B.0248 through .0251) adopted by the North Carolina Environmental Management Commission (NCEMC) in 1998.

The growth of algae and rooted aquatic plants that is encouraged by the long retention time in the proposed lake will be minimized by enforcement of the Nutrient Management Strategy rules referenced above and by post-impoundment water quality monitoring surveys proposed by the North Carolina Department of Environment and Natural Resources, Division of Water Quality (NCDWQ) to be conducted by local governments.

The conclusion from these studies and analyses is that these sources would not cause water quality problems in Randleman Lake or create a problem with the use of Randleman Lake as a public water supply.

The NCDWQ has reviewed the results of additional water quality studies and evaluations conducted since the DEIS was published and indicated in its letter of March 1, 2000 to the USACE that the proposed project is acceptable from a water quality point of view (NCDENR, 2000b). The NCEMC in its *Report of Proceedings, Proposed Reclassification of the Deep River (Proposed Randleman Reservoir)* concluded that "[the nutrient management plan]... should result in a lake that will support all designated uses assigned and that the reclassification action of the Commission would be consistent with the requirements of the Federal Clean Water Act and the State's laws and rules." (NCDENR, 1998b). The NCDWQ also issued a 401 Water Quality Certification for the project on March 11, 1999 (NCDENR, 1999c). This certification stated that "...the proposed development will not result in a violation of applicable Water Quality Standards and discharge guidelines." The U.S. Environmental Protection Agency (USEPA) also reviewed the additional studies and evaluations and indicated in its letter of October 19, 1999 to the USACE that it "...considers its previous technical concerns resolved and concurs with the [North Carolina] Environmental Management Commission conclusions." (USEPA, 1999). Copies of the above letters and the 401 Water Quality Certification are included in *Appendix D, Section 3*.

An additional area of concern is the impact of the proposed project on downstream flows within habitat areas of the Federally endangered Cape Fear shiner. Additional evaluations of project impacts on downstream flows were conducted and reviewed with the U.S. Department of the Interior, Fish and Wildlife Service (USFWS). The USFWS in its letter of March 7, 2000 to the USACE indicated that "[t]he Service therefore concurs that this project is not likely to adversely affect the Cape Fear shiner, based on the analyses of worst case scenario projected flows approximating historic norms, there being no rapid daily fluctuations, and the agreed on maintenance of flows at 75 cfs at Coleridge during reservoir filling." (USFWS, 2000). A copy of this letter is included in *Appendix D, Section 3*.

1.6 UNRESOLVED ISSUES

Every important issue that has been identified regarding the Randleman Lake project has been addressed through appropriate studies and coordination. More than 2 years have elapsed since publication of the Draft EIS to allow time for sufficient analyses. The USEPA and the North Carolina Department of Environment and Natural Resources have been heavily involved to assure that water quality and contaminant issues were thoroughly investigated. There are no unresolved issues.

2.0 PURPOSE AND NEED

2.1 IDENTIFICATION OF THE APPLICANT

The Piedmont Triad Regional Water Authority (PTRWA) is comprised of the governments of Randolph County and the municipalities of Greensboro, High Point, Jamestown, Archdale, and Randleman. Archdale and Randleman are located in Randolph County, while the other three cities are located in adjacent Guilford County. The PTRWA was formed in 1986 for the purpose of identifying, evaluating, and developing long-term water supply alternatives for member governments.

2.2 APPLICANT'S PURPOSE AND NEED

The applicant's purpose and need is to develop a safe and dependable water supply for North Carolina's Piedmont Triad region that will satisfy estimated water demands for a planning period of approximately 50 years. Based upon expected regional growth in water demand, water shortages are predicted to occur shortly after the turn of the century. While water conservation may reduce the rate of demand increase, continued regional growth is expected to lead to more water consumption and more severe shortages in the future. The PTRWA seeks to establish a water supply to provide an additional safe yield of approximately 48 mgd to meet its projected needs through the year 2050. An adequate water supply is necessary to support continued growth and economic vitality of the region.

2.3 EXISTING RAW WATER SOURCES

Guilford and Randolph Counties do not currently operate water supply or distribution systems and do not provide treated water for their unincorporated areas. Most of the rural residents rely on groundwater, although some portions of Randolph County receive water through governmental agreements between the county and the Cities of Ramseur and Asheboro. There are no county-wide water use records.

High Point, Greensboro, and Randleman operate water supply reservoirs, water treatment plants, and distribution systems. **Greensboro also has interconnections with the distribution systems of High Point, Winston-Salem and Reidsville to supply additional water to City customers (Williams, 1999). The interconnection with High Point is limited in purchases by the hydraulic characteristics of the systems and disinfection methods. Furthermore, since High Point and Greensboro are both PTRWA members, water from High Point to Greensboro is merely a shift of PTRWA's internal resources and does not increase the total water supply sources of PTRWA members. The interconnection with the City of Winston-Salem was constructed in late 1998 but is limited to no more than 2.0 mgd because of interbasin transfer considerations. Greensboro is currently constructing an interconnection with the City of Reidsville and has an agreement with Reidsville to purchase water over a 10-year period. The agreement would allow Greensboro to purchase up to 5.0 mgd of water on an annual average basis for the first five years. During the second five years, Greensboro is allowed to purchase up to 2.5 mgd of water on an annual average basis. Greensboro has the option of extending the agreement for two additional 10-year periods at the lower amount of 2.5 mgd. The agreement also allows Reidsville to curtail water sales to Greensboro when lake levels at Reidsville fall to five feet below the spillway. The interconnection with Reidsville was completed in August 2000, and improvements needed to provide the full 5-mgd capacity are to be completed by November 2000. Jamestown and Archdale operate water distribution systems that serve their customers by distributing finished water purchased from either High**

Point, Greensboro, or private water purveyors. The existing sources of raw water and purveyors of finished water presently used by the PTRWA members are shown on *Figure 2*.

Safe yields of existing raw water and finished water sources are presented in *Table 2*. **The 20-year safe yield (SY₂₀) is defined as the yield at which any given water source would fail with an average recurrence interval of once in 20 years. An SY₂₀ would meet 100 percent of the water demand 95 percent of the time or would fail to meet 100 percent of the demand only 1 year in 20.** The 50-year safe yield (SY₅₀) is defined as the yield at which any given water source would fail with an average recurrence interval of once in 50 years (CH2M Hill, 1985). An SY₅₀ would meet 100 percent of the water demand 98 percent of the time or would fail to meet 100 percent of the demand only 1 year in 50. Safe yields reported for finished water purchased from Asheboro and Davidson Water, Inc. are based on the maximum permissible withdrawal contracted between the water purveyor and the PTRWA purchaser. High Point supplies water to Jamestown and Archdale but limits Jamestown to 1 mgd and Archdale to 0.5 mgd. Greensboro also supplies water to Jamestown, with a maximum permissible withdrawal of 1 mgd. The projected total 50-year safe yield in 2050 for existing surface water sources used by the PTRWA members is 60.2 mgd. Finished water supplied by Greensboro and High Point to other PTRWA members is not included in the projected 2050 safe yield. Finished water supplied to Greensboro from Winston-Salem and Reidsville is also not included in the projected 2050 safe yield because these municipalities are not expected to have excess capacity in 2050.

2.4 WATER NEEDS

Water needs are influenced by characteristics of the water use community, as well as various changes which may occur over time. Changes in consumption patterns of existing water users, service areas of water utilities, industrial water use, and population all contribute to changes in total need.

2.4.1 Trends in Water Consumption. The total combined water use for all PTRWA members has been increasing. Water use data for the 17-year period from 1981 to 1997 appear as an annual average rate in *Table 3* (Black & Veatch, 1991a) and *Table 3a*. These data show that annual average daily water use among PTRWA members increased from 36.94 mgd to 48.07 mgd during this period. This increase exceeds 10 mgd and is approximately 30 percent.

Greensboro is experiencing the greatest increase in water consumption, as is indicated by an increase in annual average daily water use from 24.3 mgd in 1981 to 33.9 mgd in 1997. In 1998 and 1999, Greensboro entered into agreements with High Point, Winston-Salem, and Reidsville to obtain additional water (Williams, 1999). Consumption increases are also causing concerns for other PTRWA members, although on a smaller scale. The Town of Randleman has periodically exceeded the safe yield of its lake (1.4 mgd) since 1981, and must obtain an additional long-term supply. In July 1986, Randleman entered into an agreement with Asheboro to supplement its existing supply in emergencies, such as peak demand periods and distribution line breaks (Hardin, 1991). In 1988, Archdale began to purchase water from High Point to meet additional demand requirements (Ogbum, 1991).

2.4.2 Changes in Water Utility Service Areas. Increases have been occurring in the areas served by water utilities, and the number of water customers has been increasing aside from population growth. Guilford and Randolph Counties do not operate water utility departments and do not provide treated water in their unincorporated areas. However, in 1987, the Cities of Greensboro and High Point entered into a water and sewer service area agreement that designated specific unincorporated areas of Guilford County to be served

by each municipality. This agreement added 222 square miles to the service area of Greensboro and 88 square miles to that of High Point. Greensboro also provides water service to the eastern portion of Guilford County and in 1996 extended water and sewer service to the Four Oaks Country Club vicinity.

High Point, Archdale, and Randolph County recently completed a joint study of the economic development potential of the Interstate 85/Business 85 corridor that intersects southwest Guilford and northwest Randolph Counties. By-products of this study included a water and sewer service agreement and future annexation boundaries for the unincorporated areas of the corridors in Randolph County and Davidson County. This would add additional municipal service area to the Cities of High Point and Archdale. In addition, Randolph County's Strategic Planning Process, which was recently completed, anticipates "water corridors" serving portions of the county outside the municipal service areas. Randolph County now estimates that it will need 7.8 mgd by the year 2020.

2.4.3 Changes in Industrial Water Use. Increased water demand can result from expansion of existing water-using industries as well as the addition of new industries in an area. The Greensboro Area Chamber of Commerce reported 56 new and 159 expanding business firms creating 8,195 new jobs during the period 1992-1995. Industrial water demand has been increasing in Greensboro and in Guilford County.

2.4.4 Population Increases. From 1970 to 1990, the combined population of Guilford and Randolph Counties increased from 365,003 to 453,966, or 24 percent. The North Carolina Office of State Planning predicts that this population will increase another 25 percent to 567,086 by the year 2020. *Table 4* presents the population data for the two counties, by decade, from 1970 to 1990, as well as projections to the year 2020. The State has no official projections of population growth beyond the year 2020.

2.5 WATER CONSERVATION

Water conservation programs typically supplement but do not replace the development of new water supplies. Efficient use of existing supplies can save money, obviate the need for additional storage capacity, and prolong the use of existing resources during shortages. Efficient water use will become increasingly important as the costs of new supplies increase due to shortages of acceptable water supply development sites, higher land costs, and more required relocations. It is expected that these factors will further the trend toward conservation methods and pricing policies that reflect the true cost of water production.

Successful implementation of water conservation measures depends on regulatory action by state and local governments and management decisions by the local utility. Typical regulatory measures are codes and ordinances that mandate water conservation through the use of plumbing fixtures, reclaimed water, and drought restrictions. Management measures include regional coordination with other utilities, installation of meters, leak detection programs, rate structure changes, distribution of retrofit kits, and public education programs.

Individual types of water conservation measures can produce water use reductions ranging from about 3 percent for some changes in pricing structure up to about 30 percent for large programs of leak detection and repair (Black & Veatch, 1991a). The level of potential usage reduction achievable in any particular community is related to the existing efficiencies of its water system, the magnitude of existing losses, and the array of conservation measures already implemented. Water conservation is discussed in greater detail in *Appendix A*.

Per capita water consumption is defined as total water production divided by population served and is measured in gallons per capita per day (GPCD). Of the major metropolitan areas in North Carolina, Greensboro and High Point are among the lowest in per capita water consumption. *Table 5* shows consumption rates of 152 and 147 GPCD, respectively, for these cities, while the consumption rate in Asheville is 363 GPCD, or more than double these rates. The low consumption rates in Greensboro and High Point are due, in part, to the adoption of **plumbing code** requirements for water-saving devices several years ago, leakage and water loss control programs, **meter replacement programs**, and industrial water conservation programs. **Public education programs and rate structure changes are also expected to provide reductions in water demand over the planning period.**

The City of Greensboro has implemented a comprehensive water conservation program. The Greensboro Utilities Department opened its Water Conservation Office in October 1994, and it currently includes a staff of two people and a budget of \$590,000. The Office primarily targets residential water users and offers public education, technical assistance and water-saving hardware. The City's public education effort, which includes demonstration projects, news releases, print advertising, radio talk shows, and television commercials, captured the U.S. EPA Region IV 1st Place "Public Education" award for 1997. High levels of customer participation in the City's hardware distribution programs have resulted in 12,000 toilets and 7,000 shower stalls being upgraded to water-saving status. The City's hardware effort captured the U.S. EPA Region IV 1st Place "Case Study" award for 1996. Under the City's technical assistance program, commercial properties are offered free hardware in exchange for the City's right to publicize "before" and "after" findings. Three apartment demonstration projects participating in the program cut water use by amounts ranging from 25 to 40 percent. Plans are underway for the expansion of Greensboro's water conservation effort.

Another water conservation technique which can be considered by the PTRWA members is discounts on per-unit hookup fees for new construction which incorporates reduced turf area. Giveaway programs for high-efficiency shower heads and faucets and rebate programs for use of ultra-low-flush toilets, like those implemented by the City of Greensboro, can also be considered. Installation of water-saving devices and landscapes at public buildings can also allow such hardware and landscapes to become familiar and acceptable to the people who use them and can speed up adoption by the general public.

Because of the implementation of conservation measures by Greensboro and High Point and their existing low rates of per capita water use, further reductions through conservation will be increasingly difficult. In general, it is estimated that a conscientious water conservation program could reduce residential and commercial demand by about 15 percent. This is based on a 10 percent reduction due to plumbing code changes (American Water Works Association, 1991) and a 5 percent reduction due to public education and rate structure changes. Industrial water conservation may include measures such as process and equipment changes, which are difficult to assess on a general basis, although substantial reductions have been documented in many cases. However, the effects of rate structure changes are more predictable and, therefore, were used to estimate the impact of conservation on industrial water use. It is estimated that a reduction of 5 percent in industrial use is achievable.

In order to generate an estimate of overall potential reductions in water consumption, it was assumed that the future mix of water users would consist of 75 percent residential and commercial customers and 25 percent industrial customers. This mix is derived from 1992 Water Supply System Reports for the PTRWA members

(NCDEHNR, 1992). The result is a composite estimate of 12.5 percent reduction in total demand. This is calculated as follows:

75% residential/commercial use x 15% reduction	=	11.25% reduction
+ 25% industrial use x 5% reduction	=	01.25% reduction
<hr/> Total reduction	=	<hr/> 12.50% reduction

It is anticipated that this level of water use reduction could be achieved by PTRWA members over a 50-year implementation period through a 2.5 percent reduction per decade. While water conservation alone is not adequate to fully address the long-term water needs of PTRWA members, reduction in water demand through conservation is significant and is reflected in the following water demand projections.

2.6 WATER DEMAND PROJECTIONS

The North Carolina Department of **Environment and Natural Resources (NCDENR)** (name changed from the North Carolina Department of Environment, Health and Natural Resources (NCDEHNR) during 1998) maintains a statewide water supply plan, as required by North Carolina General Statute (NCGS) 143-355. **NCDENR** obtains data for periodic plan updates through water supply system reports, which are required from all municipal water systems. These system reports currently provide future water use projections for the years 2000, 2010, and 2020. The most recent projections from the system reports of PTRWA member governments (NCDEHNR, 1996b) are shown in *Table 6* and are compared to **projected safe yields** for each water supply. The projections shown in *Table 6* for Randolph County were obtained directly from the county manager since Randolph County does not have a water supply or distribution system and is not required to submit a system report.

The **projections** in *Table 6* indicate that the water needs of Greensboro, Jamestown, and Archdale will exceed their existing water supplies by the year 2000. Consequently, they will need to have additional water supplies.

The combined water supply needs for all PTRWA members projected through the mid-point of the 21st century are shown on *Figure 3*. This figure depicts actual water use data for the years 1981 through 1997 (*Tables 3 and 3a*), as well as projections of future need with and without water conservation. Projection 1 is a linear extrapolation of projected water demand between 2010 and 2020 (*Table 6*). Because the projected increase in demand for this 10-year interval is higher than the increase in actual usage or projected demand for any other 10-year period, projection 1 indicates the highest rate of increase in demand that would likely be expected. Projection 2 is an extrapolation based on estimated usage from 1990 to 2020, including a reduction to account for estimated water conservation. As was noted in *Section 2.5*, conservation is estimated to result in a reduction of 2.5 percent each decade, or a 12.5 percent reduction over 50 years. Since projection 2 is based on projected demand over a 30-year interval, it represents a lower rate of increase than projection 1 and is considered to be more realistic. **The projected design year water demand of 108.6 mgd is equivalent to an average annual increase of approximately 1.5 percent compared to the 1997 water use of 48.07 mgd. This is considered a reasonable growth rate for the Piedmont Triad region of North Carolina. For comparison, the historical population for the PTRWA members (not including Guilford County) increased at an average annual rate of 0.9 percent from 1970 to 1980 and 1.5 percent from 1980 to 1990.**

The total **projected 2050 50-year safe yield** of existing supplies of member governments is **60.2 mgd**. Projection 1 shows that, without water conservation, the total water supply need would be approximately

140 mgd by the year 2050, requiring the development of approximately 80 mgd of additional supply. Projection 2 shows that, with water conservation, the total water supply need would be approximately 108 mgd by the year 2050, requiring the development of approximately 48 mgd of additional supply. The need for an additional water supply of 48 mgd, as indicated by projection 2, is adopted as the PTRWA goal. Based upon the projected needs of the PTRWA members, a new 48 mgd water supply would be allocated as shown in *Table 7*.

3.0 ALTERNATIVES

3.1 GENERAL

The Cities of Greensboro and High Point have developed their watersheds to the maximum extent feasible. Greensboro has three lakes (Lake Brandt, Lake Townsend, and Lake Higgins), all located in the upper Haw River basin, and High Point has two lakes (High Point Lake and Oak Hollow Lake), both located in the upper Deep River basin. It is not feasible to modify these existing water supply reservoirs in order to increase their safe yield because they are located in areas essentially surrounded by urban development.

Water supply alternatives in the upper Cape Fear River basin have been studied extensively for more than 25 years. Investigations of structural and non-structural water supply alternatives were described by the USACE in its environmental impact statements for the Randleman Lake project beginning in 1976. In 1985 the Piedmont Triad Council of Governments commissioned CH2M Hill, Inc. to study 40 different water supply alternatives. **Of the 40 alternatives considered in that study, four alternatives were recommended as alternative water supply sources. Table 7a provides additional information on the four alternatives recommended in the CH2M Hill report as well as the reasons for rejecting the other 36 alternatives that were considered. Primary reasons for the rejection of alternatives included inadequate safe yield and excessive cost.** In 1991 the PTRWA contracted with Black & Veatch to further assess water supply alternatives. The alternatives described here were selected for further review based on the CH2M Hill study recommendations. The locations of project alternatives are shown on *Figure 1*. Alternatives are described in *Section 3.2* and evaluated in *Section 3.3*. Each of these alternatives would provide a safe yield in the range of 40 to 48 mgd. In order to sufficiently address the project purpose and need, water conservation would have to be implemented along with project construction, as was discussed in *Sections 2.5* and *2.6*. Otherwise, the water yields in this range cannot adequately meet the projected long-term water demands.

3.2 DESCRIPTION OF ALTERNATIVES

3.2.1 The Proposed Project - Randleman Lake. Randleman Lake has long been anticipated as the future water supply for the Piedmont Triad Region. First considered as a Federal project, it was authorized by the U.S. Congress in 1968 to be constructed by the USACE as a multi-purpose reservoir that would address water supply, flood control, water quality control, and recreational needs in the upper Cape Fear River basin. Local governments intended to purchase the water supply storage of Randleman Lake, but changes in Federal funding criteria stopped the project. Randleman Lake was also the recommended alternative of the studies done by CH2M Hill, Inc. (1985) and Black & Veatch (1991a). The PTRWA now proposes to construct a reservoir at the same site for water supply only (Figures 4 and 5). Through the elimination of the flood control and recreational components of the 10,000-acre Federal project, the proposed project would be reduced to approximately 6,000 acres. It would inundate approximately 3,000 acres to form the reservoir, and would require additional lands of approximately 3,000 acres to form a 200-foot-wide perimeter buffer.*1 North Carolina regulations require that a margin of at least 50 feet around the impoundment be owned or controlled by the water supplier.

*1 *Note: For Randleman Lake, the acreage in the 200-foot buffer zone is approximately equal to the surface area of the lake; this ratio is considered applicable for all the reservoir alternatives.*

The proposed project would be located in Randolph and Guilford Counties, and its watershed would cover approximately 171 square miles.*² A roller-compacted concrete (RCC) dam with a multi-level outlet structure would be constructed on the Deep River approximately 2 miles upstream from the Town of Randleman. The elevation of the conservation pool would be 682 feet mean sea level (m.s.l.), the same as the authorized Federal project. Randleman Lake would impound approximately 62,000 acre-feet of water and would provide a minimum safe yield of 48 mgd. A summary of pertinent project data appears in *Table 8*.

The stream bed and the lake floor at the dam site are at an elevation of approximately 604.0 feet m.s.l. A plan and a cross section of the proposed dam are shown on *Figures 5a* and *5b*, respectively. The outlet structure would consist of a riser which discharges into an outlet conduit. The riser would be attached to the vertical upstream face of the dam at the right (south) abutment. The outlet conduit would be 120 feet long and would be placed in a rock cut at the base of the abutment. The outlet conduit would discharge into the stilling basin for the emergency spillway on the downstream side of the dam. Gates installed in the sides of the riser at various levels would be used for controlling downstream releases. One or more large gates at the base of the riser would be provided for draining the reservoir.

Soil erosion and sediment control measures to be used during construction of the proposed dam would be determined during preparation of the sediment and erosion control plan. The plan would be developed in accordance with the guidelines of the North Carolina Division of Land Resources, Land Quality Section and submitted to the Land Quality Section for approval.

Reservoir capacity, streamflow data, sediment data and volume increments for water supply and sediment storage are included in *Table 8*. Sediment accumulation was projected for 100 years because that is the projected design life for the proposed reservoir.*³ This means that the proposed reservoir would provide a minimum safe yield of 48 mgd throughout its design life. Sediment accumulation in 50 years would be one-half of the 100-year sediment accumulation, or 4,000 acre-feet.

The water impounded by Randleman Lake is expected to be of moderate quality as a water supply. Currently, there are 25 National Pollutant Discharge Elimination System (NPDES) dischargers in the Randleman Lake watershed (discussed in Section 4.3.5.2 and listed in *Table 15b*). These include one municipal wastewater treatment plant (WWTP), the High Point Eastside WWTP; 10 small domestic treatment facilities; one municipal water treatment plant (WTP), the High Point Ward WTP; two groundwater remediation facilities; and 11 stormwater or cooling water dischargers. Municipal WWTPs that discharge into the upper Deep River and its tributaries have historically contributed to water quality problems, and discharges from High Point's Eastside WWTP have continued to be a major source of nitrogen and phosphorus in the upper Deep River (NCDEHNR, 1994b). Nevertheless, water quality has been improving since 1983, and improvements to High Point's Eastside WWTP in 1985 have led to reductions in ammonia concentrations and 5-day biochemical oxygen demand (BOD₅). **Benthic macroinvertebrate data indicated stable water quality at most sites in the Randleman Lake watershed since 1993 (NCDENR, 2000a).** The Deep River at Randleman was rated as Good-Fair in both 1993 and 1998. High Point is currently expanding its Eastside

*² Note: *Previous reports have cited the acreage of the Randleman Lake watershed as 169 square miles in some cases and 171 square miles in others. This report will cite this area as 171 square miles.*

*³ Note: *Design life addresses the minimum expected physical life of a facility based upon engineering design; planned life addresses the anticipated period of time that a facility is expected to fulfill its intended purpose based upon economic projections, estimated demands, and/or other factors.*

WWTP and upgrading it through the addition of **nutrient removal facilities**. These improvements, which are scheduled for completion in **2003**, are expected to further improve water quality in the upper Deep River through additional phosphorus and nitrogen removal capabilities. Water quality modeling studies conducted for the proposed project have concluded that substances discharged from the Eastside WWTP directly into Randleman Lake should not create a problem with treated water meeting requirements of the Safe Drinking Water Act (Black & Veatch, 1990). The proposed plan in the **Draft EIS** included the discharge of effluent from the Eastside WWTP directly into the upstream end of the lake, unlike the earlier Federal plan for Randleman Lake, which included discharge of this effluent through a sewer bypass directly into the Deep River downstream of the Randleman dam. **The final proposed plan includes relocation of the Eastside WWTP discharge to a downstream point along the lake near Freeman Mill (location appears on Figure 5).** This relocation is expected to be required for issuance of the NPDES permit for expansion of the Eastside WWTP to 26 mgd and is estimated to cost \$8 to \$10 million. Additional operation and maintenance (O&M) costs will be associated with conveying the effluent to the downstream discharge point. The additional present worth O&M cost is estimated at approximately \$750,000. *Section 3.3.3* below includes consideration of the additional costs associated with the proposed discharge relocation as part of the cost for the proposed Randleman Lake alternative.

Contamination of groundwater in the vicinity of the proposed reservoir has created concern regarding potential impacts on water quality of the lake. Toxic substances from the abandoned Seaboard Chemical Corporation and the closed High Point landfill, both of which are located along the upper Deep River adjacent to the proposed reservoir, have contaminated the groundwater at each site. However, modeling and remedial investigation studies have predicted that contaminated groundwater from these sites should not have an adverse impact on the water quality of Randleman Lake. This topic is discussed further in *Section 5.3.5.4 and Appendix F*.

Raw water obtained from Randleman Lake would be treated at a **proposed** water treatment plant and pumped to the water distribution systems of the PTRWA member governments. The water treatment plant would be located on the lower portion of the lake on the west side of the U.S. 220 bypass approximately 4 miles south of NC 62 (Hazen and Sawyer, 1997). Modeling studies indicate that this area would have the highest water quality in the reservoir (Black & Veatch, 1990). **The proposed water treatment plant would be located on an upland site near the reservoir, and its construction would have no direct wetlands impacts. A separate environmental document is being prepared for the water treatment plant to comply with requirements of the State of North Carolina under the State Environmental Policy Act. Since there are no wetland impacts for the water treatment plant, it will not require a permit under Section 404 of the Clean Water Act.**

Finished water transmission mains would be constructed from the proposed water treatment plant to the finished water distribution systems of the PTRWA member governments. Initially, water transmission mains would be constructed to the Greensboro and Archdale water distribution systems. The locations of these lines are shown on *Figure 5c*. The proposed water transmission lines would be primarily located along roadways within the road right-of-way. Stream crossings would be required of the Deep River, Muddy Creek and two unnamed tributaries of the Deep River within the proposed lake, and Bob Branch and an unnamed tributary of Muddy Creek outside the proposed lake. Direct wetlands impacts would be required for these creek crossings. Affected wetland areas would be restored to existing grade following construction, and this would promote natural recovery to pre-disturbance conditions. These impacts are discussed in *Section 5.3.8* below.

Road modifications and abandonments would be required for the proposed lake. Existing roadways would either be abandoned if traffic loads permit or raised so that the roadway is above the maximum water level in the lake. The locations of the proposed road modifications and abandonments are shown on Figure 5d. All wetlands impacts associated with the proposed road relocations and abandonments are included in the wetlands impacts of the proposed project.

Up to 30.5 mgd, or approximately 63 percent of the lake's total yield of 48 mgd, would be diverted from the Deep River basin to other river basins through wastewater discharge. The authority for this transfer was granted to the PTRWA by the North Carolina Environmental Management Commission (NCEMC) on December 12, 1991, following the State's evaluation of the project and preparation of an Environmental Impact Statement (EIS) (NCDEHNR, 1991). The certificate from the NCEMC appears in *Appendix B*. Of the water pumped to High Point, up to 2.0 mgd would be transferred to the Yadkin River basin through the High Point Westside WWTP on Rich Fork Creek. Most of the water pumped to Greensboro (up to 28.5 mgd) would be discharged as wastewater into the Haw River basin. Greensboro currently is expanding its WWTPs to accommodate this additional flow to the Haw River. Since water demand for the PTRWA is expected to increase gradually over time, the interbasin water transfers are expected to be small immediately after reservoir completion but to gradually increase up to the permitted limits over several decades.

Up to 17.5 mgd of the Randleman Lake yield would return to the Deep River watershed. Of this amount, up to 11.5 mgd would be discharged to the reservoir, while the remaining 6.0 mgd would be discharged in other areas of the Deep River watershed. Discharges to Randleman Lake would include most of High Point's water allocation (up to 10.08 mgd), which would enter as effluent from the Eastside WWTP. A small portion of the Greensboro allocation would be returned to the Deep River basin, because the Greensboro water distribution system contractually serves unincorporated areas in Guilford County that are located in the Deep River basin. In addition, some portions of Greensboro's water service area are served by the Jamestown wastewater system, which also discharges into the Deep River basin.

The reservoir would employ a three-tiered release schedule to provide low-flow augmentation in the Deep River. This plan provides for normal minimum releases of 30 cubic feet per second (cfs), followed by reductions to 20 cfs and 10 cfs with increasing drought conditions. This release plan is consistent with the current NCDENR policy on minimum flows from public water supply systems (NCDEHNR, 1994c).

The PTRWA has no specific plans to develop recreational facilities for the proposed project. However, the PTRWA will cooperate with Guilford and Randolph Counties in their plans to develop recreational facilities adjacent to the buffer area around the proposed lake. The recreational facilities will be limited to boat access and day visitor picnic facilities. Guilford County also plans to include comfort stations and walking and/or bicycle trails. All facilities would be located in the land adjacent to the buffer area except for boat access facilities, which would be within the buffer area. Acceptable recreational activities may include boating, fishing and picnicking, as well as nature study and bird watching. No hunting will be permitted in the buffer area.

The estimated total cost of constructing the Randleman Lake project is approximately \$140 million. This includes the costs of land acquisition, land clearing, **road modifications**, engineering and design, dam construction, wetland mitigation, water treatment plant construction, water intake and transmission facilities, **and relocation of the discharge for the Eastside WWTP.**

The proposed project fully satisfies the PTRWA's purpose and need. Its potential benefits and impacts are discussed further in *Section 3.3, Evaluation of Reservoir Alternatives* and *Section 5.0, Environmental Consequences of the Proposed Action*.

3.2.2 Alternative A - Upper Deep River Lake. This project alternative would include the construction of an RCC dam on the Deep River south of N.C. Highway 62 to create a reservoir of approximately 2,440 acres. A 200-foot-wide buffer zone around the reservoir is assumed to contain equal acreage (as was the case for Randleman Lake). The 4,880-acre project would be located entirely in Guilford County east of High Point, and its watershed would cover approximately 127.5 square miles. Upper Deep River Lake was previously considered for water supply by the USACE, but was not recommended for implementation (CH2M Hill, 1985; **which referred to this alternative as the Upper Deep River Lake - Lower Pool Only**).

This lake would impound 45,000 acre-feet of water at a normal pool elevation of 715 feet m.s.l. and would provide a safe yield of 40 mgd (CH2M Hill, 1985; Black & Veatch, 1991a). Due to the lake's location further upstream and closer to High Point, it would inundate more developed land. This alternative would also inundate approximately 20 percent of three adjacent sites of concern - the abandoned Seaboard Chemical site, the High Point landfill, and the High Point Eastside WWTP. These sites occupy elevations ranging from 690 feet m.s.l. to 770 feet m.s.l. Groundwater contamination was identified at the Seaboard Chemical Corporation in 1983, and sections of the landfill are unlined and allow contaminants to leach into the groundwater beneath the site (Environmental Investigations, 1992; Geraghty and Miller, Inc., 1993; Sitex Environmental, Inc., 1989). Inundation by the reservoir would hamper ongoing monitoring and cleanup of contaminants at the Seaboard Chemical and landfill sites. It would also render substantial portions of the **Eastside** WWTP inoperable. As a result, the **Eastside** WWTP would require relocation at a cost estimated by Black & Veatch to be approximately \$64 million (16 million gallon current capacity rating x \$4 per gallon = \$64 million).

Upper Deep River Lake can be expected to provide a water supply of moderate quality based upon the **moderate level of development in the watershed and ratings of conditions in the Deep River (NCDEHNR, 1996a)**. **NPDES dischargers in the watershed for the Upper Deep River Lake include all of the dischargers for the proposed Randleman Lake, except for three small domestic treatment facilities which discharge to Muddy Creek or to the Deep River downstream of the Upper Deep River Lake dam site**. Modeling studies similar to those performed for Randleman Lake would be required to determine the impacts of existing groundwater contamination on reservoir water quality. Adding nutrient removal facilities to the new **Eastside** WWTP would also improve water quality in the Deep River as outlined in the Randleman Lake alternative.

Up to 25.4 mgd, or approximately 64 percent of the 40 mgd safe yield, would be diverted from the Deep River basin to other river basins through wastewater discharges. Most of the interbasin transfer from Greensboro (up to 23.7 mgd) would be discharged as wastewater into the Haw River basin. Of the water allocated to High Point, up to 1.7 mgd would be transferred to the Yadkin River basin through High Point's Westside WWTP on Rich Fork Creek. A permit from the NCEMC would be required for these interbasin transfers.

The estimated total cost of constructing the Upper Deep River Lake project is approximately **\$192 million**. This includes the cost of land acquisition, land clearing, road relocations, engineering and design, dam construction, wetland mitigation, water treatment plant construction, water intake and transmission facilities, and relocation of the High Point Eastside WWTP.

Upper Deep River Lake could satisfy the projected water needs of the PTRWA through approximately the year 2040. While this only partially satisfies the stated 50-year need, it is nevertheless, a long-term alternative and is further evaluated in *Section 3.3*.

3.2.3 Alternative B - Altamahaw Lake. Altamahaw Lake was originally evaluated by the USACE as a water supply reservoir that would operate in conjunction with several smaller reservoirs (CH2M Hill, 1985). However, it was considered by the PTRWA as an independent project alternative due to its large estimated SY₅₀ of 48 mgd. This alternative would consist of constructing an RCC dam on the Haw River north of SR-1560 to form a 3,640-acre reservoir. The reservoir would be located in Guilford, Alamance, and Rockingham Counties with its conservation pool at elevation 655 feet m.s.l. The project would include a 200-foot-wide buffer zone assumed to require approximately 3,640 acres. Thus, the total land requirements are estimated at 7,280 acres. The project watershed would cover about 136 square miles (CH2M Hill, 1985).

Altamahaw Lake would be located primarily in Guilford and Rockingham Counties, but would extend into Alamance County. Since neither Rockingham nor Alamance Counties has adopted watershed protection ordinances, implementation of this alternative would require that each county adopt land use management programs to protect the watershed. The Water Supply Watershed Protection Act (NCGS 143-214.5 and 143-214.6) states that municipalities must protect supply sources to comply with established minimum criteria for the affected watershed. The adoption of a watershed protection program would restrict development within the critical area around the proposed lake, control point source pollution, and minimize nonpoint source pollution from impervious surfaces. In addition, acquisition of land in Rockingham County for Altamahaw Lake would require the consent of the Rockingham County Board of Commissioners, as mandated by Chapter 973, S. B. 1404 of the 1989 State Sessions Law (NCDEHNR, 1991).

Based on the existing moderate level of development in the Altamahaw Lake watershed, the Altamahaw Lake alternative is expected to provide a water supply of moderate quality. Currently, there are 11 NPDES dischargers in the Altamahaw Lake watershed. These include the Reidsville WWTP, the Reidsville WTP and nine small domestic treatment facilities. Little Troublesome Creek downstream of the Reidsville WWTP was rated Poor for both fish and macroinvertebrates in 1998 (NCDENR, 2000a). Data indicated toxic conditions in this creek in 1998. The Haw River at NC 87 has fluctuated between Good-Fair (1985, 1987 and 1993) and Fair (1990, 1998) benthos bioclassifications. Part of this change may be due to lower flow in 1998. The project would require that the Reidsville WWTP be upgraded to include nutrient removal. Black & Veatch has estimated that this would cost approximately \$1 million. WWTP upgrades should improve raw water quality in Little Troublesome Creek and the Haw River through time, and the resultant raw water quality in the reservoir should also be improved.

This alternative would require an interbasin transfer of approximately 20 mgd from the Haw River basin to the Deep River and Yadkin River basins and would, therefore, require an interbasin transfer permit from the NCEMC, as was required for Randleman Lake. Long-term hydrologic impacts would be reduced by

implementing an approved minimum release program that would augment flow in the Haw River downstream of the reservoir.

The estimated total cost of constructing the Altamahaw Lake project is approximately **\$169 million**. This includes upgrading the Reidsville WWTP, as well as all other project costs.

Altamahaw Lake would adequately address the PTRWA goal of 48 mgd and would satisfy the project purpose and need. The Altamahaw Lake alternative is further evaluated in *Section 3.3*.

3.2.4 Alternative C - Benaja Lake and Polecat Creek Lake. The Benaja Lake and Polecat Creek Lake alternative combines two independent water sources. Benaja Lake was initially considered by the USACE for water supply (CH2M Hill, 1985), and Polecat Creek was investigated by the U.S. Soil Conservation Service (now the Natural Resources Conservation Service) for pollution control and low flow augmentation (Fox, 1991). Combined, these projects would encompass about 9,960 acres in Guilford, Randolph, and Rockingham Counties, and, thus, represent the largest of the project alternatives considered.

The Benaja Lake site is located in Rockingham and Guilford Counties. An RCC dam would be constructed on the Haw River north of SR-2429 to create a lake of approximately 3,830 acres at elevation 712 feet m.s.l. This would impound approximately 18,630 acre-feet of water to form a water supply with an estimated SY₅₀ of 26 mgd (CH2M Hill, 1985). A buffer zone around the perimeter of the lake would require about 3,830 acres. The total project would cover about 7,660 acres, and its watershed would be 69 square miles.

Polecat Creek Lake would be located in the Deep River basin in Randolph and Guilford Counties and would have a drainage area of 55 square miles. An RCC dam would be constructed below the confluence of Polecat Creek and Little Polecat Creek (Fox, 1991). The reservoir would store approximately 15,500 acre-feet of water supply at elevation 700 feet m.s.l. to provide a safe yield of approximately 14.3 mgd. The lake and a 200-foot-wide buffer zone would each require about 1,150 acres resulting in a total project area of about 2,300 acres.

Together, Benaja Lake and Polecat Creek Lake would encompass approximately 9,960 acres, far more than any other reservoir alternative (66 percent more than Randleman Lake). However, this alternative may provide a water supply of higher quality than the other reservoir alternatives because the watersheds of these two reservoirs are less developed. **Currently, there are three NPDES dischargers in the Benaja Lake watershed and four NPDES dischargers in the Polecat Creek Lake watershed. The dischargers in the Benaja Lake watershed are small domestic treatment facilities. The dischargers in the Polecat Creek Lake watershed include two small industrial facilities and two small domestic treatment facilities. For the Benaja Lake watershed, benthic macroinvertebrate data for the Haw River at Guilford County SR 2109 indicated a Fair water quality in 1993 and 1998 (NCDENR, 2000a). The Haw River was rated Poor for fish in 1998 at the same location. Instream habitat degradation associated with agricultural nonpoint sources may be the cause of impairment. Biological ratings may also reflect the low flow conditions in this stream. Benthic macroinvertebrate data for Polecat Creek at Randolph County SR 2113 indicated Good water quality in 1993 and 1998.**

Up to 3.8 mgd, or approximately 9 percent of the 40.3 mgd safe yield, would be diverted from the Haw and Deep River basins. Up to 2.1 mgd would be diverted from the Haw River basin to the Deep River basin, and up to 1.7 mgd from the Deep River basin would be diverted to the Yadkin River basin through High Point's

Westside WWTP on Rich Fork Creek. A permit from the NCEMC would be required for these interbasin transfers.

The estimated total cost of constructing the Benaja Lake and Polecat Creek Lake project is approximately \$178 million.

The combination of Benaja Lake and Polecat Creek Lake would provide a combined SY₅₀ of 40.3 mgd. Based on existing demand projections, this alternative could provide an additional water supply sufficient to satisfy the needs of PTRWA members through approximately 2040, or about 80 percent of the 50-year planning horizon. This alternative is further evaluated in *Section 3.3*.

3.2.5 Alternative D - Purchasing Water from Other Municipalities. The City of Burlington's Lake Mackintosh is located in the Haw River basin approximately 10 miles east of Greensboro. Completed in the spring of 1993, this lake provides a SY₂₀ of 36 mgd. The 1992 Water Supply Plan for the City of Burlington lists a second water supply source for the city, the Stony Creek Reservoir, with a SY₂₀ of 12 mgd. A third reservoir, Lake Cammack, is upstream of and drains into the Stony Creek Reservoir and is not a separate water supply source. The total SY₂₀ for the two water supply sources is assumed to be 48 mgd. Both water supply sources are used to meet the water demands of the City of Burlington.

On July 6, 1990, the City of Greensboro experienced its then greatest daily demand for water, 44.03 mgd, with an hourly peak that reached 55.96 mgd. This surpassed the City's total treatment capacity and prompted the Greensboro City Council, in January 1991, to authorize improvements at the Lake Townsend WTP to expand its treatment capabilities. While expansion of treatment capacity did not increase the safe yield of the water supply, it did permit intermittent withdrawals greater than the existing safe yield from the three lakes which provide raw water for Greensboro.

Subsequently, in March 1992, officials from Burlington approached the City of Greensboro concerning the potential for sale of raw or finished water to Greensboro. Initial discussions included a proposal from Greensboro to acquire ownership of a portion of Burlington's water resources (treatment plant capacity and reservoir capacity), as an alternative to expanding the Townsend plant. This option was rejected by Burlington.

The staffs of Burlington and Greensboro were then directed to develop a plan that would ultimately ensure delivery of 10 mgd from the Burlington system to the Greensboro system until the year 2000. Comparisons of the cost of the Townsend WTP expansion versus the short-term purchase of water from the Burlington system indicated that it was more cost-effective to expand the Townsend WTP. In June 1993, the City of Greensboro awarded the construction contract to make the necessary improvements. This decision provided a solution to Greensboro's problem only for short-term intermittent periods of high water usage.

There is no indication on the part of the City of Burlington that Lake Mackintosh and the Stony Creek Reservoir can be considered an additional long-term alternative for the City of Greensboro and the other PTRWA member governments. The projected year 2020 water use for the City of Burlington from the City's 1992 Water Supply Plan is 14.2 mgd. The 1992 Water Supply Plan also indicated that the total contract amount for purchase of water from the Burlington system by other jurisdictions was 4.27 mgd. The sum of the 2020 water demand for the City of Burlington and the current total contract amount for water supplied to other jurisdictions is approximately 18.5 mgd. Allowing for increases in the water

demand for the City of Burlington from 2020 to 2050, it is estimated that less than 20 mgd would be available in 2050 for sale to other water systems. Therefore, the alternative of purchasing water from the City of Burlington would not meet the projected water demand for the PTRWA members for the 50-year planning period and is not a feasible alternative. In addition, extensive discussions have been held between Greensboro and Burlington officials and the City of Burlington has expressed a willingness to sell water to Greensboro in an emergency or on a short-term basis only. Since this alternative can not be developed as a long-term solution, it was eliminated from further consideration.

3.2.6 Alternative E - Development of Groundwater Wells. Groundwater may offer an attractive water supply alternative to surface water impoundments. The potential for groundwater use has previously been researched during the Cape Fear River Basin Study (NCDNRCD & U.S. Water Resources Council, 1983) and by the USACE (1980).

The upper Cape Fear River basin falls within the physiographic area known as the Piedmont province, where groundwater is stored in the regolith (the surface layer of loose incoherent rock material) and in the underlying bedrock. Nearly all groundwater is found in the regolith, which has an average thickness of 50 feet and an average depth to water table of 15 feet. Assuming that the remaining 35 feet is saturated and has a 20 percent drainable porosity, 1.5 billion gallons of groundwater are stored in each square mile. This amount would vary seasonally from about 1.3 to 1.7 billion gallons per square mile (NCDNRCD & U.S. Water Resources Council, 1983).

Groundwater in the Piedmont has a relatively low cost of development and generally is of good chemical quality, requiring little treatment. The quantity of stored groundwater is estimated to be sufficient to sustain moderate yields during annual drought periods. The maximum availability of groundwater in the study area is estimated to be approximately 0.29 to 0.36 mgd per square mile of land surface. Wells sited using geohydrologic knowledge and technology can be expected to produce average long-term yields of 0.072 mgd. Given optimum site conditions, long-term yields as high as 0.108 mgd are possible (NCDNRCD & U.S. Water Resources Council, 1983). Assuming an average yield of 0.072 mgd per well and 0.29 mgd per square mile, approximately 670 wells and 165 square miles (106,000 acres) would be required to supply the same yield as a 48 mgd reservoir.

There are, however, a number of environmental, institutional, and economic constraints to the development of groundwater for a regional water supply system. Withdrawal of groundwater on a large scale reduces streamflow in the area around and downstream of the wells. Also, seasonal variations in the thickness of the saturated zone place practical limits on withdrawal rates. During summer months, pumping rates may have to be lower than the average yearly recharge rate (the rate at which groundwater storage is replenished through precipitation) to prevent groundwater depletion. The use of groundwater would require locating and acquiring reliable well sites and obtaining easements for a complex water collection system. The cost of the land rights, of constructing up to approximately 670 wells, and of piping the water from so many wells to the customer distribution system would be very high, and the complex system would be difficult and costly to operate. In addition, land use controls would have to be implemented to protect the areas of recharge and maintain the quality of the groundwater supply.

For these reasons, the use of groundwater alone to meet the projected water demands for the area was considered not to be a viable alternative and was eliminated from consideration. The use of groundwater on a more limited scale was considered in conjunction with the development of a small reservoir in *Section 3.2.7, Alternative F, Combination of Benaja Lake and Groundwater Wells*.

3.2.7 Alternative F - Combination of Benaja Lake and Groundwater Wells. The construction of Benaja Lake could be augmented with the development of a well field in the vicinity of the lake to provide a water supply with a SY₅₀ of 48 mgd.

Identical to its description in *Alternative C*, the Benaja Lake site is located in Rockingham and Guilford Counties. An RCC dam would be constructed on the Haw River north of SR-2429 to create a lake of approximately 3,830 acres at elevation 712 feet m.s.l. This would impound approximately 18,630 acre-feet of water to form a water supply with an estimated SY₅₀ of 26 mgd (CH2M Hill, 1985). A buffer zone around the perimeter of the lake would require about 3,830 acres. The total project would cover about 7,660 acres, and its watershed would be 69 square miles.

A well supply could be developed to provide the additional 22 mgd (48 mgd – 26 mgd = 22 mgd) necessary for meeting the PTRWA goal. The development of a groundwater supply has been previously discussed in *Section 3.2.6*. Using an average yield of 0.072 mgd per well and 0.29 mgd per square mile, 22 mgd would require 305 wells and would necessitate the purchase or land use control of approximately 75 square miles (48,000 acres). It is assumed that this well field would be in the Haw River basin, and the majority of the estimated 305 wells would be situated in Rockingham County.

Although the majority of this combination project would be located in Rockingham County, no project land can be condemned or acquired in that county without the approval of the Rockingham County Commissioners. In addition, Rockingham County would have to adopt watershed protection ordinances and adopt zoning, as necessary, to protect well sites and recharge areas if they existed in the county.

The tremendous acreage affected by this alternative would have major impacts on its costs and practicality. With estimated well development costs of \$61 million, the total project is estimated to cost approximately **\$187 million**, which is **the second highest cost for the feasible alternatives**. Nevertheless, the estimated safe yield of this Combination Alternative would adequately address the estimated water supply needs of the PTRWA members over the next 50 years. Therefore, this Combination Alternative is further evaluated in *Section 3.3*.

3.2.8 Alternative G - No Action. This alternative considers using the existing sources of water supply to serve the projected need of the PTRWA members. This would require no action by the PTRWA. No additional groundwater or surface water sources would be developed to augment existing supply, and withdrawal rates from existing supply sources would be maximized.

No action would result in a water supply deficit for all members of the PTRWA before the end of the 50-year planning period. Therefore, this alternative is unacceptable and is not considered for further evaluation.

3.2.9 Summary of Characteristics of Reservoir Alternatives. Alternatives D (Purchasing Water from Other Municipalities), E (Development of Groundwater Wells), and G (No Action) were eliminated from detailed evaluation due to serious deficiencies which made them unacceptable. Alternatives A (Upper Deep River Lake), B (Altamahaw Lake), C (Benaja Lake-Polecat Creek Lake), and F (Combination of Benaja Lake and Groundwater Wells) were all analyzed in greater detail. *Table 9* summarizes the physical characteristics, yields, costs, and factors affecting their suitability as a water supply.

3.3 EVALUATION OF RESERVOIR ALTERNATIVES

3.3.1 Introduction. The proposed project and additional reservoir alternatives were evaluated and compared as a potential new water supply. The factors in this analysis included the following:

- Environmental impacts
- Project costs
- Effectiveness in meeting the purpose and need

3.3.2 Environmental Impacts. The categories of environmental impacts would be similar for all the reservoir alternatives. Impacts would differ primarily in the degree to which specific aspects of the environment may be affected. The impacts of the proposed project and the project alternatives are presented in a comparative form in *Table 10* and discussed in *Sections 3.3.2.1* and *3.3.2.2*. The impacts are evaluated, by category, for all pertinent aspects of the man-made and natural environments. All alternatives would generate some impacts which may be insignificant when considered singularly. However, the collective impacts of any of the alternatives would be significant.

All the reservoir alternatives represent large projects which would result in the acquisition of thousands of acres of land. Project land requirements would be smallest for Upper Deep River Lake (4,880 acres) followed, in ascending order, by Randleman Lake (6,000 acres), Altamahaw Lake (7,280 acres), Benaja Lake-Polecat Creek Lake (9,960 acres), and the Combination of Benaja Lake and Groundwater Wells (7,660 acres for reservoir plus land use controls or purchase of approximately 48,000 acres for well fields). Some of the adverse impacts of these alternatives are reflections of project size, such that alternatives with larger land requirements produce greater adverse effects. In this respect, the larger projects would change current land uses over larger areas and would be more destructive of plant communities and their associated wildlife inhabitants and habitat. When evaluated on this basis, Upper Deep River Lake and Randleman Lake are expected to generate less significant impacts than the other alternatives.

Other types of impacts are more related to environmental characteristics and the level of existing development of the project location than to project size. Such impacts include the numbers of residences affected, the numbers of stream miles inundated, the numbers of roadways requiring modifications, the amounts of interbasin water transfer, and the acreages of wetlands affected. As *Table 10* indicates, no project alternative would be clearly superior in minimizing all categories of environmental impacts.

The main adverse impacts of implementing the proposed Randleman Lake project include the following:

- Acquisition of approximately 6,000 acres of land and conversion of its land uses.
- Inundation of approximately 3,000 acres, including over 2,100 acres of forests, 28 miles of free-flowing streams, 121 acres of wetlands, 868 acres of agricultural land, **approximately 337 acres of prime farmland**, 45 acres of developed land, 28 residences, one business, and portions of 15 roads.
- A direct capital cost of approximately **\$140 million** and a loss of local tax revenues through removal of lands from the tax rolls.
- Direct, permanent loss of approximately 3,000 acres of terrestrial wildlife habitat by inundation, and the related loss of many of its wildlife inhabitants, either through direct mortality or by displacement to other areas. Those displaced to other lands would be subject to overcrowding stress and mortality if the carrying capacity of those areas is exceeded.
- Direct, permanent loss of the stream environment along 28 miles of affected area. Fish and wildlife species unable to adapt to a lake environment would decline or disappear.
- The disruptions of community and family interactions and the personal inconvenience resulting from the displacement of 28 residences and portions of 16 farms. Some area residents would experience longer driving distances due to necessary road closures and the physical barrier posed by the lake.
- Flow reductions at downstream hydropower facilities. During the period of reservoir filling, these reductions would range from 76 percent of average flow at Randleman to 9 percent at Moncure. **This reduction would be slightly less during May through July because of additional releases to maintain a minimum flow of 75 cfs at Coleridge (except when natural flows are less than 75 cfs) during spring spawning and juvenile development periods for the Cape Fear shiner.** After filling, permanent reductions in average flow would range from 27 percent at Randleman to 3 percent at Moncure. The economic consequences of these reductions would vary on a case-by-case basis and have not been confirmed by the affected facilities.

The primary beneficial impact of the proposed project is the development of an adequate and reliable long-term water supply for the Piedmont Triad region. This would help to sustain the existing high quality of life in the area and would promote the economic viability of the region. Additional beneficial effects would include the preservation of approximately 3,000 acres in the project buffer zone in a natural state amidst an urbanizing environment. The 3,000-acre lake would also be capable of providing a good sport fishery representing an improvement over the present degraded stream fishery. **The lake fishery and the green space provided by the project buffer area could provide additional recreational opportunities.**

3.3.2.1 The Man-Made Environment. The principal differences in impacts among project alternatives, relative to the man-made environment, are the magnitude of land use changes, the number of residences displaced, the number of roadways requiring relocation, and the project costs.

The implementation of the proposed Randleman Lake project would require the acquisition of approximately 6,000 acres and the conversion of its present land uses to that of permanent water storage. This acreage would also be removed from local tax rolls, resulting in a loss of tax revenues to the affected municipalities and counties. The project alternatives vary in these size-related aspects from Upper Deep River Lake, with 4,880 acres (19 percent smaller than Randleman), up to the Combination Alternative, which would require 7,660 acres (28 percent more than Randleman) plus acquisition or land use controls of about 48,000 additional acres for well field requirements (for a total of 55,660 acres, or 828 percent more than Randleman). Altamahaw Lake would utilize 7,280 acres (21 percent larger than Randleman), while Benaja Lake-Polecat Creek Lake would require 9,960 acres (66 percent larger than Randleman).

Randleman Lake would displace 28 residences, while the other alternatives would displace from 7 (Altamahaw Lake) to 41 (Upper Deep River Lake). While the impacts on the affected residents could certainly be substantial, the displacement of fewer than 50 families for a large water supply project would represent a relatively small amount of impact.

Roadway relocation and abandonment for Randleman Lake would affect portions of 15 roadways. However, the long anticipation of this project has led the N.C. Department of Transportation (NCDOT) to plan and accomplish its road upgrades in a manner compatible with this alternative. Interstate-85 and U.S. 220 Business were constructed in this way. The other alternatives would impact from 5 (Combination Alternative) to 15 (Upper Deep River Lake) roadways. Altamahaw Lake would impact 10 roads and one railroad. Benaja-Polecat Creek Lakes would affect 11 roads.

Project costs vary substantially. Randleman Lake, at approximately \$140 million, is the least expensive, while the Upper Deep River Lake Alternative, at \$192 million (37 percent higher), is the most expensive. In increasing order of cost above Randleman are Altamahaw Lake at \$169 million (21 percent higher), Benaja Lake and Polecat Creek Lake at \$178 million (27 percent higher), and the Combination Alternative at \$187 million (34 percent higher).

All the project alternatives would produce similar types of impacts on population, employment, municipal and county services, utilities, energy consumption, social and community structure, and cultural resources. Overall, the degree of these impacts is not expected to be major and would be similar among alternatives. These impacts are listed in *Table 10*.

3.3.2.2 The Natural Environment Major differences in impacts among project alternatives, in terms of the natural environment, relate to differences in project sizes and the associated changes in values of the vegetation and wildlife resources. In addition, differences among alternatives are moderate relative to the number of stream miles inundated and are substantial in terms of the amount of interbasin water transfer.

The approximately 6,000-acre Randleman Lake project would impact wildlife values in several major ways, both positive and negative. First, the lake would permanently inundate about 3,000 acres of terrestrial wildlife habitat, including over 2,100 acres of forests that would no longer be available. Second, the wildlife on these lands would experience either direct mortality or displacement to adjacent lands. Since the adjacent lands have a finite carrying capacity, it is possible that all displaced animals could not be accommodated and that some or most would perish. The approximately 3,000-acre buffer zone would be permanently protected in a

natural state, thereby preserving wildlife habitat in an urbanizing environment where such habitat is disappearing. Therefore, the future without Randleman Lake would entail gradual urbanization and development of the **approximately 6,000 acres** of project lands, with an attendant loss of wildlife habitat. With Randleman Lake, **approximately 3,000 acres** of wildlife habitat would be lost immediately, but **approximately 3,000 acres** in the buffer zone would be permanently protected. A similar situation would exist if any other project alternative is implemented. The impacts would differ only in scale, with the smallest acreage affected by Upper Deep River Lake, and the greatest by Benaja Lake-Polecat Creek Lake or the Combination Alternative (depending upon how lands for well fields are controlled and managed).

All project alternatives would inundate several miles of main stem stream habitat. The amounts would vary from 14 miles for the Combination Alternative, which includes only a small reservoir, to 28 miles for the Randleman Lake project. Upper Deep River Lake, Altamahaw Lake, and Benaja Lake and Polecat Creek Lake would inundate 20, 25, and 26 miles of stream, respectively. In each case, the stream habitat would be lost, and fish and wildlife species unable to adapt to a lake environment would decline or disappear. Species primarily affected would be fish and invertebrates characteristic of stream riffles. Fish species such as darters and shiners, which utilize such habitat, would not survive in the reservoir. Each project alternative would establish a new lake environment capable of supporting a good sport fishery with viable populations of bullheads, catfish, bluegill, largemouth bass, crappie, and other sunfish. Each would also provide expanded habitat for waterfowl. The magnitude of these beneficial effects would reflect the project size.

All project alternatives would result in some interbasin transfer of water. Water of each alternative would pass through an intake, treatment, and distribution system to the users. Water not lost through consumptive uses would pass through wastewater treatment facilities and, ultimately, to a discharge point on a waterbody. The point of discharge may be located in a river basin or subbasin different from the point of origin; hence the term "interbasin transfer." The effects of such transfers are to deprive some streams (in the water supply basin) of their natural flow rates and provide unnaturally high flows in other streams (in the discharge basins). In addition, the water discharged from WWTPs into the receiving streams may be of lower quality than the water supply withdrawn. Such alterations of natural conditions may result in changes of biota within and adjacent to the affected streams. Changes within streams may include alteration of water temperatures, dissolved oxygen levels, nutrient concentrations, and concentrations of chemical pollutants. Changes adjacent to streams may include altered groundwater levels which affect the suitability for plant growth and the types of plant communities able to thrive. The altered stream flow rates which result from interbasin transfer may also impact downstream manmade facilities, such as hydropower facilities and water supply reservoirs. The amounts of interbasin transfer for the project alternatives are shown in *Table 11*.

The data in *Table 11* indicate that the effects of interbasin transfer would probably be similar for Randleman Lake and Upper Deep River Lake since the same water supply basin and same receiving basins are involved and the amounts of transfer are comparable. Likewise, Altamahaw Lake and the Combination Alternative are similar to each other, but would involve somewhat lower amounts of transfer. Only the Benaja and Polecat Creek Lakes alternative would involve a substantially lower amount of interbasin transfer. The significance of these potential transfers is difficult to assess. The Randleman Lake project would appear to be the potential worst case; and yet it has already passed the public review process associated with the State EIS and has been granted an interbasin transfer permit by the NCEMC. Consequently, the specific impacts of interbasin transfer associated with the proposed project have already been judged acceptable by the State of North Carolina. Based upon the lower amounts of transfer for the other alternatives, the impacts of these potential

transfers may likely also be acceptable. This topic is discussed in more detail in *Section 5.3.5.8, Interbasin Transfer*.

In terms of water transfers, all the alternatives could potentially affect the operation and management of B. Everett Jordan Lake, which is located on the Haw River approximately 4.2 miles upstream of its confluence with the Deep River. Since flows in the Haw River affect the amount and quality of water stored in Jordan Lake, water transfers to or from the upper Haw River basin could affect the dependability of the lake's water supply storage and water quality. Randleman Lake and Upper Deep River Lake would contribute 28.5 mgd and 23.7 mgd, respectively, of treated wastewater to the headwaters of the Haw River basin. Altamahaw Lake, Benaja and Polecat Creek Lakes, and the Combination Alternative would remove 19.5 mgd, 2.1 mgd, and 19.5 mgd, respectively, from the Haw River upstream of Jordan Lake and discharge into other river basins. Because of concerns regarding Jordan Lake's nutrient levels and water allocations, alternatives that remove water from the Haw River system would likely be more detrimental than those contributing additional treated wastewater. Thus, Randleman Lake and Upper Deep River Lake may present fewer problems in the future management of Jordan Lake. Adverse effects on Jordan Lake, if they occur, may not be apparent for years or decades depending upon the rate of increase in interbasin transfer. In addition, such effects could be influenced by a number of factors, such as advances in water and wastewater treatment technology, the destinations of water allocations from Jordan Lake and other water supply lakes, and hydrologic changes due to alteration of land uses in the drainage basins of the reservoirs involved. The potential effects of such interbasin transfers **have not been** estimated. Water reallocation modeling studies for Jordan Lake **have been** conducted by the State of North Carolina (Moffatt & Nichol, 2000). **However, the model does not address water quality in Jordan Lake, and therefore does not address measures for operation and management of Jordan Lake Dam to mitigate water quality problems in Jordan Lake.**

All project alternatives would involve wetland losses. Because the Randleman Lake project has long been anticipated by local governments as the water supply for the Piedmont Triad, funds were committed to thoroughly delineate its wetlands through the use of available wetland mapping and detailed, site-specific field investigations. The resulting delineations were verified by the USACE and mapped. The amount of unavoidable wetland loss for the Randleman Lake project is 121 acres. Since detailed wetland delineations were not conducted for the other project alternatives, and National Wetland Inventory (NWI) maps are not available for the project area, wetland impacts of the alternatives can only be estimated. Such estimations are based upon the characteristics which define wetlands.

Lands qualify as wetlands only if they meet certain criteria, including (1) the presence of hydric soils, (2) specific soil saturation conditions, and (3) the presence of specific indicator plant species. Without data to address all three criteria, the amount of hydric soils present in an area is the single characteristic that can best be used to roughly estimate the potential presence of wetlands. This is due to the more permanent nature of hydric soil characteristics, as opposed to the natural and manmade fluctuations that occur in soil saturation conditions and vegetation.

In the largest perspective, soils with potential hydric inclusions provide the broadest measure of the potential existence of wetlands. All the project alternatives are similar in this respect in that they have from 645 to 845 acres of such soils. On this basis, the alternatives cannot be clearly differentiated in terms of potential wetland impacts.

A closer approximation of wetlands present can be provided by the acreage of mapped hydric soils within a project area. The acreage of mapped hydric soils within the reservoir area of the project alternatives varies from 7 acres for Upper Deep River Lake to 735 acres for the Benaja Lake and Polecat Creek Lake alternative and the Combination Alternative. Intermediate acreages of mapped hydric soils in the reservoir areas of the Randleman Lake and Altamahaw Lake alternatives are 37 and 470 acres, respectively.

Without an onsite wetland delineation, even the acreage of mapped hydric soils quite often provides an inexact estimate of wetlands present. For example, Randleman Lake has only 37 acres of mapped hydric soils, but was found to have 121 acres of wetlands based upon detailed site-specific investigations. Despite this difference, acreages of mapped hydric soils provide the best indicator of wetland presence, in the absence of detailed site-specific data. In this respect, Upper Deep River Lake (7 acres) and Randleman Lake (37 acres) reflect levels of potential wetland impact at the lower end of the scale, while Altamahaw Lake (470 acres), the Combination Alternative (735 acres), and Benaja and Polecat Creek Lakes (735 acres) suggest a considerably higher level of impacts.

A band of new wetlands would gradually develop along some portions of the perimeter of any reservoir alternative due to the wet soil conditions. The width of this band would depend upon the slope of the adjacent land, and flatter areas would generate wider bands. Many areas have steep slopes, so the wetland band would be expected to be narrow, if present. Newly formed wetlands would be primarily emergent and would provide habitat for wildlife.

All project alternatives are similar in other impacts, as shown in *Table 10*. Each would result in temporary soil erosion and sedimentation during project construction, temporary reductions in local air quality during construction, temporary increases in noise during construction, permanent inundation of soils in the reservoir, topographic modifications associated with the dam and lake surface, permanent reductions in downstream flows, and augmentation of downstream low flows.

No project alternative is expected to **adversely affect listed endangered or threatened species or to cause substantial impacts on climate, geology, air quality, noise, State-protected natural areas, or scenic rivers.**

All project alternatives can be expected to provide improved sport fisheries, new outdoor recreational opportunities, and new scenic vistas associated with a lake environment.

As was noted previously, no project alternative would be clearly superior in minimizing all categories of environmental impacts. However, in terms of size-related factors such as number of acres to be acquired, acres of land use changes, acres of plant communities destroyed, and acres of wildlife habitat affected, the impacts generated by Upper Deep River Lake and Randleman Lake would be less than those of the other alternatives. Upper Deep River Lake and Randleman Lake would also rank most favorably, if alternatives are compared on the basis of minimizing the loss of wetland acreage.

3.3.3 ECONOMIC COMPARISON OF ALTERNATIVES

Project development would incur costs for numerous elements, including **land** acquisition, land clearing, dam construction, **modification** of roadways and utilities, environmental and cultural resource compliance, permitting, engineering and design, technical studies, construction management, and contingencies. **Reservoir**

development cost for the proposed Randleman Lake is shown in *Table 12*. For the proposed project, estimated road modification costs and reservoir development costs are presented in *Tables 12a* and *12b*, respectively. Costs are presented in *Tables 12c* through *12f* for the reservoirs for Alternatives A, B, C, and F. Road modification and reservoir development costs for the alternative reservoir projects were estimated based on a comparison with the more detailed costs prepared for the proposed Randleman Lake project. Other cost items were estimated using the unit costs included in the notes in *Table 13*.

Total project costs would include, in addition to reservoir costs, any associated costs for water treatment plant construction, water intake structures, water transmission lines and pumps, replacement and upgrades required at WWTPs, contaminated site cleanup, and, in the case of the Combination Alternative, well development costs. The total capital costs for the five alternatives range from a low of approximately \$140 million for Randleman Lake to a high of approximately \$192 million for the Upper Deep River Lake alternative. This represents a 37 percent difference between low and high capital cost estimates. Altamahaw Lake (\$169 million), Benaja and Polecat Creek Lakes (\$178 million), and the **Combination Alternative** (\$187 million) are intermediate in cost. A summary of the costs for each alternative is presented in *Table 13*.

Randleman Lake is the lowest cost alternative. The capital cost for development of the Randleman Lake is estimated at approximately \$140 million, or approximately \$2.9 million per mgd of safe yield. On the basis of total cost or cost per mgd, the next lowest cost alternative is Altamahaw Lake, which is approximately 21 percent higher than Randleman. The annual operation and maintenance costs for the Randleman Lake, Upper Deep River Lake, and Altamahaw Lake alternatives are considered approximately equal, while the annual operation and maintenance costs would be higher for the Benaja and Polecat Creek Lakes alternative (due to the necessity of two water plants) and the Combination Alternative (due to the operation and maintenance of one water plant and approximately 305 wells).

3.3.4 EFFECTIVENESS IN MEETING THE PURPOSE AND NEED

3.3.4.1 Water Quantity. All the reservoir alternatives would provide from 40 to 48 mgd of additional water supply for PTRWA member governments. Randleman Lake, Altamahaw Lake, and the Combination Alternative are each capable of fully meeting the projected additional water demands (48 mgd) of the PTRWA over the 50-year planning horizon. Upper Deep River Lake and Benaja Lake/Polecat Creek Lake would meet the projected demands over approximately 40 years (40 mgd), or 80 percent of the planning period.

3.3.4.2 Water Quality. All the feasible alternatives would provide a water supply of moderate to good quality raw water which could, with conventional water treatment, meet the requirements of the Safe Drinking Water Act and NCDENR criteria for finished drinking water.

3.3.4.3 Reliability. Reservoirs provide a very reliable source of water for municipal water supply. Due to the immense quantity of stored water, daily and seasonal flow variations associated with river supplies are significantly diminished. Groundwater is subject to seasonal variations and may require periodic withdrawal constraints. In terms of the reliability of water quantity, all four reservoir-only alternatives would be similar. However, the Combination Alternative may be less reliable due to the uncertainties associated with the development of a large well field.

The accomplishment of watershed protection and zoning controls is expected to be easier in counties which are members of the PTRWA. Therefore, Randleman Lake and Upper Deep River Lake would be more reliable in this respect than the other alternatives.

3.3.5 SUMMARY COMPARISON OF RESERVOIR PROJECT ALTERNATIVES

All five reservoir alternatives would create similar types of environmental impacts (*Table 10*), and the cumulative impacts of any of these alternatives would be significant. Impacts that are a function of project size, such as land use changes, destruction of plant communities, and wildlife habitat losses, would be less severe for the smaller alternatives. In this respect, Upper Deep River Lake and Randleman Lake are considerably smaller than the other **three reservoir** alternatives and would produce lower levels of impacts. Impacts that result from factors other than project size, including wetland impacts, stream miles inundated, amounts of interbasin transfer, and numbers of roadways affected, cannot be collectively minimized by alternative selection. For example, less significant wetland impacts would be created by Randleman Lake or Upper Deep River Lake, stream mile inundation would be lowest for the Combination Alternative followed by Upper Deep River Lake, the amount of interbasin water transfer would be lowest for Benaja Lake and Polecat Creek Lake, and the number of roadways affected would be lowest for the Combination Alternative followed by Altamahaw Lake. In minimizing overall environmental impacts, Randleman Lake and Upper Deep River Lake rate highest due to their smaller size and less significant wetland impacts.

In comparison to Randleman Lake, Upper Deep River Lake would inundate more developed land in High Point as well as about 20 percent of the Seaboard Chemical site, the High Point landfill, and the High Point Eastside WWTP. Randleman Lake (48 mgd and **\$140 million**) would provide a safe yield about 20 percent higher than Upper Deep River Lake (40 mgd and **\$192 million**), and its cost would be about **\$52 million** less. Randleman Lake is the applicant's preferred alternative for several important reasons. These reasons are:

- it fully satisfies the project purpose and need by providing a safe, reliable water supply that is adequate to meet projected needs over approximately 50 years;
- it is the least costly alternative by a substantial margin (**\$29 million** less than the next cheapest alternative, **and \$52 million** less than Upper Deep River Lake, the most expensive alternative);
- it is located within the counties of member governments so that watershed protection and zoning controls can be effectively managed;
- its wetland impacts are judged to be in a range comparable to those of Upper Deep River Lake and substantially lower than those of all other alternatives; and
- its adverse impacts, while significant, are comparable to or lower than those of the alternatives.

The USACE finds that the applicant's preferred alternative is substantially less expensive than the other reservoir alternatives, and that the environmental impacts would be in a range comparable to those of Upper Deep River Lake and substantially lower than those of all other reservoir alternatives. The applicant's preferred alternative is evaluated and discussed in further detail in *Section 5.0, Environmental Consequences of the Proposed Action*.

3.3.6 PRELIMINARY COMMITMENTS OF THE APPLICANT

Randleman Lake has been anticipated as the water supply for the Piedmont Triad region since the late 1960s. As a result, numerous steps have already been taken toward implementing this alternative, even though there has been no assurance that the necessary Section 404 permit would be issued. Watershed protection measures have been in place for more than ten years. **The entire Randleman Lake watershed is currently protected under water supply watershed protection ordinances enacted by the local governments with jurisdiction in the watershed. All of the watershed protection ordinances were approved by the NCEMC by January 1, 2000. These include specific watershed protection measures for a water critical area extending one-half mile beyond the normal pool (shown on *Figure 8* and discussed in Section 5.4.2) and separate protection measures for the remainder of the watershed.** As road and highway modifications have been required in the area, they have been accomplished by the NCDOT in a manner compatible with the expected development of Randleman Lake. The Randleman Lake project has been through the State EIS process, and in December 1991 the PTRWA was granted the powers of eminent domain and interbasin water transfer for the project by the NCEMC. Land acquisition has since been initiated.

No other alternative has undergone this level of preparation. The watershed protection measures implemented for Randleman Lake would also apply to Upper Deep River Lake because Guilford County would be involved in either project. However, the other alternatives involve Rockingham and Alamance Counties. **Rockingham and Alamance Counties have both adopted watershed protection ordinances which protect approved water supply watersheds in their jurisdictions; however, neither has adopted protections for any of the alternatives evaluated above.** In addition, the local governments in these counties are not members of the PTRWA and do not offer political support for a PTRWA project in these counties. If a project were developed in these counties, the PTRWA would not be able to exert control of the water supply, which is considered a serious disadvantage.

These preliminary commitments toward the implementation of the Randleman Lake project clearly reflect the applicant's preference for this alternative. However, this cannot be a reason for the issuance of a Section 404 permit if one of the other alternatives is preferable. Such actions taken by the applicant will not influence the permit decision options available to the USACE.

4.0 AFFECTED ENVIRONMENT

4.1 GENERAL

The existing conditions and status of the project area are described in this section. The project area includes all lands required for the dam and spillway, the 3,000-acre reservoir, and the 200-foot-wide perimeter buffer strip measured outward from the edge of the normal pool. The project vicinity includes the zone of primary influence of the project and is comprised of Guilford and Randolph Counties. This two-county area includes most of the likely water supply service area of the project. A map of the proposed project appears as *Figure 5*. Its relationship to the surrounding vicinity is shown in *Figures 1* and *4*.

4.2 THE MAN-MADE ENVIRONMENT

4.2.1 Population. The populations of Guilford and Randolph Counties have been in an upward trend which is anticipated to continue into the foreseeable future. The 1990 population of 453,966 for the two-county area (NC State Demographer, 1991) is predicted to increase by 25 percent to reach 567,086 by the year 2020 (NC Office of State Planning, 1995).

4.2.2 Land Use. The entire project area has been heavily disturbed by human impacts. The majority of the forestland has been altered to the point that its species composition does not fit easily into any of the natural community classifications. Development is expanding and the loss of forest habitat is expected to continue. New residences and businesses are being built, the natural fire regime and hydrology patterns have been altered, and forest habitats have been severely fragmented. Since the initiation of the proposed Federal project over 20 years ago, many landowners have had their timber clear-cut, possibly in anticipation of purchase or condemnation by the USACE or PTRWA.

The existing mix of land uses in the project watershed appears in *Table 14*. The predominant land use categories are forest and pasture, which comprise 52.5 and 11.9 percent, respectively. All other land use categories individually comprise less than 10 percent of the total, although combined single family residential categories total 13.7 percent.

Over 80 percent of the reservoir pool area and the buffer area is comprised of three land use categories. These include open pastures, fields, and agriculture; alluvial forest; and mesic mixed hardwood forests. Individually, each of these categories makes up from about 28 to 29 percent of the combined pool and buffer acreage. Acreages of land uses and plant communities within the **reservoir pool and buffer area** are further described in *Section 4.3.7, Vegetation Resources* and shown in *Table 16*.

Based on land use information from Carter and Associates (1993), approximately 70 to 72 percent of the land area in the proposed reservoir normal pool and buffer areas is forested land. Approximately 27 to 28 percent of the land area in the normal pool and buffer areas is open pasture or fields. The remaining 1 to 2 percent comprises other land uses, including residential, acidic cliff, low elevation seeps, other agricultural, developed, industrial, ponds, and powerline rights-of-way. Additional data on acreages of community types in the proposed reservoir project area are presented in *Appendix C*.

There are currently six operating dairies in the proposed Randleman Lake watershed, five of which are required to submit a registration form to NCDWQ and to have an approved animal waste management plan under NCDENR regulations (15A NCAC 2H.0217(a)(1)). The six dairies are all located in Randolph County, and four are within the water critical area for the proposed reservoir (described in Section 3.3.6 and shown in *Figure 8*). The locations of the six dairies are shown on *Figure 5e*. Additional information on these dairies is provided in the Responses to NCDWQ Comments on the Draft Nutrient Reduction Strategy for Randleman Lake (March 19, 1998), which are contained in the *Draft Nutrient Reduction Strategy and Implementation Plan* (Hazen and Sawyer, 1998). Information on these dairies is summarized in *Table 14a*.

Based on communication with the State Veterinarian office, there are a total of 20 poultry farms in Subbasin 03-06-08 in the Cape Fear River Basin (Wray, 2000). This subbasin includes the entire Randleman Lake watershed, plus the land area tributary to the Deep River from the proposed Randleman Lake dam to a point approximately 1 mile downstream of the Town of Randleman.

4.2.3 Employment and Economic Activities. Employment by industry is detailed in *Table 15*. The major job sector in Guilford and Randolph Counties is manufacturing, which makes up about 24 percent and 54 percent, respectively, of their annual average employment. Other important sectors include Retail Trade and Service jobs which also make up significant portions of the annual average employment in both counties. Existing mining operations in Guilford County consist of open sand, rock and gravel pits located southwest of the City of Greensboro. Currently, two mining operations are permitted. Information on these two operations is summarized in *Table 15a*. These two operations drain to tributaries of the Deep River within the Randleman Lake watershed. Neither operation is in the water critical area for the proposed lake (see *Figure 8*).

4.2.4 Municipal and County Services. In addition to the water purchase agreements that are detailed in *Section 2.3, Existing Raw Water Sources*, the PTRWA members have entered into other cooperative efforts to ensure that development in the area served by the Randleman Lake would be well-planned, economically feasible, and environmentally sensitive.

Development pressures in the unincorporated portions of northwestern and southwestern Guilford County prompted High Point and Greensboro to enter into an annexation and water/sewer service agreement in 1987. This agreement establishes boundaries, based on existing municipal facilities and growth patterns, within which each city may serve development with water and sewer services and, when appropriate, extend its corporate limits.

Greensboro, High Point, and Guilford County governments have also established economic development incentive programs, through which the costs of water and sewer service extensions and other development costs may be offset if a development meets tax value, job creation, and wage rate thresholds.

High Point, Archdale, and Randolph County have completed a study of the development potential of the Interstate 85/Business 85 corridor that straddles the Guilford/Randolph County line, and High Point and Randolph County have adopted a water and sewer service agreement for the unincorporated areas of the corridor in Randolph County.

in accordance with the designation by the NCEMC of the Randleman Lake watershed as a water supply watershed, all of the local governments with jurisdictions in the Randleman Lake watershed have implemented watershed protection ordinances which restrict land uses to protect the proposed lake.

4.2.5 Cultural Resources. The Randleman Lake project area has numerous known cultural resource sites. Archaeological and architectural surveys have been conducted to identify archaeological and architectural resources in the project area and, where possible, to determine if these resources are potentially eligible for inclusion in the National Register of Historic Places. For the archaeological and architectural surveys, the project area was expanded from that defined in *Section 4.1* above to include property within up to 0.5 miles from the outer edge of the 200-foot buffer zone (Graybeal, 1997).

4.2.5.1 Prehistoric and Historic Archaeological Resources. The initial archaeological work completed for the Randleman Lake project area was done in the late 1970s under the National Park Service, Interagency Archaeological Services Program. Prior to the involvement of the PTRWA in the Randleman Project and while the project was still being considered for Federal participation, the USACE undertook archaeological and historical surveys in portions of the project area (Coe, 1976; Woodall, 1977; Lewarch, 1985). Additional archaeological survey was performed by consultants of the PTRWA in the unsurveyed portions of the project area within the present project boundary that will be subject to land disturbing activities (Lautzenheiser et al., 1997; Lautzenheiser and Lynch, 1998; Reid, 1998). All areas within the present project boundary have been subjected to archaeological survey. These investigations resulted in the discovery of three prehistoric archaeological sites that were determined eligible for the National Register of Historic Places. The bibliographic references for the archaeological site reports resulting from the above investigations can be found in the references cited section of this EIS and are incorporated herein by reference.

4.2.5.2 Architectural Resources. Systematic countywide architectural surveys have been undertaken in Randolph County (Whatley, 1985) and Guilford County (Smith, 1979). This resulted in the discovery of 19 buildings that required further study. A Phase II study conducted for the PTRWA was performed in the project area, as determined in consultation with the North Carolina State Historic Preservation Officer (SHPO) for the area to be inundated and 1/2 mile surrounding the proposed lake boundary (Graybeal, 1997). This survey completed in June 1997 concluded that two historic districts, the Freeman Mill Historic District and the Coltrane Mill Historic District, would be adversely affected by the project. No other significant architectural resources were found within the project's area of potential effect. The bibliographic references for the architectural reports resulting from the above investigations can be found in the references cited section of this EIS and are incorporated herein by reference. All of the architectural surveys and treatments were conducted in consultation with and with the approval of the North Carolina SHPO.

4.3 THE NATURAL ENVIRONMENT

4.3.1 Climate. The region has a moderate climate with an average annual temperature of approximately 60 degrees F and average annual precipitation of about 46 inches. The frost-free season is approximately 200 days, and there is no prolonged wet or dry season.

4.3.2 Topography. The Piedmont is an uplifted peneplain in various stages of dissection, with a general slope from the mountains on the west to the coastal plain on the east. In the Randleman Lake project area of

eastern Randolph and southern Guilford Counties, the hills are generally well-rounded, indicating a geologically intermediate stage of erosion. The topography slopes from 850 feet in northwestern Randolph and southern Guilford Counties to approximately 300 feet in southern Randolph. Local relief rarely exceeds 200 feet and averages 50 to 100 feet. The Deep River and its tributaries are deeply incised into the northeast/southwest-trending, gently rolling hills and valleys. Generally, the primary impact area of the Randleman Lake project is characteristic of the regional trends in the piedmont physiographic province (USACE, 1980).

4.3.3 Geology. The area of the proposed Randleman Lake project is underlain by rocks of the Central Piedmont Granite Belt (Carolina Igneous Belt) and the Carolina Slate Belt. The mineral resources within the two-county area are relatively unimportant to the economy of the area, but are nevertheless diverse. Small deposits of gold, copper, and coal have been found, but are not now of any significant commercial value. There are, however, a few commercially valuable stone, clay, and sand and gravel sites. Sand and stone are being produced within the primary impact area of the proposed project. A meander scar that represents past geologic conditions and expresses geologic processes particularly well is located along the Deep River about one mile from Jamestown, N.C. The feature is recognized as a potential National Natural Landmark by the National Park Service (USACE, 1980), but it is outside the project boundary.

4.3.4 Soils.

4.3.4.1 Major Soils Associations. The Randleman Lake project area encompasses two major soil associations: (1) Helena-Wilkes and (2) Georgeville-Tirzah. The Helena-Wilkes association is derived primarily from acid crystalline rocks or mixtures with basic crystalline rocks. The association is characterized by yellow, brown, or yellowish-brown firm sandy clay to clay subsoils, often less than 18 inches thick and seldom more than 35 inches thick, and by a gray loam sand to yellowish-gray sand clay loam surface soil. Generally, the slope gradients range from 5 to 18 percent, resulting in a medium to rapid surface runoff. Internal drainage is slow, due to firm subsoil and shallow parent rock. A considerable portion of the land has suffered severe erosion, and many large farming tracts have been abandoned. Most of the association is subject to severe erosion because of the predominance of coarse surface particles and the firm, fine-textured subsoils.

The Georgeville-Tirzah association is derived primarily from the Carolina Slate Belt rocks. The association is characterized by light red to dark red firm silty clay subsoils and gray-brown to red moderately firm silt loam to silty clay loam surface soils. Generally, the slope gradients range from 4 to 18 percent, resulting in medium to rapid surface runoff. Internal drainage is medium. The surface has suffered moderate to severe erosion. Under normal management practices, generally less than 50 percent of the soils are suitable for farming within the primary impact area of the proposed Randleman Lake project (USACE, 1980). Agricultural lands currently comprise about 28 percent of the project area that will be inundated and about 27 percent of the project buffer zone (Carter and Associates, 1993).

4.3.4.2 Prime Farmland. Prime farmland is one of several kinds of important farmland defined by the U. S. Department of Agriculture (USDA). It is of major importance in meeting the nation's short- and long-range needs for food and fiber. Prime farmland soils are soils that are best suited to food, feed, forage, fiber, and oilseed crops. The soils need only to be treated and managed by acceptable farming methods. Prime farmland soils produce the highest yields with minimal expenditures of energy and economic resources. Farming these soils results in the least damage to the environment. The acreage of high-quality farmland is limited, so the wise use of the Nation's prime farmland is extremely important.

The majority of the acreage in Guilford County to be inundated by Randleman Lake is Congaree loam. The Deep River and its tributary streams are situated in Congaree loam. The USDA classifies Congaree loam as prime farmland only when protected from flooding or not frequently flooded during the growing season. The majority (greater than 90 percent) of this affected Congaree loam is wooded and in the floodplain, thus not meeting the prime farmland definition due to frequent flooding. A few pockets of Vance sandy loam are immediately adjacent to the Congaree loam and appear to be farmed. Within Guilford County, the total acreage of prime farmland, outside of floodplains, which would be inundated by Randleman Lake is **estimated to be approximately 27 acres.**

The majority of the prime farmland to be inundated in Randolph County is Riverview loam with lesser amounts of Chewacla loam, Altavista sandy loam, Georgeville silt loam and clay loam, and Wickham sandy loam. Of the approximate 2,200 acres of land in Randolph County that would be inundated by Randleman Lake, a **total of approximately 310 acres has been estimated to be prime farmland. Therefore, the total estimated area of prime farmland to be inundated by Randleman Lake is 337 acres.**

4.3.5 Water Resources.

4.3.5.1 Groundwater. The upper Cape Fear River basin is within the physiographic area known as the Piedmont province, where groundwater is stored in the regolith (the surface layer of loose, incoherent rock material) and in the underlying bedrock. The regolith contains nearly all ground water, and it has an average thickness of 50 feet and an average depth to water table of 15 feet. Assuming that the remaining 35 feet is saturated and has a 20 percent drainable porosity, 1.5 billion gallons of groundwater is stored in each square mile. The amount would vary seasonally from about 1.3 to about 1.7 billion gallons per square mile (NCDNRCD and USWRC, 1983). The maximum availability of groundwater in the study area is estimated to be approximately 0.29 to 0.36 million gallons per day per square mile.

Located along the upper Deep River and adjacent to the proposed Randleman Lake, the Seaboard Chemical Corporation and the High Point landfill (both now closed) have been identified as sources of toxic substances that have contaminated the groundwater at each site. This situation aroused public concern and led to studies concerning potential effects of the contaminated groundwater on water quality of the proposed project. Modeling studies conducted by Black & Veatch predicted that contaminated groundwater from these sites would have no significant adverse impacts on Randleman Lake being used as a public water supply or the proposed water treatment plant being able to meet requirements of the Safe Drinking Water Act (Black & Veatch, 1990, 1991b, and 1994b). **Recent modeling and remedial investigation studies have supported this conclusion.** These studies are discussed in **Section 5.3.5.4 and Appendix F.**

4.3.5.2 Surface Water. The Cape Fear River basin is the largest river basin in North Carolina and is completely within the State boundaries. The Deep River watershed is one of the six major hydrologic areas in this basin, and it drains about 1,442 square miles. The watershed of the proposed Randleman Lake covers approximately 171 square miles in the upper Deep River basin, including two existing water supply reservoirs - High Point Lake and Oak Hollow Lake. Randleman Lake would inundate portions of the Deep River and several of its tributaries, including Muddy Creek, Richland Creek, Reddicks (Register's) Creek, Hickory Creek, and Bob Branch. Most reaches of the tributary streams are less than 50 feet wide, shallow, and often turbid.

The streams are subject to a flashy hydrology due to the rolling topography, steep gradients, narrow valleys, and predominantly clay soils that are conducive to fast runoff.

The State of North Carolina assigns a primary water classification to all surface waters according to their existing or contemplated best use as Class C, B, or WS (15A NCAC 2B .0200). Each classification is assigned best uses and water quality criteria to protect those uses. Class C waters are suitable for propagation and protection of aquatic life, as well as secondary recreation. Class B waters are suitable for primary recreation and Class C uses. The WS classification is assigned to water supply watersheds, and best uses include water supply and Class C uses. There are five WS classes, I through V, which are assigned to watersheds based on the land uses and the amount of development in the watershed. These classifications limit development, restrict point source discharges, and control other management practices within water supply watersheds. Each WS classification has designated management strategies to protect the quality of the water supply.

The upper portion of the Deep River basin, which provides water to High Point Lake and Oak Hollow Lake, is designated as Class WS-IV, **Critical Water Supply Watershed**. The **WS-IV** classification applies to "water supplies in moderately to highly developed watersheds." **The Critical Water Supply Watershed classification is assigned to waters that are subject to a special management strategy. Nutrient Management Strategy rules for the proposed Randleman Lake watershed (15A NCAC 2B.0248 through .0251) have been adopted by the NCEMC and are currently in effect. The rules are designed to address potential problems in the proposed lake resulting from nutrient loadings to the lake. All the watercourses in the Randleman Lake watershed are designated as WS-IV or WS-IV Critical Area, Critical Water Supply Watershed, and are subject to the above rules.**

The State of North Carolina assesses surface water quality to determine how well a waterbody is supporting its designated best uses, such as water supply, swimming, or fishing. All biological and chemical monitoring data for a particular stream segment are evaluated to assign an overall *use support* rating - either *fully supporting* (S), *partially supporting* (PS), or *not supporting* (NS). In addition, the *support-threatened* (ST) rating applies where all uses are currently being supported but where water quality conditions are marginal and may not be able to support uses in the future if conditions worsen. Streams which are either partially supporting or not supporting their uses are considered *impaired* (NCDEHNR, 1996a).

Due to the public interest in the plans for the construction of Randleman Lake, the NCDEM conducted studies in 1992-93 to measure existing water quality in the Deep River (NCDEHNR, 1994a, 1994b). Those studies identified a number of concerns, including high bacterial levels; metals concentrations higher than action levels for copper, zinc, and iron; a few dissolved oxygen concentrations below the water quality standard of 4.0 mg/L; elevated nutrient levels, and violations of the water quality standard for lindane and dieldrin.

The N.C. water quality standards for lindane and dieldrin for all freshwater are 0.01 and 0.002 ug/L, respectively. There is no separate water quality standard for lindane in WS waters, but the applicable standard for dieldrin in WS waters is 0.000135 ug/L. Samples were analyzed in 1992 and 1993 for pesticides and organic chemicals at seven stations in the area of the proposed Randleman Lake (NCDEHNR, 1994b). Of these samples, one had a dieldrin concentration of 0.003 ug/L, which exceeded the State standard for all freshwater as well as for WS water. Numerous violations of the State freshwater standard for lindane were detected, and the lindane concentrations ranged from 0.005 ug/L (estimated) to 0.05 ug/L. Sampling for lindane and dieldrin was later conducted by NCDWQ in 1997 and

no reportable concentrations were found (NCDENR, 1998a). *Appendix F* includes additional information on modeling conducted to estimate lindane concentrations in the proposed lake.

The *Cape Fear River Basinwide Water Quality Management Plan* (NCDEHNR, 1996a) indicated that effluents from municipal wastewater treatment plants make up the majority of the flow in the Deep River during low flow periods, resulting in severe water quality problems throughout the upper portions of the Deep River. According to the *Cape Fear River Basinwide Water Quality Management Plan*, an effluent discharge at the permitted flow rate of 16 mgd for the High Point Eastside WWTP makes up 73 percent of the flow in the Deep River at Freeman Mill, just downstream of the confluence of Richland Creek and the Deep River, during 7Q10 (7-day, 10-year low flow) conditions. During 7Q10 conditions, the proposed expanded WWTP discharge of 26 mgd will make up approximately 82 percent of the flow in the Deep River at Freeman Mill. This WWTP is a major source of nitrogen and contributes more phosphorus to the Deep River than all other discharges combined.

Tests were performed which indicated that the waters of Deep River and Muddy Creek have the potential for significant problems from algal response to nutrients. While nutrient loading in the Deep River receives contributions from nonpoint source input and numerous point source discharges (NPDES permits), the High Point Eastside WWTP is a major contributor to this water quality problem and others (NCDEHNR, 1996a).

A list of NPDES dischargers in Subbasin 03-06-08 of the Deep River watershed is included in *Table 15b*. Urban areas in portions of the Deep River watershed that would drain to the proposed lake include Kernersville, Jamestown, and High Point. Agricultural areas also contribute runoff to the proposed Randleman Lake watershed. These include six operating dairies which are located in the watershed (see *Section 4.2.2* above). Currently, the water quality in the lower Deep River downstream of the proposed project is severely impacted by nutrient loading from upstream sources (NCDEHNR, 1996a). In addition, the Deep River flows over 14 small hydroelectric and mill dams between High Point Lake dam and its confluence with the Haw River, which results in lower stream velocity and reduces assimilative capacity. These conditions have encouraged algal growth in the impoundments behind the dams, resulting in excessive chlorophyll *a* concentrations and major changes in dissolved oxygen (DO). Frequently occurring low DO values have been reported in the Deep River at SR 1400 near Cumnock, the upstream monitoring station for the Sanford Big Buffalo Creek WWTP.

The most recent information on use support for the upper Deep River basin is found in the *Cape Fear Basinwide Water Quality Management Plan* (NCDEHNR, 1996a). Ratings of use support are available for two stations on the portion of the Deep River that would be inundated by Randleman Lake. A station on **Secondary Road (SR) 1921** near the Guilford County-Randolph County line (NCDWQ # B-8) received a biological rating of fair, a chemical rating of partially-supporting, and an overall rating of partially-supporting. This stream section is, therefore, considered impaired. A station located at N.C. 220 Business (NCDWQ # B-9) received a biological rating of good-fair, did not receive a chemical rating, and had an overall rating of support-threatened. For comparison, recent assessments of 6,204 miles of freshwater streams and rivers in the Cape Fear River basin indicate that 38 percent are fully supporting their designated uses, 34 percent are support-threatened, 15 percent are partially supporting, 3 percent are not supporting, and 10 percent are not evaluated.

The Greensboro "tank farm" (bulk petroleum storage facility along I-40) is within the watershed of the East Fork of the Deep River upstream of High Point Lake, one of the City of High Point's two water supply reservoirs. Water quality in the East Fork of the Deep River was evaluated in the *Cape Fear River Basinwide Water Quality Management Plan* (NCDEHNR, 1996a). According to this report, macroinvertebrate sampling by the NCDENR during 1993 showed that the water quality in the East Fork was Fair, and indicated that the stream was adversely affected by nonpoint source runoff, small dischargers and low summer flows. The report also indicated that the East Fork was rated as "partially supporting" its designated uses, with potential sources of pollution being minor, nonmunicipal wastewater discharges and agricultural runoff. The Greensboro "tank farm" was not identified as a possible source of existing contamination of the Deep River in this report. The report also indicated that the NCDWQ was considering the development of a general NPDES permit for bulk petroleum storage facilities. According to the report, if tank farm facilities maintain proper treatment systems and on-site management practices, the risk posed to surface water quality by their minimal discharges is negligible. The NCDWQ also recommended that local emergency management agencies develop extensive contingency plans to protect water supplies in the event of spills, substantial leaks, or any other incidental petroleum product releases. One of the City of High Point's regional stormwater detention ponds, Piedmont Lake, is located downstream of the tank farm. Due to the potential for spills from the tank farm, Piedmont Lake has spill containment capabilities.

For the Deep River at Ramseur, benthos data have shown improvement from Fair in 1983 and 1985 to Good-Fair in 1993. Benthos data from a downstream location in Moore County have consistently indicated an Excellent bioclassification.

At High Falls and Carbonton, action levels for copper and iron have been exceeded for the following percentages of samples:

Location	% of Samples Exceeding Action Levels	
	Copper	iron
High Falls	33	29
Carbonton	38	56

Fecal coliform counts also exceeded State standards for 38 percent of the samples from the Carbonton site.

Despite continuing problems, water quality in the Deep River has been improving since the early 1980s. Ammonia concentrations and 5-day biochemical oxygen demand (BOD₅) levels have decreased due to the 1985 improvements to the High Point Eastside WWTP. In addition, monitoring has indicated that biological conditions have improved in the Deep River at a station near the Guilford County-Randolph County line. Because the High Point Eastside WWTP continues to be a major source of nitrogen and phosphorus in the upper Deep River (NCDEHNR 1994b), continued upgrading of this facility is anticipated. Additional capabilities for the removal of phosphorus and nitrogen will be included in the plant expansion facilities expected to be completed in 2003. This will result in reduced nutrient loadings to the Deep River and improved water quality in the upper Deep River basin.

Monitoring is conducted by the NCDWQ as a part of the Basinwide Water Quality Management Plan process and includes benthic macroinvertebrate monitoring, fisheries monitoring, lake assessment program, aquatic toxicity monitoring, chemical-physical characterizations, sediment oxygen demand monitoring, and Ambient Monitoring System monitoring. Monitoring at upstream and downstream points in receiving streams is also conducted by NPDES dischargers. Nonpoint source control programs under the N.C. Pesticide Law of 1971 are managed by the N.C. Department of Agriculture (NCDOA), and include regulations for the use, application, sale, disposal and registration of pesticides for the protection of the health, safety and welfare of the people and for the promotion of a healthy and safe environment. The NCDOA also administers a Pesticide Disposal Program to provide an available, affordable and environmentally acceptable mechanism by which any homeowner, farmer or institution can dispose of unwanted or unusable pesticides. No specific monitoring and/or treatment for pesticides or herbicides is planned for the proposed reservoir.

4.3.6 Air Quality. The Clean Air Act Amendments of 1990 and the North Carolina Administrative Code establish ambient air quality standards for ground level concentrations of various air pollution parameters. Randolph County is currently characterized as an attainment area, which means that ambient air quality standards are being met. Guilford County is designated a "maintenance area" for ozone. As such, the State of North Carolina requires emission testing for vehicles to ensure that Guilford County continues toward becoming an attainment area.

4.3.7 Vegetation Resources. A botanical survey of the Randleman Lake project site was recently conducted (Carter and Associates, 1993) to update a 1973 study (Moore and Leonard, 1973). The major plant communities were categorized and mapped, and the approximate acreage of each type was determined. Table 16 outlines the acreage involved in each category. A total of 648 vascular species (127 trees and shrubs, 521 herbs) and 11 non-vascular species were found during the recent survey. This study reported at least 20 species that were not found in the earlier study, but the total number of vascular species was slightly lower than the 666 vascular species found previously. This decrease is due to less emphasis on cultivated areas, where numerous exotic or weedy species occur. These studies indicate that plant life of the project area is diverse but not unique.

Natural communities of the project area are generally disturbed and altered. Much of the forest has been degraded by logging or grazing, or consists of young stands of trees. However, vegetation is rather diverse for the piedmont due to the interaction of environmental attributes such as topography, soils, humidity, and fluctuating water levels. Within the project area are six natural community types as defined by the North Carolina Natural Heritage Program (Schafale and Weakley, 1990). Forested communities include (1) Piedmont/Low Mountain Alluvial Forest, (2) Piedmont/Mountain Bottomland Forest, (3) Mesic Mixed Hardwood-Piedmont subtype, (4) and Dry-Mesic Oak-Hickory Forest. Rock outcrops are classified as Piedmont/Coastal Plain Acidic Cliff communities and small hillside seeps are classified as Low Elevation Seeps. All of these plant communities are common in the North Carolina piedmont. Within the project area the predominant forest communities are alluvial forest and mesic mixed hardwood forest. These comprise approximately 34 and 26 percent, respectively, of the pool area and 22 and 32 percent, respectively, of the project buffer zone (Carter and Associates, 1993). A more detailed discussion of the plant communities in the Randleman Lake project area is presented in *Appendix C*.

4.3.8 Wetlands. Wetlands generally include swamps, marshes, bogs, and similar areas, and are defined as areas that are inundated or saturated by surface or ground water at a frequency or duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands share three key characteristics: wetland hydrology, wetland soils, and wetland plants. All these criteria are essential for the establishment of jurisdictional limits for wetlands.

Wetlands in North Carolina occur from the mountains to the coast. Approximately 95 percent of these wetlands are found in the coastal plain (USGS, 1997), while the remaining 5 percent occur in the mountains and the piedmont, which is the location of the proposed Randleman Lake project. Piedmont wetlands are found on fertile soils along large streams and rivers, in depressions, and around lakes and reservoirs. Wetlands vary in type from the mountains to the coast and are generally smaller at higher elevations.

Wetlands are transitional areas between upland and aquatic systems. Hence, they retain characteristics of both and yet are unique in composition and function. They act as natural sponges by slowing, absorbing, and gradually releasing water from precipitation and runoff to groundwater and surface streams. The soil characteristics and depressional size of a wetland affect its ability to perform this function. Wetland forests are very efficient at storing water and, thus, are highly valued for flood control.

Wetlands are also natural filters which remove sediments and nutrients from runoff and stream waters. Filtration is accomplished by physical removal and biological processes. The ability to remove nutrients and sediments is determined by the position of the wetland in the landscape, the gradient of the watershed, extent and duration of flooding, vegetation, soil type, pH, nutrient concentrations, and the opportunity to receive sediments. Vegetation is essential for a wetland to remove pollutants because it slows water velocities and lengthens the path of water through wetlands, thereby promoting sedimentation, removing soil particles by direct contact, and absorbing soluble nutrients from water. Wetland forests are efficient at trapping sediments and nutrients. Their effectiveness is diminished if the stream waters can no longer inundate the adjacent floodplain or if nutrient concentrations exceed the assimilative capacity of the wetland. Sediment trapping is extremely valuable for pollutant removal because sediments often carry with them chemically or physically bound phosphorus, heavy metals, organic compounds, and pesticides.

Wetlands are among the most productive ecosystems in the world and rival the most productive farmland. Wetland plants are efficient converters of solar energy, converting sunlight into plant material or biomass. This plant material is food for a multitude of animals and provides a key link in the food chain.

Wetlands perform vital ecological functions that are essential for the continued existence of resident and transient wildlife. Wetlands provide food, breeding and nursery habitat, and shelter for both aquatic and terrestrial organisms. Many animals seek refuge in wetlands. Waterfowl, beavers, muskrats, and other animals spend most of their lives in wetlands and adjacent waters. Fish, amphibians, and many invertebrates require the presence of surface water during the year to survive and reproduce. The ability of a wetland to provide habitat depends on plant cover, sources of food, access to water, and size. For aquatic habitat, hydrology is important. Additionally, the opportunity of a wetland to provide habitat depends on adjacent land use. A structurally diverse wetland can support greater species diversity.

In February 1993, the USACE verified that 121 acres of wetlands exist within the Randleman Lake impoundment area. This determination was based on work performed in 1992 by Jim Poteat of Triangle

Wetland Consultants, and verified by the USACE. The categories and acreages by wetland type are shown in *Table 17*.

The Randleman Lake project has been planned for more than 20 years. As a result, the vast majority of the woodlands along the river and in the proposed impoundment have been harvested in anticipation of the project. Wetlands of the project area have been substantially impacted due to farming practices, timber harvesting, and forest fragmentation, as well as alteration of their hydrologic and vegetational characteristics (Carter and Associates, 1993). Of the 274 verified wetland sites identified within the reservoir boundaries, only 30 (11 percent) are larger than an acre, and their average size is 2.83 acres. The remaining 244 wetland sites (89 percent) average 0.14 acres, or about 6,000 square feet. Maps of these delineated wetland areas are available for examination at the USACE, 69 Darlington Avenue, Wilmington, NC 28403.

4.3.9 Wildlife Resources. Wildlife habitats within and surrounding the proposed site of Randleman Lake historically are typical of those of the central Piedmont of North Carolina, with hardwood dominated floodplains and hillsides, and pine-hardwood and hardwood-pine dominated ridges. Today the headwaters of the proposed lake are within the urbanization zone associated with the southern portion of the City of High Point and the Town of Jamestown. Residential development has steadily increased over the last decade along the numerous roads that cross through the project area. Dairy farms and agricultural fields dominate the undeveloped portion of the landscape, having replaced the native forestlands with an open, pastoral environment. Most native forest communities had become restricted to the stream corridors and associated steep hillsides in the project area. However, much of the remaining forests have been clearcut by the owners in the last decade in anticipation of the construction of Randleman Lake. The net result of these land uses and changes therein is that comparatively little natural terrestrial habitat remains in the project area or on the project site.

Wildlife species that remain common are those adapted to developed habitats, pastures and fields, and several stages of forest vegetation. Such habitats are common throughout the Piedmont. Game species that occur in the project area include white-tailed deer (*Odocoileus virginiana*), eastern cottontail (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis*), and mourning dove (*Zenaidura macroura*). Furbearers such as gray fox (*Urocyon cinereoargenteus*), muskrat (*Ondatra zibethicus*), and raccoon (*Procyon lotor*) are common in the project area.

The project area is not a major wintering site for migratory waterfowl, nor does it provide significant habitats for neotropical migrants. Birds of prey, as a whole, are probably more common in the open countryside now present than would have been the case when the area was mostly or completely forested. Resident and wintering bird species, small mammals, and reptiles and amphibians are typical for the habitats present in this part of North Carolina.

The avian and mammalian faunas of this part of North Carolina are well known, and no species of concern are known from the project area. However, field surveys in 1992-93 recorded the occurrence of two unusual bird species. A yellow-crowned night heron (*Nycticorax violaceus*) was seen on April 16, 1992, as it caught crayfish in the unnamed tributary of Deep River crossing S.R. 1938 in Randolph County. Also, a singing clay-colored sparrow (*Spizella pallida*) was observed in a hedgerow in a cow pasture along Muddy Creek on April 27, 1992. This species is exceedingly rare in North Carolina in the spring (Carter and Associates, 1993).

Amphibians and reptiles observed during recent field surveys are listed in *Table 18* (Carter and Associates, 1993).

4.3.10 Fishery Resources. Approximately 30 species of fish have previously been recorded from the general vicinity of Randleman Lake (Menhinick, 1991). Additional fishery surveys were conducted in 1992-93, under the direction of Mr. William F. Palmer (former Director of Research and Collections at the North Carolina State Museum of Natural Sciences), to update existing data and to gather current data on the presence of species of concern. Fish samples were collected at 24 stations in selected locations along the Deep River and its tributaries. A total of 32 species was collected, and one additional species was observed. Species collected in the largest numbers included the speckled killifish (*Fundulus rathbuni*), satinfin shiner (*Cyprinella analostana*), swallowtail shiner (*Notropis procne*), sandbar shiner (*Notropis scepticus*), highfin shiner (*Notropis altipinnis*), redlip shiner (*Notropis chiliticus*) rosyside dace (*Clinostomus funduloides*), creek chub (*Semotilus atromaculatus*), and bluehead chub (*Nocomis leptcephalus*). The bluegill (*Lepomis macrochirus*), redbreast sunfish (*Lepomis auritus*), and largemouth bass (*Micropterus salmoides*) were collected in small numbers but were widespread. *Table 19* lists the fish species collected and observed in the 1992-93 surveys. Collections showed no evidence of protected fish species within the proposed Randleman Lake project area (Carter and Associates, 1993).

The fishery occurring in the portion of the Deep River and its tributaries that will be inundated by Randleman Lake **appears to have been adversely affected by poor water quality.** The mainstem of the Deep River, and particularly its headwaters in the southern portion of the City of High Point and the Town of Jamestown, have low species diversity. There are no game fish populations capable of supporting a sport fishery, and the only human use noted was occasional individuals fishing for catfish. The most healthy fish populations, though largely of non-game species, occur in the lower sections of Muddy Creek, in Hickory Creek, and in some of the small unnamed tributaries to the Deep River. **The N.C. Division of Water Quality rated the streams of the area only fair to good-fair in 1993 for benthic invertebrates, and rated Muddy Creek only good-fair in 1994 for fish community structure (NCDEHNR, 1996a). NCDWQ attributed decreased fish abundance to urban stormwater runoff. The Deep River from High Point Lake to approximately the Guilford County line is designated as only partially supporting its uses. Lower reaches are designated support-threatened. Upstream discharges from point and nonpoint sources are believed to have adversely impacted the water quality in this section of the river, which has affected the quality of the fishery.**

4.3.11 Endangered, Threatened, and Rare Species. No Federally or state-listed endangered or threatened species are known from the project area (personal communication, N.C. Natural Heritage Program, 1992). Field surveys conducted during 1992 and 1993 also failed to note the occurrence of any listed endangered or threatened species, and no evidence was found that any exist within the Randleman Lake project area (Carter and Associates, 1993). The field surveys did, however, locate several rare and unusual plant species. Results of the surveys are summarized below and presented in *Appendix C*.

Three populations (totaling six subpopulations) of dissected toothwort (*Cardamine dissecta*), a significantly rare species in North Carolina, were found along Hickory Creek, Richland Creek, and the Deep River. In North Carolina, this species has been found in rich woods in six counties. The Hickory Creek population of dissected toothwort is characterized by a beech subtype of the Mesic Mixed Hardwood Forest, growing on steep slopes. This is also one of the few locations noted in the project area for little sweet betsy (*Trillium cuneatum*). Prostrate blue violet (*Viola walteri*), which is on the North Carolina Watch List, was also found at this location.

A search was made for three uncommon plant species which had been found at one location during the 1973 survey by Moore and Leonard. These included ginseng (*Panax quinquefolium*), monkshood (*Aconitum uncinatum*), and closed gentian (*Gentiana quinquefolia*). The previously identified location was found, but the forest there had been clear-cut one year prior to the recent survey. Two populations of monkshood were identified (one in this location and one elsewhere), but neither ginseng nor gentian could be found.

Table 20 lists the endangered, threatened, and rare animal species that are known from Guilford and Randolph Counties. The 1992-93 surveys focused on the possible occurrence of several threatened or rare animal species and their habitat within the area of influence of the proposed project. These included protected species of freshwater mussels (family Unionidae), the Greensboro burrowing crayfish (*Cambarus catagious*), the bog turtle (*Clemmys muhlenbergii*), the mole salamander (*Ambystoma talpideum*), and the four-toed salamander (*Hemidactylius scutatum*).

On-site surveys were conducted for freshwater mussels of the family Unionidae in that part of the Deep River and its tributaries subject to inundation by the proposed project. Field observations were conducted on August 30, October 3, and December 19, 1992, when stream flow was seasonally low and optimal for this work. Sites were examined within, above, and below the proposed lake area, along the length of the Deep River between Jamestown at the upstream end of the reservoir, and Cedar Falls, downstream of Randleman. Muddy Creek was examined at three locations. It was concluded that the Deep River does not support viable populations of any native freshwater mussels in the reach between Jamestown and Cedar Falls. The extreme paucity of dead relict shells implies very low population densities, if not actual extirpation. A small remnant of a native *Elliptio* sp. apparently survives in the reach immediately below the High Point Lake dam, possibly only as old adults that are not being replaced by juvenile recruitment. The same species occurs in very low numbers in an unnamed tributary of the Deep River northwest of Level Cross (above S.R. 1938).

The biological survey also addressed the Greensboro burrowing crayfish (*Cambarus catagious*), a Federal C2 candidate. Little habitat was found in the proposed lake pool, which now consists primarily of the narrow floodplains along the Deep River and its tributaries and the adjacent lower (often steep) hillsides. More suitable habitat occurs in seeps on uplands, such as is present in limited amounts in the buffer zone. However, no Greensboro burrowing crayfish were found, and no burrows were located that suggested the presence of this species (Carter and Associates, 1993).

The bog turtle (*Clemmys muhlenbergii*) is state-listed as a threatened species in North Carolina. In addition, the USFWS proposes to list the northern population of the bog turtle (from New York and Massachusetts south to Maryland) as threatened and the southern population (from Virginia to Georgia) as threatened due to similarity of appearance to the northern population. The species has never been recorded from the Cape Fear drainage, or from either Randolph or Guilford Counties. However, its occurrence is known at a site in Forsyth County only about 20 air miles from the northwestern-most corner of the proposed Randleman Lake. Bog turtles are extremely secretive and difficult to find, even in ideal habitat, and no specific search for the species had ever been undertaken in the area of the proposed lake. Since the species had been newly discovered in three North Carolina counties (including a new drainage record) during the previous two years, it was appropriate to determine its status in the Randleman Lake project area. A survey was conducted, but it revealed no evidence of bog turtles, no ideal habitat, and very little suitable habitat in the proposed lake site (Carter and Associates, 1993).

The potential exists in the area for two other state-listed species, the mole salamander (*Ambystoma talpideum*) and the four-toed salamander (*Hemidactylius scutatum*), both listed as of special concern. No evidence of

either of these species was found, and very little potential habitat was noted for either (Carter and Associates, 1993).

Two fish species known from the lower reaches of the Cape Fear drainage are of particular concern. The Cape Fear shiner (*Notropis mekistocholas*), a minnow endemic to the Cape Fear drainage near the Fall Line, is found most often in moderately large and shallow streams with moderate gradients, riffles, long pools, and rocky bottoms; beds of water willow (*Justicia americana*) commonly occur in shoal areas of the habitat (Snelson 1971). This species was Federally listed as endangered on September 25, 1987. At the time of listing, only three populations were known. The nearest occurrence to the Randleman site was approximately 33 miles downstream in extreme southern Randolph County in Fork Creek within 1.5 miles of its confluence with the Deep River and in adjacent Moore County in the Deep River proper. This area was designated as critical habitat for the shiner (approximately 1.5 miles of Fork Creek, from a point 0.1 river miles upstream of Randolph County Road 2873 Bridge downstream to the Deep River, then downstream approximately 4.1 river miles of the Deep River in Randolph and Moore Counties, to a point 2.5 river miles below Moore County Road 1456 Bridge)(USFWS, 1988). Since 1987, additional surveys (NCWRC, 1994) show that the Cape Fear shiner occurs in the Deep River as far upstream as Coleridge, which is approximately 22 miles downstream from the Randleman dam site. There are no records indicating the occurrence of this species in the Randleman Lake area, and no habitats closely resembling those occupied by this species farther downstream were observed during the 1992-93 surveys by Carter and Associates.

The Carolina darter (*Etheostoma collis*) is a species of special concern at the state level. It occurs in the lower Piedmont and most of the Atlantic drainage of North Carolina, but it seems to be rare throughout its range. Carolina darters live in quiet backwaters and among submerged leaves and other detritus along the banks of small streams with rocky, sandy, or muddy bottoms, often covered with silt or detritus (Collette, 1962). This species was reported on a range map (Menhinick, 1991) at a location in extreme northwestern Guilford County, apparently from the Haw River or a tributary. Also, two specimens (NCSM 19340[2]) have been collected from Flat Creek about a mile from its confluence with Deep River, in extreme southeastern Randolph County. There are no records of occurrence in the project area, but several small streams of the area offer habitat apparently suitable for this small darter.

Several bird species that are rare or of special concern in the state are known from the two-county area. Loggerhead shrikes (*Lanius ludovicianus*) were noted in the general project vicinity, but not within the project boundaries. This species is of special concern in North Carolina, but its habitat (fields and pastures) is abundant in the project area.

Bald eagles (*Haliaeetus leucocephalus*) and peregrine falcons (*Falco peregrinus*) may occur occasionally along the Deep River and in adjacent open habitats, but none were seen during the 1992-93 biological assessment. Eagles occasionally nest in inland North Carolina, but no nests are known in this part of the state. Peregrines occur primarily during migration.

4.3.12 Unique Natural Areas and Scenic Rivers. There are no Federal, state, or locally significant natural areas or scenic rivers in the project area. **A scenic cliff, which is also a black vulture nesting area, is located along the Deep River approximately 2 miles downstream of Coltrane Mill and 1000 feet upstream of an electrical power transmission line crossing of the Deep River (Pleasant Garden U.S.G.S. Quad). This cliff is located above the normal pool and within the 200-foot buffer for the proposed lake.**

5.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

5.1 GENERAL

Potential impacts of the proposed project are described in this section. Beneficial and adverse effects are discussed, as are unavoidable adverse impacts and measures to mitigate these impacts. A comparison of impacts of the feasible project alternatives was presented in *Section 3.3*.

Randleman Lake will provide significant regional benefits through the creation of a reliable water supply to meet regional water demands and will support continued economic development resulting in job growth and an increased tax base. In addition, approximately 3,000 acres in the project buffer zone would be preserved in a natural state, and the 3,000-acre lake could provide an improved sport fishery.

These achievements would be accompanied by moderate adverse impacts to the environment. Short-term impacts would be primarily construction-related, while long-term impacts would be associated with the inundation of approximately 3,000 acres of land, the permanent loss of approximately 28 miles (188 acres) of free-flowing streams and 121 acres of wetlands, and permanent reductions in annual flow in the Deep River downstream. Substantial downstream flow reductions would occur in the Deep River during the reservoir filling period of 6 to 11 months, **although consideration for habitat of the endangered Cape Fear shiner would require that flow releases from the reservoir be adjusted to maintain a minimum flow rate of 75 cfs at Coleridge during May through July, except when natural flows in the river would provide less than this amount.** The project would be achieved at an estimated cost of approximately \$140 million.

5.2 DIRECT, INDIRECT AND CUMULATIVE EFFECTS OF THE PROPOSED WATER SUPPLY PROJECT ON THE MAN-MADE ENVIRONMENT

5.2.1 Population. The project would result in the availability of a future water supply for the Piedmont Triad region of North Carolina and would allow it to maintain localized population growth. Growth in the water critical area, within approximately 1/2 mile of the impoundment, has been restricted since 1987 by the watershed protection ordinances of Guilford and Randolph Counties.

Short-term population increases in the project area may result from an influx of workers who would be employed for project construction. Some workers may temporarily live in the vicinity of the project. Others may commute from nearby permanent residences. This portion of the population would be temporary and would not significantly influence the long-term population in the watershed.

5.2.2 Land Use. Project implementation would impact approximately 6,000 acres through land acquisition and the subsequent establishment of the dam and spillway, conservation pool, and buffer zone. Of this total, roughly 3,000 acres would be inundated and dedicated to water storage, while the remaining 3,000 acres would be protected in the buffer zone. Existing land uses would be converted to new ones over much of this acreage. The reservoir pool is expected to cover approximately 2,143 acres of forested land (including 188 acres of free-flowing streams), 868 acres of agricultural lands, and 45 acres of developed land. The project buffer area would result in losses of approximately 768 acres of agricultural lands and 24 acres of developed lands. Plant communities of the protected buffer area are expected to change through ecological succession to

result in expansion of its forest from the present 2,056 acres to nearly all of the 3,000 acres. The acreages noted here are based upon the measurements of Carter and **Associates** (1993), which included 3,076 acres in the pool and 2,851 acres in the buffer for a project total of 5,927 acres. These numbers differ slightly from the measurements of other investigators presented in other sections of this report due to differences in survey procedures. Affected land use categories are itemized in *Table 16*.

It is estimated, based upon examination of tax maps, that 237 separate properties would be acquired for the impoundment and buffer area. Of these properties 28 are residences and one is a business. Portions of 16 farms, including four operating dairies, would be inundated. **One small dairy is expected to be shut down as a result of the proposed project. No poultry farms would be shut down.**

Indirect and cumulative effects of the proposed project on land use will be new development which occurs as a result of the economic growth made possible by the increased water supply from the proposed reservoir. It is likely that this development will occur within and around the urban services areas of the PTRWA members. Development that occurs will result in conversion of existing pasture and farmland, open space, and forested land to residential, commercial, or industrial uses. Future development in the Piedmont Triad region would be directed in accordance with the land use plans and development and watershed protection ordinances of the local governments within the Randleman Lake watershed.

5.2.3 Employment and Economic Activities. Project construction would create short-term job opportunities for construction workers. This may lead to an influx of people that may provide a temporary boost to the local economy. Timbering in the impoundment area may also contribute to local income. Long-term employment would not be significantly affected in any direct way by the reservoir.

In terms of indirect and cumulative impacts, the presence of an additional water supply in the Piedmont Triad area may stimulate development and encourage in-migration from nearby cities. This may create avenues for commerce that could stimulate economic activity, enhance the tax base and **provide greater employment opportunities for Piedmont Triad area residents.** This activity is likely to occur in several economic sectors, including manufacturing, retail trade, and services.

The proposed project would remove about 6,000 acres of land from local tax rolls. **Based on 1999 tax rates,** Randolph County would lose about **\$57,700** in annual tax revenue through the loss of 4,500 acres valued at \$2,500 per acre and taxed at a rate of **\$0.5125** per \$100. Guilford County would lose about **\$23,900** annually through the loss of 1,500 acres valued at \$2,500 and taxed at a rate of **\$0.6372** per \$100. Completion of the project would offset some of this loss through an anticipated increase in development in the project vicinity, and continued economic growth resulting from the project would further enhance the tax base of the counties and cities involved.

5.2.4 Municipal and County Services. Existing intergovernmental agreements among the PTRWA members would not be immediately affected by the Randleman Lake project. However, it is anticipated that water and sewer services would be gradually expanded to meet the needs of most residents of the two-county area. Intergovernmental agreements would be initiated or modified to address these needs, as required.

Indirect and cumulative effects of the proposed project on municipal and county services would result from new industries or residents attracted to the area because of the additional water supplies. Services that are likely to be impacted include solid waste facilities, schools, police and fire protection, and medical services, which may experience increased demand.

5.2.5 Transportation and Utilities. Construction of Randleman Lake would impact portions of 15 roadways, including NC Highway 62, and 14 NC secondary roads. Alterations of these roadways would include removal or replacement of drainage structures, raising of roadbeds, and terminations. The locations and proposed modifications of affected roadways are briefly described in *Table 21*. Interstate-40 crosses the upper end of the lake's drainage area but would be unaffected by the lake. Interstate-85 and US Highway 220, which also cross the lake site, have been constructed to accommodate the anticipated Randleman project. A road modification plan for the proposed work has been submitted to the NCDOT for approval. No railroads would be affected by the construction of Randleman Lake.

Environmental impacts of the proposed roadway modifications are as follows:

- **The proposed improvements will involve the removal and abandonment of seven bridges and the replacement of two bridges at new locations. Bridges to be relocated include SR 1921 over the Deep River near Coltrane Mill and SR 1140 at Register's (Reddicks) Creek. These improvements will involve changes in land use for the abandoned and new bridge sites. The remaining modifications of twelve roadways will consist of raising the roadway at the existing location and will involve minor changes in land use associated with the increased roadway elevation.**
- **The proposed roadway improvements could impact approximately 2.5 acres of wetlands. The actual amount will depend on the final design of the roadway improvements. *Table 21* shows the amounts of wetlands that are estimated to be impacted for each roadway project. The acres to be impacted are based on the delineated wetlands located within 200 feet on either side of the roadway where it crosses the entire project area, including the proposed lake and the buffer area. The wetlands associated with the road crossings within the proposed project area are already included in the total acres of wetlands to be impacted.**
- **Prime farmland soils would be impacted by the proposed relocation of SR 1921 near Coltrane Mill. Approximately 0.5 to 1.0 acres of prime farmland soils would be lost as a result of the proposed roadway modifications at this site. No public land or scenic or recreational areas would be affected by the proposed roadway improvements.**
- **Of the twenty-one proposed roadway improvements, one, SR 1921 over the Deep River, is located near an archaeological site (Coltrane Mill) which has been determined to be eligible for the National Register of Historic Places. All required archaeological investigations have been completed for this site and accepted by the North Carolina SHPO.**
- **The proposed roadway improvements would result in temporary adverse effects on air quality from airborne dust and construction equipment exhaust. These impacts would be localized and of relatively short duration. Noise levels would also increase as a result of construction activities.**
- **The proposed roadway improvements are not expected to have any significant impacts on groundwater quality.**

- **No significant impacts on surface water quality, water supplies, or eutrophication of surface waters are expected as a result of the proposed roadway improvements. Some erosion and sedimentation will occur as a result of construction activities and will cause short-term increases in turbidity in downstream surface waters. These effects would be minimized by sedimentation and erosion control measures installed in accordance with an approved sedimentation and erosion control plan for each project. The proposed roadway improvements are not expected to have any significant effects on downstream water supplies, the nearest of which is the Gulf-Goldston water supply, approximately 70 miles downstream of the proposed Randleman Lake.**
- **The proposed roadway improvements are not expected to have any significant effects on shellfish, fish, or wildlife and their habitats. One endangered species, the Cape Fear shiner, has been identified in the Deep River at Coleridge, approximately 22 miles downstream of the proposed dam site. One of the designated critical habitats for this species is located in the Deep River approximately 33 miles below the dam site. Increased turbidity associated with erosion and sedimentation during construction may occur as a result of the proposed roadway improvements. However, based on maintenance of effective erosion and sedimentation control measures for each construction project, and the long distance between the proposed roadway projects and the habitat areas for the Cape Fear shiner, the proposed roadway improvements would not adversely affect this species.**
- **No significant introduction of toxic substances is expected as a result of the proposed roadway improvements. The proposed bridges are expected to be designed with hazardous spill basins to collect any hazardous spills that occur on the roadways over the reservoir. No significant amounts of toxic substances are expected to be released to the environment as a result of construction activities.**

Electric power, gas, telephone, cable television, and water service lines within the project area would be relocated as necessary. Cooperative efforts with utility companies would be implemented to minimize inconvenience to local residents and impacts to the environment. Some utility relocations have occurred in the project area in anticipation of the development of Randleman Lake.

Indirect and cumulative effects of the proposed project on local transportation systems would result from new industries and population attracted to the area by the increased water supplies. Increases in traffic volumes would occur in areas of new industrial, commercial, and residential construction.

5.2.6 Energy. Project construction would require the consumption of diesel fuel to operate construction equipment as well as small amounts of electricity. Electricity in the project area is provided by Duke Power Company and ample electric power is available for future demand.

Ten hydroelectric projects currently exist along the Deep River (*Figure 6*). The Coltrane Mill project (not licensed by the Federal Energy Regulatory Commission) would be flooded by Randleman Lake, while the other nine projects would be impacted to various degrees. The amount of impact at each site would depend on (1) flow duration curves, (2) the distance downstream from Randleman dam, and (3) the optimum operating streamflow requirements at each site. Impacts would also depend, to a limited extent, upon the design of the spillway for Randleman Lake and interim and final reservoir operating procedures.

In 1990 the North Carolina Division of Water Resources (NCDWR) sent flow duration curves and questionnaires to each hydroelectric facility to assist in the estimation of site-specific economic impacts. The requested information was not provided by any of these facilities. However, comments received during the 1991 public hearing process for the State of North Carolina's EIS on Randleman Lake stated that the filling and operation of Randleman Lake would adversely impact the hydroelectric projects.

The PTRWA has acknowledged that downstream impacts would occur (**See Sections 5.2.6.1 and 5.2.6.2**) and desires to optimize flow releases during the early project years (about 20 or so) to help compensate for economic losses. When the operators provide the information on operating flow regimes, the PTRWA would accommodate identified needs through modification of flow releases, to the extent feasible.

Indirect and cumulative effects of the proposed project on energy resources would consist of additional energy requirements for new industrial and economic growth resulting from the increased water supplies. Ample electrical power is available for future growth needs.

5.2.6.1 Impact During Filling of Randleman Lake. Reservoir fill times for Randleman Lake were estimated based on a month-by-month accounting of water inputs and losses (Black & Veatch, 1991a). Water inputs consisted of natural inflows from the watershed. Water losses included net evaporative losses and the normal release rate of 30 cfs. Infiltration losses from the reservoir into the soil of the lake bottom were assumed negligible. It was also assumed that the filling of the reservoir would be completed prior to any withdrawals for water supply. The reservoir was assumed to be filled when inputs exceeded losses by 20.2 billion gallons (62,000 acre-feet), which would result in the normal pool elevation of 682 feet m.s.l. *Figure 7* depicts the relationship between reservoir surface elevations and water storage capacity (stage-storage curve) for Randleman Lake.

Natural inflows to the reservoir were calculated from available USGS gaging station streamflow data for the period of record from water year (October through September) 1930 through 1988. The resulting average inflow rate is 163 cfs. An average monthly inflow volume was used to calculate fill time because the month in which reservoir filling would begin is not known. Assuming a 30-day month, the 163 cfs reservoir inflow rate produces a monthly volume of 9,703 acre-feet. The number of months required for filling was calculated using a constant 30 cfs release as well as the three-tier release rate (30, 20, and 10 cfs depending on the reservoir level). *Table 22* shows that the estimated average time requirement for reservoir filling using a constant 30 cfs release rate would be 8 months. Filling the reservoir by using a tiered release rate could shorten the time requirement to about six months. The PTRWA proposes to fill the reservoir using a minimum 30 cfs release rate.

Flow releases during reservoir filling will be increased during May through July to provide additional stream flow downstream during spring spawning and juvenile development periods for the Cape Fear shiner. The flow releases will maintain a minimum flow rate of 75 cfs in the Deep River at Coleridge, except when natural flows in the river would provide less than this amount.

Even though the minimum release rate of 30 cfs during reservoir filling would provide the benefit of supplying a consistent downstream flow, the resulting reductions in average flow could have a negative impact on hydropower facilities, as shown in *Table 23*. Predicted reductions in average flow would range from 76 percent at the Town of Randleman gradually diminishing to 9 percent at Moncure, which is located about 88 miles below the Randleman dam site.

5.2.6.2 Impact During Normal Operations. After Randleman Lake is filled, water withdrawals and interbasin transfers would result in continued reductions in average flow in the Deep River at the downstream hydroelectric facilities, although the reductions would be less severe than during the filling period. Reductions in streamflow due to interbasin transfer would be small initially but would increase as the project ages. The impacts of flow reductions would likely be felt by the hydroelectric facilities by the tenth year after project completion, and, after a period of from 40 to 50 years, the full 30.5 mgd would be diverted from the basin. *Table 24* shows that the full impact of these reductions would range from 27 percent at the Town of Randleman to 3 percent at Moncure. Losses to hydroelectric generation along the Deep River have been estimated to range from 5 to 15 percent (NCDEHNR, 1991). **Losses would be expected to occur primarily in the later years of the project, when more water would be diverted from the basin.**

5.2.7 Social Effects. Permanent changes in the social and community structure of the project area would occur due to the physical barriers posed by road closures and the presence of the reservoir. Existing community and family interactions may be disrupted, and psychological ties to the affected lands and places may suffer. The families displaced by the project would experience the inconvenience and disruption of their personal affairs associated with finding other homes and relocating.

5.2.8 Cultural Resources.

5.2.8.1 Treatment – Prehistoric and Historic Archaeological Resources. As a result of the investigations undertaken over the years, three archaeological sites were determined eligible for inclusion on the National Register of Historic Places. A data recovery plan was developed to address the impact that construction of Randleman Lake would have on the three prehistoric archaeological sites (NCDCCR, 1998). This plan was implemented by the PTRWA and all required investigations were completed and reviewed by the SHPO. All required prehistoric archaeological investigations were conducted in consultation with and were approved by the North Carolina SHPO. Work was completed and accepted by the SHPO in May 1999.

5.2.8.2 Treatment – Architectural Resources. Two architecturally significant sites, the Freeman Mill Historic District and the Coltrane Mill Historic District, were the only architectural resources determined to be affected by the Randleman project. The proper course of treatment for the Freeman Mill Historic District and the Coltrane Mill Historic District was determined by the PTRWA in consultation with the North Carolina SHPO to be recordation of the properties.

A data recovery plan was developed to address both the architectural and archaeological significance of the Freeman Mill and Coltrane Mill sites. This plan was implemented and the recordation was completed (Lautzenheiser and Lovett, 1998). This work has been reviewed by the North Carolina SHPO and was approved in December 1998 (NCDCCR, 1999).

The PTRWA has also been in consultation with the North Carolina SHPO in determining the course of treatment for the James Parsons House, which is a part of the Freeman Mill Historic District. The result of that consultation was that the proper course of treatment is recordation of the property (NCDCCR, 2000a). The PTRWA has since completed the required work and submitted the results to the North Carolina SHPO. Review and approval have been completed by the SHPO (NCDCCR, 2000b). All cultural resources obligations for the proposed project have been fulfilled.

indirect and cumulative impacts of the proposed project on historical and archaeological resources include potential adverse impacts from development projects that may be facilitated by the proposed reservoir project. If such projects occur, they may be subject to State and local review and/or permit programs. State or Federal review would be required for all projects, such as roads or utilities, for which an environmental assessment or environmental impact statement is required under the North Carolina Environmental Policy Act. Local review may be required for projects requiring a site review as a part of a special use permit or rezoning approval process in accordance with development ordinances of the PTRWA member governments. Development may also result in the discovery of additional archaeological resources which may provide information on the area's prehistory. Some historic sites may be preserved or protected through renovation for other uses.

5.3 DIRECT, INDIRECT AND CUMULATIVE EFFECTS OF THE PROPOSED WATER SUPPLY PROJECT ON THE NATURAL ENVIRONMENT

5.3.1 Climate. The presence of Randleman Lake would result in a slight increase in relative humidity in the immediate project vicinity. However, no significant change is anticipated in local precipitation or weather patterns. The proposed project should have no effect on the overall climate of the area.

5.3.2 Topography. The existing topography of the Randleman Lake watershed would be changed by construction of the project. The dam would be approximately 2,090 feet long and would extend to a maximum height of about 102 feet above the existing streambed. This would impound water covering about 3,000 acres and would establish a new water surface at elevation 682 feet m.s.l. Some roadways would require realignment or abandonment resulting in minor topographic changes.

Construction and operation of the proposed project would have indirect and cumulative impacts on the topography of the region outside the project area. These impacts would result from construction due to industrial, commercial, and residential growth attracted by the increased water supplies. The location of these impacts would be subject to existing and future zoning controls of the PTRWA member governments, with industrial growth likely to be concentrated along major transportation corridors.

5.3.3 Geology. The Randleman Lake project is not expected to produce any significant changes in geologic characteristics or seismic activity. Inundation would render about 3,000 acres of land inaccessible for direct mineral extraction. Although most of the known mineral deposits in the impact zone have little commercial value, some sites of active sand and stone production will be covered by water. However, overall direct, indirect and cumulative impacts of the proposed project on geological resources are not expected to be significant.

5.3.4 Soils. The clearing and grading required for project construction would promote soil erosion and sedimentation. However, these effects would be limited through the implementation of an approved sediment and erosion control plan in accordance with the North Carolina Sedimentation Pollution Control Act. This plan must be approved prior to construction.

Project implementation would also result in the inundation of prime farmland soils in Guilford and Randolph Counties. Prime farmland soils affected by the proposed project have been estimated based on county

soils maps and information on prime farmland soil classifications from U.S. Department of Agriculture, Natural Resources Conservation Service representatives. Based on this information, prime farmland soils that will be inundated by the proposed lake are estimated to comprise approximately 26 acres in Guilford County and 270 acres in Randolph County. Additional areas that will be inundated are classified as prime farmland if they are drained and are protected from flooding or not frequently flooded during the growing season. Locations of these soil types were compared to flood plain areas identified on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps. Additional prime farmland soils that are not located in flood plains are estimated at approximately one acre in Guilford County and 40 acres in Randolph County. Thus, the total acreage of prime farmland to be inundated is estimated at 337 acres.

Prime farmland soils in the buffer area for the proposed reservoir were also evaluated and are estimated at approximately 18 acres in Guilford County and 285 acres in Randolph County for a total of 303 acres. The loss of prime agricultural land represents a permanent reduction of this finite and valuable resource.

Indirect and cumulative impacts on soils would occur in areas of new industrial and residential development related to the increased water supplies from the proposed project. Wind erosion and sedimentation would occur with this new construction. New areas served by water distribution systems are generally provided with central wastewater facilities at the same time. Consequently, the project is not expected to have significant adverse impacts on soils related to development of on-site wastewater disposal systems for residential and commercial developments. Indirect and cumulative effects on prime farmland would occur as existing agricultural land is converted to residential, commercial and industrial uses as a result of the development that occurs as an indirect result of the increased water supplies.

Indirect and cumulative impacts may also include an increase in sediment loading to the Haw River Basin which results from construction activities associated with new development in the Greensboro service area resulting from the increased water supply from the proposed project. Control of erosion and sediment will be by the existing Guilford County Soil Erosion and Sedimentation Control Ordinance and City of Greensboro stormwater regulations.

5.3.5 Water Resources

5.3.5.1 Groundwater. Potential impacts related to groundwater may include changes in groundwater levels, changes in groundwater flows, and movement of contaminants in groundwater. Groundwater levels may experience significant increases within and around the perimeter of the proposed reservoir. In general, when the reservoir is filled, the hydraulic gradient will rise to reach a new equilibrium level. During periods when the reservoir level is high, bank storage will tend to feed the groundwater. During periods when the reservoir level is falling, the groundwater will discharge to the reservoir as it does to other surface waters.

Groundwater wells were installed in rock at the dam site during geology testing for the proposed dam (GEI Consultants, 1996b). The readings at the wells indicate that groundwater in the valley section within 100 feet of the Deep River is very close to the elevation of the water in the Deep River. Groundwater elevations in wells installed on the sloping abutments of the dam indicate that

groundwater elevations rise approximately 40 feet above the surface of the Deep River at a distance of approximately 600 feet from the river.

Based on the groundwater elevations and the distances between the observation wells, a gradient for groundwater flow was estimated downslope and along the axis of the dam toward the river. The gradients in the abutment rock are indicative of low permeability in the underlying rock. Areas of higher permeability were also encountered. Any potential problems associated with seepage loss beneath the reservoir closure at the dam because of fractured rock will be addressed with blanket and curtain grouting beneath the dam axis.

Groundwater contaminants are present at the abandoned Seaboard Chemical Corporation and closed High Point landfill sites, both located along the Deep River adjacent to the proposed reservoir. Concerns have been raised concerning how this situation may affect water quality of the lake, as well as drinking water derived from the lake. Studies indicate that contaminants from these sites would have no unacceptable adverse effect on the water quality of Randleman Lake. This topic is discussed in *Section 5.3.5.4, Toxic Substances Evaluation*.

Overall, groundwater effects on the water quality of Randleman Lake are expected to be insignificant. Also, the construction and operation of the project would have no significant effect on the groundwater in the project vicinity, including the Seaboard Chemical site and the former High Point municipal landfill (See *Section 5.3.5.4, Toxic Substances Evaluation*).

The proposed project is not expected to have significant indirect or cumulative effects on groundwater resources. New residential housing areas are generally connected to central water and wastewater service at the same time. Therefore, the proposed project is not expected to have significant adverse effects on groundwater through increased wastewater disposal through individual on-site septic systems.

5.3.5.2 Surface Water. The Deep River downstream of the proposed dam site would experience short-term increases in turbidity and fluctuations in flow due to land clearing activities and construction of the dam. However, these effects would be limited by implementation of effective erosion control measures in accordance with an approved sedimentation and erosion control plan, as well as dam construction techniques that minimize flow alterations. Dewatering activities for dam construction would route the flows through a portion of the dam site while keeping a portion of it dry. Overall, the impacts of construction operations on surface waters would be adverse, but minor and temporary.

Major long-term effects of project implementation would be the creation of a 3,000-acre reservoir and the loss through inundation of 28 miles (188 acres) of free-flowing streams, including portions of the upper Deep River, Muddy Creek, Richland Creek, Reddicks (Register's) Creek, Hickory Creek, and Bob Branch. Randleman Lake would become a major source of water supply for the Piedmont Triad region. In addition, attendant changes would occur in downstream flows, and water in amounts up to 30.5 mgd would be diverted to other river basins. These effects are discussed in the following sections.

On a long-term basis, the proposed reservoir would be expected to reduce the turbidity downstream of the proposed project by trapping sediment within the proposed lake. The proposed watershed protection measures adopted in accordance with the Nutrient Management Strategy rules (15A NCAC

2B.0248 through .0251) (see *Section 5.4.2* below) would also result in reduced levels of sediment discharged to the proposed lake through nonpoint source controls on new development in the watershed. The projected siltation rate for the proposed reservoir is 0.461 acre-feet per square mile per year, or an accumulation of approximately 8,000 acre-feet in 100 years (*Appendix A, p. III-4*). A portion of the organic and inorganic pollutants entering the reservoir will be removed by incorporation in the sediment. The level of pollutants in the sediment is not expected to be substantially different from that for other reservoirs in the upper Cape Fear River Basin.

Potential sources of surface water contamination of the proposed lake include agricultural areas which are inundated by the lake, estimated to cover approximately 868 acres; agricultural areas in the watershed but outside the proposed lake, estimated to cover approximately 21,810 acres, or approximately 20 percent of the proposed Randleman Lake watershed; livestock areas in the watershed, including six operating dairies; urban or other developed areas; and point source dischargers to surface waters tributary to the proposed lake (see *Section 4.3.5.2* above). Potential chemicals of concern include nutrients, oxygen-demanding materials, heavy metals, pesticides and herbicides, and other organic and inorganic chemicals. Control of pollutants from these sources will be in accordance with water quality regulations for point source, nonpoint source and stormwater pollution in Class WS-IV watersheds (15A NCAC 2B.0216) and the Nutrient Management Strategy rules (15A NCAC 2B.0248 through .0251) for the Randleman Lake watershed (See *Section 5.4.2* below). Measures to control nonpoint source and stormwater pollution will also include those provided under the N.C. Sedimentation Pollution Control Act for construction activities. Agricultural areas to be inundated will be cleared and structures associated with agricultural operations will be demolished and hauled away for disposal. All materials that could result in surface water contamination will also be removed to suitable sites for disposal.

The 7-day, 10-year (7Q10) low flow for the Deep River at Freeman Mill is estimated to be approximately 5.9 mgd. The High Point Eastside WWTP and the High Point Ward Water Treatment Plant are the only major NPDES dischargers to the Deep River Basin upstream of the proposed Randleman Lake. Based on the expanded wastewater flow capacity for the Eastside WWTP of 26 mgd, the instream wastewater concentration for Randleman Lake would be approximately 82 percent. Predicted impacts of the Eastside WWTP discharge on the water quality in Randleman Lake are discussed in *Sections 5.3.5.4* and *5.3.5.5* below.

An analysis of projected fecal coliform concentrations in the proposed lake was also conducted (Hazen and Sawyer, 1998). The analysis included estimates of the potential upper bound fecal coliform bacteria concentrations in each segment of the proposed lake. Segmentation of the proposed lake for this analysis and other water quality modeling is shown on *Figure 7a*. The predicted range of the 80th percentile of fecal coliform concentrations is shown in *Table 24a*. In all cases, the predicted range is less than the 400 organisms per 100 mL water quality standard for the 80th percentile. The conservative predictions are also less than the geometric mean water quality standard of 200 organisms per 100 mL in all segments except Deep River 1, reflecting the fact that die-off is substantially increased in a lake compared to existing free-flowing stream conditions. Reductions in fecal coliform concentrations in the proposed lake would be primarily due to the increased residence time and dilution volume. Predicted concentrations are highest in the Deep River 1 segment because the dilution volume is small and the residence time is short. It was also assumed for this analysis that the High Point Eastside WWTP would discharge into Deep River 1. Since the High Point Eastside

WWTP is currently planned to discharge into Deep River 2, fecal coliform concentrations in all segments are expected to be below the water quality standard.

The screening analysis predictions are segment-wide averages. Therefore, exceedances of the standard for fecal coliforms may still occur in the locality of any concentrated sources, such as operating dairies. Since there are no dairies in the Deep River 1 segment of the lake, high fecal coliform concentrations in this segment appear to be associated with urban development, particularly in the areas draining Richland Creek and the portion of the Deep River immediately below the confluence with Richland Creek. The PTRWA is planning to construct a wetlands mitigation site on Richland Creek upstream of the Eastside WWTP which would provide interception of urban runoff from High Point and would also provide additional opportunity for inactivation of bacterial loads before they reach the proposed lake. The PTRWA also intends to work with local jurisdictions to ensure that priority is placed on enforcement of all ordinances regarding on-site disposal of domestic wastewater, including septic tanks.

The proposed lake is predicted to support all designated uses. This prediction is based on extensive modeling conducted by the North Carolina Division of Water Quality (NCDWQ) (see *Section 5.3.5.5* below). In accordance with the results of this modeling, the NCEMC took the proactive step of adopting stormwater runoff and buffer rules more stringent than those applied in any other WS-IV classified water body in the State (see *Sections 5.3.5.5* and *5.4.2* below). Evaluation of water quality issues and coordination with the State and the USEPA took place over a two-year period beginning in early 1998. Discussions of these water quality issues are included in *Sections 5.3.5.4* and *5.3.5.5*.

Water quality in the proposed Randleman Lake and its suitability for its intended uses for aquatic life support, recreational use, and drinking water supply will be monitored under the North Carolina Lakes Assessment Program and under a long-term monitoring program to be conducted by the PTRWA. The Lakes Assessment Program is administered by the NCDWQ and includes assessment of lakes to determine the trophic state of each lake, a measure of the lake's nutrient enrichment and productivity, and whether the designated uses of the lake have been threatened or impaired by pollution. The monitoring program to be conducted by the PTRWA is currently being developed in cooperation with the NCDWQ.

A portion of the yield of the proposed reservoir could result in additional discharges to the Deep River downstream of the lake. Wastewater flows associated with the Randleman and Randolph County portions of the Randleman Lake yield (totaling 7.01 mgd) are assumed to be discharged downstream of Randleman Lake. A portion of the flow is expected to be treated in individual septic tanks. The remainder would be treated in wastewater treatment facilities and discharged to surface waters in the Deep River Basin. The Randleman WWTP currently has a permitted capacity of 1.745 mgd. Randolph County does not currently have a wastewater collection and treatment system.

The location of potential future wastewater treatment facilities for Randolph County has not been determined. The County established a Water Task Force, whose mission was to examine a broad range of water-related issues and their impact on the quality of life and long-range development of Randolph County. The Water Task Force Report, issued in January 1995, set the following goal: to ensure quality, economically feasible wastewater treatment systems within Randolph County which provide protection of groundwater and surface water resources. One strategy under this goal was to determine

areas within the County in need of wastewater treatment facilities and to explore feasible alternatives. There are no specific plans to provide additional wastewater treatment plants to serve Randolph County. Any new treatment facilities will be evaluated and modeled by the NCDWQ in accordance with basinwide modeling conducted for the Cape Fear River Basin after an NPDES permit application is submitted for the proposed discharge. An environmental assessment will also be prepared for any new NPDES discharges to ensure that the most acceptable alternative has been selected and that environmental impacts have been fully evaluated.

5.3.5.3 Reservoir Yield and Downstream Flow Analyses. In 1990, the PTRWA contracted for an analysis of reservoir yield and downstream flow for Randleman Lake (Black & Veatch, 1990). The purpose of the yield analysis was to estimate the safe yield of Randleman Lake considering historic hydrologic conditions, WWTP return flows, future water demands by High Point from its two reservoirs located in the Randleman Lake watershed, and the three-tiered operating rule recommended by the NCDWR to assure minimum flows downstream from Randleman Lake. The purpose of the downstream flow analysis was to calculate the distribution of flows in the Deep River, downstream from Randleman Lake, both with and without the reservoir project (*Appendix A*).

The yield of Randleman Lake was calculated to be at least 48 mgd. The two upstream reservoirs, Oak Hollow Lake and High Point Lake, have a combined yield of approximately 18 mgd. The yield of Randleman Lake assumes that 12 mgd of wastewater associated with the yields of Oak Hollow and High Point lakes is discharged into Randleman Lake by way of the High Point Eastside WWTP and contributes to the ultimate Randleman Lake yield. It is estimated that up to 17.5 mgd of the Randleman Lake yield would return to the Deep River watershed. Of this amount, up to 11.5 mgd would be discharged to the reservoir, while 6 mgd would be discharged to other areas of the Deep River watershed.

On an average annual basis, flows in the Deep River with Randleman Lake would be less than flows in the river without the reservoir (*Table 24*). The difference is approximately equal to the interbasin transfer amounts. **Since the flow reductions reflect the rate of water withdrawals from Randleman Lake, they would be low initially but would increase over time.** The percent reduction in flow would be greatest at Randleman directly downstream of the dam and would decline downstream. By the year 2050, Randleman would experience an estimated reduction in average flow of 27 percent, while Moncure, located 88 miles downstream, would experience a reduction of about 3 percent.

The presence of Randleman Lake would also alter the downstream flow regime of the Deep River by moderating high flow conditions and augmenting low flow conditions below the dam. Watercourses in the Piedmont are subject to rapid fluctuations in response to storm events. These may be either minor, short-term rises in water level after summer storms, or prolonged flooding due to major rainfall events with long return intervals. Water levels are normally highest during the winter and early spring, and lowest in the late summer and fall. By holding back water during high flow conditions, Randleman dam would tend to reduce the natural variation of water levels.

Conversely, during low flow periods, flows in the Deep River downstream from Randleman Lake would be higher with the reservoir than without it. The existing 7-day, 10-year low flow (7Q10) at the Randleman gage on the Deep River is 7.7 cfs. The tiered release program for Randleman Lake would result in minimum low flow releases of 30 cfs except during drought periods, when lower releases would be allowed. When water in

the reservoir drops to 60 percent full, 20 cfs would be released. When the reservoir is depleted to 30 percent full, then 10 cfs would be released. **According to the Dam Safety rules (15A NCAC 2K.0502(c)(6)), when the usable water supply storage has been reduced to the level which triggers the first reduction in the minimum flow release (from 30 to 20 cfs for Randleman Lake), the average daily water withdrawal must be reduced by at least 10 percent compared to the average daily withdrawal for the 60-day period immediately prior to the first reduction in minimum flow. The water supply operator must accomplish this reduction in withdrawal within two weeks of the reduction in the minimum flow release. When the usable water supply storage has been reduced to the level which triggers the second reduction in the minimum flow release (from 20 to 10 cfs for Randleman Lake), the average daily withdrawal must be reduced by at least 20 percent. Randleman Lake is expected to operate at a volume above 60 percent of its capacity approximately 90 percent of the time over the long term.**

5.3.5.4 Toxic Substances Evaluation. Four potential sources of toxic substances have raised concerns about the water quality of Randleman Lake. These include the abandoned Seaboard Chemical Corporation site, the closed High Point landfill, the Randleman town dump, and the High Point Eastside WWTP.

Seaboard Chemical Corporation Site and High Point Landfill. The Seaboard Chemical Corporation site and the High Point landfill, both located along the Deep River adjacent to the proposed lake site, have been identified as sources of toxic substances which have contaminated the groundwater at each site. **The results of previous evaluations conducted on the potential effects of these two sites on the water quality in the proposed lake were presented in the DEIS. Comments on the DEIS were received and indicated that additional issues related to potential contamination from these sites needed to be evaluated. In order to further evaluate potential water quality impacts from these sites two additional evaluations were conducted. The first evaluation was conducted prior to the time when the data from the second set of studies were available and consisted of a screening analysis conducted by Tetra Tech, Inc. to assess whether the maximum reasonable loading rate from these sites would potentially result in violations of water quality standards in the proposed reservoir (Hazen and Sawyer, 1998). This approach was applied to the ten organic solvent priority pollutants which have been detected in groundwater at the site, and is expected to overestimate the likely concentrations which will occur in the lake. If these very conservative screening estimates can be shown to still be below relevant water quality standards, it can be concluded that contaminated groundwater from the sites will not result in exceedances of water quality standards in the proposed lake. The screening analysis predicted maximum pollutant concentrations at two sites, one below the source of the pollutants and one at the proposed water intake. The results of this analysis are summarized in *Appendix F*. For both locations, the maximum screening concentration was well below the applicable standard or criterion for each pollutant. Based on the screening analysis, no exceedances of water quality standards associated with groundwater loading from the Seaboard Chemical Corporation and High Point Landfill sites are expected.**

The second set of evaluations was conducted by consultants for Seaboard Group II and the City of High Point and consisted of Remedial Investigation (RI) studies for the two sites. Results and conclusions of these studies were presented in four separate reports. The first report discussed groundwater flow and transport model studies that measured the rates and direction of contaminant migration (Synesis Environmental, 1999). The second Remedial Investigation (RI) report examined remediation options, including natural attenuation, hydraulic containment by groundwater pumping, in-situ treatment by air sparging, and expanded groundwater recovery and treatment (Blasland, 1999). The third report examined the impacts of the site on human health and site ecology (Environmental

Resources Management, 1999a). The fourth report presented the results of a Feasibility Study (FS) and identified and evaluated remedial alternatives for addressing potentially unacceptable risks to human health and the environment identified from the RI and risk assessment studies (Environmental Resources Management, 1999b). The ultimate goal of the FS was to determine the most appropriate remedial approach for the site. Additional information on these reports is presented in *Appendix F*. While these reports and associated supporting data and evaluations were undergoing review by the North Carolina Division of Waste Management (NCDWM) and the public, the NCDWM provided the following assessment in a letter to the U.S. Environmental Protection Agency (NCDENR, 1999d) (A copy of this letter is included in *Appendix D, Section 3*):

The report provides detailed information on the nature and extent of the contamination at the site and compares the relative effectiveness of several remediation technologies that have potential application to address surface and groundwater pollutant concentrations found at the site.

In response to a question on the acceptability of the documents, until the reviews are complete and agency and public comments are available, I can not conclude that the documents will be approved as they now exist. However, I can state that they do provide alternatives that can achieve our goals for protection of the environment at the site and in adjacent waters of the Deep River or the Randleman Reservoir, if it is constructed. Based upon significant remediation experience with Superfund and RCRA Subtitles C, D, and I, the [NC]DWM is confident that the proposed alternatives reflect sound technical and scientific merit. Based on information available to us, we remain confident that it is technically feasible and economically viable to achieve a drastic reduction in any pollutants leaving the site and accordingly minimize the potential of pollutants from this site causing any violations of water quality in the lake. Furthermore, as I have indicated in the past, the [NC]DWM has a strong commitment that the over-riding criterion for actions from our Division will be that all water quality standards and uses will be protected in the lake. This is our goal and we believe we have the knowledge, technology, and financially responsible parties available to achieve this goal.

The U.S. Environmental Protection Agency also reviewed the above reports and the conclusions of the NCDWM and provided the following comments in a letter to the USACE (USEPA, 1999) (see *Appendix D, Section 3*):

EPA believes that the NCDENR is examining contamination issues in a responsible and thorough manner and is including the public in these deliberations. There is a suite of technological options available to manage groundwater contamination, and EPA has confidence that the programs NCDENR are considering are adequate to prevent significant amounts of contaminants in the proposed lake water.

Regarding the significant issue of whether the pollution from the toxic chemicals found at the former Seaboard Chemical facility and the High Point Riverdale Landfill sites in Guilford County pose a serious threat to the water quality of the reservoir, we accept the state's conclusion that "...[I]t is technically feasible and economically viable to achieve a drastic reduction in any pollutants leaving the site and accordingly minimize the potential of pollutants causing any violations of water quality in the lake." (NCDENR, 1999d). The NCDENR has indicated its confidence that, even though the final approval process for the remediation plan is not complete,

there is sufficient evidence and "strong commitment" that "...[A]ll water quality standards and uses will be protected in the lake." (NCDENR, 1999d). Furthermore, we are encouraged by the information we've seen on the various remediation alternatives and the public health risk assessments that have been performed and are now under public review. Although the alternative to remediate the site has not been specifically selected, we believe that the alternatives do offer options which will ensure the protection of the lake and we have confidence in the commitment of the State agencies to see that the selected option is implemented and the lake is protected.

Based on the above information, including the additional evaluations conducted on the two sites, groundwater contamination from the Seaboard Chemical Corporation and the closed High Point landfill sites should not have an unacceptable adverse impact on Randleman Lake water quality.

Randleman Town Dump. The location of the Randleman town dump is shown on *Figure 7b*. The site was investigated for hazardous material by the N.C. Division of Health Services in 1985 and by Black & Veatch in 1988. These studies found no evidence of groundwater contamination. In 1990, the PTRWA surveyed the property on which the dump was located in preparation for purchasing the property from Mr. J. L. Coble. This survey indicated that a portion of the approximately 1-acre dump site would be inundated by the lake, while the remainder would be located in the buffer. During a public hearing conducted by the NCEMC in 1991, concerns were raised by area residents that hazardous material placed in the abandoned Randleman town dump would threaten water quality of the proposed Randleman Lake.

In 1993, the PTRWA contracted with Trigon Engineering Consultants to install four groundwater monitoring wells at the dump site and to analyze groundwater samples taken from them. Generally, the results of that investigation indicate that State groundwater quality standards are exceeded for lead, barium, chromium, and silver (GEI, 1996a). The highest results, however, were found in a well up-gradient from the main landfill area. These inconclusive results indicated the need for continued monitoring. In 1995 the PTRWA contracted with **GEI Consultants, Inc.** to further test the site. **Eight representative samples were taken of soils on the site and analyzed for pesticides, polychlorinated biphenyls (PCBs), and Toxicity Characteristic Leaching Procedure (TCLP) Resource Conservation and Recovery Act (RCRA) metals.** The soils on the sites were found to contain very low concentrations of pesticides, PCBs and metals, with values not exceeding applicable regulatory limits or guidelines. Groundwater samples were also taken from the site at four locations, one uphill of the dump area and one downhill of the dump area (Trigon, 1993). Samples were analyzed for volatile organic compounds, semi-volatile organic compounds, PCBs, total RCRA metals, nitrate/nitrite, biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Test results indicated that unfiltered groundwater samples from two of the sites exhibited concentrations of total RCRA metals slightly above North Carolina groundwater quality standards. No other chemicals were found at concentrations exceeding State standards. A representative of the Superfund Section of the NCDWM indicated that, based on these results, no additional groundwater analysis is warranted (GEI, 1996a). The GEI site evaluation concluded that the landfill contents were derived from residential sources. Heavy metal contaminants can appear in domestic waste due to the disposal of source items such as flashlight and car batteries, washing machines, refrigerators, and paint cans. Analytical testing indicated that none of the samples collected at the site would be considered a hazardous waste (GEI, 1996a). Therefore, there is no anticipated impact on Randleman Lake water quality. Nevertheless, **all buried wastes and surface material at the Randleman dump will be removed and disposed of off-site prior to completion of the proposed project.** The removal cost is estimated to be **approximately \$225,400 and is based on an estimated volume of material for removal and disposal of approximately 32,270 cubic**

yards (based on a depth of materials of 10 feet and an area of 2 acres). A breakdown of the estimated costs for cleanup is listed as follows:

Loading	\$ 50,475
Hauling	107,640
Disposal	67,275
Total	\$ 225,390

This cost is included in project cost estimates for Randleman Lake in *Section 3.3.3 (Table 13)* above. Cleanup of the Randleman dump will be conducted in conformance with *NCDWM Guidelines for Assessment and Cleanup* under the Inactive Hazardous Waste Sites Program (NCDEHNR, 1997).

High Point Eastside WWTP. The High Point Eastside WWTP was also evaluated as a source of toxic substances. Recent evaluations were conducted of the effects of the discharge of organic and inorganic pollutants from the High Point Eastside WWTP into the proposed lake (see *Appendix F*). Based on a review of seven priority pollutant scans for the effluent from the Eastside WWTP for the two-year period from February 1996 through January 1998, the only organic pollutant which exceeded the State water quality standards was toluene. For toluene, the water quality standard of 11 ug/L was exceeded for one sample. The water quality standard for cyanide of 5 ug/L was exceeded for three samples. The Eastside WWTP is expected to have a weekly average effluent limit for cyanide of 5 ug/L (NCDENR, 1999b). Predicted metals concentrations in the proposed lake were also evaluated (see *Appendix F*). Based on this analysis, copper concentrations in the Upper Deep River arm of the proposed lake are estimated to be in the range of 0.5 to 1.9 ug/L, well below the State Action Level of 7 ug/L. Predicted concentrations for zinc are estimated to range from 2.4 to 14.1 ug/L, also well below the State Action Level of 50 ug/L. Operation of the Eastside WWTP in compliance with existing and projected future NPDES permit limits will result in concentrations for cadmium, total chromium, lead, mercury, and nickel which are well below the applicable water quality standards. Silver has been detected one time at a concentration well above the State Action Level. This anomalous observation is likely due to an industrial process discharge and is not reflective of average loadings. It is suspected that average silver concentrations in the effluent will be low, and that any occasional peak loads will be rapidly diluted upon entering the lake. Continued enforcement of the City's industrial pretreatment program will minimize the incidence of excessive silver concentrations in the Eastside WWTP effluent. Monitoring for silver is required by the plant's NPDES permit.

In general, minimization of potential human health impacts of the Eastside WWTP discharge will be by control of toxic chemicals discharged from the High Point Eastside WWTP, including (1) control measures of the City's Industrial Pretreatment Program for toxic substances which may be introduced to the treatment plant, and (2) monitoring and enforcement procedures contained in the plant's NPDES discharge permit. Planned measures to minimize WWTP bypasses, overflows, or spills to the proposed lake include an infiltration/inflow (I/I) reduction program, which will enable the Eastside WWTP to operate within the hydraulic design capacity of the expanded plant, and inclusion of measures to minimize the potential for treatment system failures in the design of the Eastside WWTP expansion facilities. Additional information on these control measures is included in *Appendix F*.

Concentrations of organic and inorganic pollutants at the proposed water supply intake should be less than the concentrations predicted by the reservoir model. This is because most of the pollutants would enter the reservoir at the upper end of the Deep River area, and the water intake would be located approximately 8.5 miles downstream at the lower end of the reservoir. It is expected that a considerable percentage of organic and inorganic pollutants would be removed by sedimentation and volatilization as the water is routed through the reservoir to the intake location (see *Appendix F*). Discharge of effluent, including any toxic substances present, from the High Point Eastside WWTP directly to the proposed Randleman Lake should not prevent the reservoir water treatment plant from meeting the SDWA requirements using conventional water treatment techniques.

5.3.5.5 Reservoir Trophic Level Evaluation. The DEIS indicated that previous studies have predicted that Randleman Lake is highly likely to be eutrophic (NCDEHNR, 1995). Eutrophication refers to enrichment of a waterbody due to the presence of high concentrations of the major plant nutrients, phosphorus and nitrogen. While small amounts of nutrients can be beneficial to aquatic life, elevated concentrations can stimulate the growth of algae and other aquatic plants, resulting in excessive plant biomass. Nutrient inflows may be derived from both point and non-point loadings. In the case of the upper Deep River, discharges from High Point's Eastside WWTP have been and continue to be a major source of phosphorus and nitrogen (NCDEHNR, 1994b). This results in a high potential for algal growth in the proposed Randleman Lake. In addition, algal blooms may be exacerbated by the long reservoir retention time, which is estimated to be 229 days under average flow conditions (NCDEHNR, 1995).

The amount of algal biomass in a waterbody can be measured as chlorophyll *a* concentration, and higher values are associated with higher levels of eutrophication. The water quality standard for chlorophyll *a* is 40 micrograms per liter (ug/L). Concerns were raised in the comments on the DEIS that the chlorophyll *a* standard would be exceeded in the proposed lake. The main issues with regard to meeting the chlorophyll *a* standard were the total point and nonpoint source loadings of nutrients to the Randleman Lake watershed. The largest single source of nutrient loadings to the proposed lake would be the High Point Eastside WWTP, which would discharge into the upper Deep River arm of the proposed lake. In order to address the projected impacts of nutrient loadings to the lake, the NCDWQ indicated that the PTRWA should prepare a comprehensive nutrient management plan for the proposed Randleman Lake watershed. This plan was needed to address existing and projected nutrient loadings to the proposed lake and to determine required nutrient management measures to provide for meeting the water quality standard for chlorophyll *a*. To address this request by the NCDWQ, modeling was conducted by Tetra Tech, Inc., and the results were summarized in the *Draft Nutrient Reduction Strategy and Implementation Plan* (Hazen and Sawyer, 1998). As a part of their review of this report, the NCDWQ conducted additional modeling and evaluated additional nutrient management options (Research Triangle Institute, 1998).

The results of these two modeling studies were incorporated in a modeling study prepared by the NCDWQ and presented in the NCEMC "Report of Proceedings" on the proposed reclassification of the Deep River for water supply purposes (NCDENR, 1998b). The modeling study by NCDWQ indicated that moving the High Point Eastside WWTP discharge away from shallow water to a deeper point near Freeman Mill (approximately 1.5 miles below the present outfall) would result in significantly lower eutrophication in the upper arm of the Deep River. The NCDWQ study concluded that this discharge relocation would substantially reduce the potential for eutrophication in the upper Deep River arm because of the elimination of a major source of nutrients that would support algal growth in that arm,

and the ability of the lake waters to better assimilate the nutrients at the downstream site. Stringent basin-wide nutrient control measures were also proposed by NCDWQ to address expected elevated trophic conditions in the proposed lake. In early 1997, NCDWQ staff informed the PTRWA of the need to implement a "Comprehensive Watershed Management Plan" as part of the State 401 water quality certification process. The Plan was to include assurances that point and nonpoint controls on nutrients would be imposed to provide protection of the lake waters. Elements of this Plan are now specified in NC Administrative Code rules adopted by the NCEMC on November 12, 1998 (15A NCAC 2B.0248 through .0251). The major elements of the rules include provisions for 50-foot buffers along both sides of all perennial and intermittent streams, regulation of tree cutting around those streams, control of housing density within the reservoir watershed and more stringent controls within the first 1/2 mile outside the lake (above the normal pool elevation of 682 feet), limitations on nutrient loadings for the High Point Eastside WWTP based on an effluent phosphorus limit of 0.5 mg/L at the expanded 26 mgd permitted flow (In addition to relocating the discharge approximately 1.5 miles downstream), and other stormwater protection measures.

Based on the above nutrient control measures, the modeling study by NCDWQ concluded that the average chlorophyll *a* of the reservoir should be less than 20 ug/L, with all segments predicted to average less than the standard of 40 ug/L. Predicted chlorophyll *a* concentrations in the proposed lake are summarized in *Table 24b* (NCDENR, 1998b). In adopting the rules for the Randleman Lake watershed, the NCEMC recognized that, as in other Piedmont lakes in the State, the 40 ug/L criterion for chlorophyll *a* will be violated some time during the growing season in most years. For this reason, the stormwater runoff and buffer rules adopted by the NCEMC are more stringent than those applied in any other WS-IV classified waterbody in the State. Additional information on the recent reservoir trophic level evaluations is included in *Appendix F*.

Estimates of nutrient loadings and chlorophyll *a* levels in the proposed lake are predictions based on mathematical models and, as such, are only estimates of conditions that might exist in the future. The models indicate that lake water quality will be within State regulatory guidelines; however, post-impoundment water quality may not meet or may exceed expectations. These unknowns would be determined by post-impoundment water quality monitoring surveys to be conducted by the PTRWA member governments under a long-term monitoring program to be developed in cooperation with the NCDWQ. Should post-impoundment water quality require reduction of nutrient loadings into the system, then additional restrictions or alternative strategies would be adopted as required. The USEPA has indicated that it believes that the nutrient control measures proposed by NCDENR and adopted by the NCEMC constitute measures that can reasonably be expected to improve the control of nutrients into the proposed lake. This conclusion was contained in its letter of October 19, 1999 to the USACE summarizing its conclusions on the water quality issues for the proposed lake (USEPA, 1999) (see *Appendix D, Section 3*). The USEPA further indicated that it:

" ...believes that the nutrient control measures should be given an opportunity to demonstrate efficacy in controlling algal growth and chlorophyll *a* in the proposed lake. We also concur with the North Carolina Environmental Management Commission's conclusion that "[the nutrient management plan] ...should result in a lake that will support all designated uses assigned and that the reclassification action of the Commission would be consistent with the requirements of the Federal Clean Water Act and the State's laws and rules." "

The NCDWQ in its letter to the USACE of January 25, 1999 indicated that its water quality concerns had been resolved (NCDENR, 1999a) (see *Appendix D, Section 3*). In this letter, the NCDWQ stated that "[t]he rules [adopted by the NCEMC] contain a combination of requirements which we believe will significantly reduce the nutrients and other pollutants to the lake and provide adequate protection of the water quality standards." The NCDWQ also issued a 401 Water Quality Certification for the proposed project on March 11, 1999 (NCDENR, 1999c) (see *Appendix D, Section 3*). The 401 Water Quality Certification included the statement that the proposed project "...will not result in a violation of applicable Water Quality Standards and discharge guidelines." The NCDWQ also reviewed draft FEIS documents and indicated in their letter of March 1, 2000 to the USACE that the documents were "...acceptable from a water quality point-of-view" (NCDENR, 2000) (see *Appendix D, Section 3*). The NCDWQ added that the documents were "...consistent with the positions and information provided in our January 25, 1999 letter to Dr. Wright" (USACE, Wilmington District, Chief, Regulatory Division).

The expected water quality of Randleman Lake was also compared to the water quality at other eutrophic lakes in North Carolina. Predicted Secchi depth (distance to which light penetrates as measured using a black and white disk), total phosphorus, and chlorophyll *a* values are expected to be comparable to those of other regional reservoirs and lakes. A comparison of projected water quality in the proposed Randleman Lake was included in the FEIS prepared by the N.C. Department of Environment, Health and Natural Resources, Division of Water Resources (NCDEHNR, 1991). Predicted model values were compared with other regional reservoirs and lakes. *Table 25* presents Secchi depth, total phosphorus, chlorophyll *a*, and size data for eight regional lakes, along with corresponding estimated values for Randleman Lake. The Randleman Lake values were based on the assumption that the effluent total phosphorus for the High Point Eastside WWTP was reduced to 0.5 mg/L. Secchi depth, total phosphorus, and chlorophyll *a* values predicted for Randleman Lake were within the range of values measured in the other lakes. An updated chlorophyll *a* value from the modeling conducted by NCDWQ is also shown in *Table 25*. The predicted value from this modeling is also within the range of values for other regional lakes.

5.3.5.6 Summary Evaluation of the Effects of Toxic Substances and Trophic State. In order to collectively address all water quality aspects of the proposed Randleman Lake, an independent review of past studies was commissioned by the PTRWA (and discussed in the DEIS). This review was conducted by Dr. Patrick Brezonik (Department of Civil Engineering, University of Minnesota) (Brezonik, 1995). The report by Dr. Brezonik is included in *Appendix G*.

Since the DEIS was published, additional studies have been conducted on the impact of toxic substances and nutrients on the water quality in the proposed lake (see *Sections 5.3.5.4* and *5.3.5.5*). The results of these studies have been reviewed by the NCDWM, the NCDWQ and the USEPA and these agencies have indicated that their previous technical concerns have been resolved and adequate measures have been taken to protect the water quality in the proposed lake. Letters from these agencies are referenced in *Sections 5.3.5.4* and *5.3.5.5* and included in *Appendix D, Section 3*.

With regard to the potential toxic substances impacts from the Seaboard Chemical Corporation and High Point Landfill sites, additional Remedial Investigations have been conducted and the NCDWM has indicated that it "...remain[s] confident that it is technically feasible and economically viable to achieve a drastic reduction in any pollutants leaving the site and accordingly minimize the potential of

pollutants from this site causing any violations of water quality in the lake." (NCDENR, 1999d). The USEPA has concurred with this conclusion.

With regard to reservoir trophic levels, additional modeling has been conducted by NCDWQ and private consultants specializing in waste loading and contamination issues. Based on this modeling, the NCEMC has recommended that the discharge for the High Point Eastside WWTP be relocated approximately 1.5 miles downstream to a point near Freeman Mill. The NCEMC has also adopted watershed protection measures that are more stringent than those applied in any other WS-IV classified water body in the state. The NCDWQ is also requiring the PTRWA member governments to conduct post-impoundment water quality monitoring studies to evaluate actual lake water quality. Should post-impoundment water quality require reduction of nutrient flows into the system, then additional restrictions or alternative strategies would be adopted as required. The USEPA and the State have concluded that the nutrient control measures already proposed and adopted should result in a lake that will support all designated uses assigned and that the reclassification by the NCEMC of the proposed lake as a water supply is consistent with the requirements of the Federal Clean Water Act and the State's laws and rules.

5.3.5.7 Downstream Water Quality. The proposed project will result in increased flows in the Deep River downstream of the proposed lake during low flow conditions. This is a result of the planned minimum flow release during normal conditions of 30 cfs. The minimum flow release would be reduced during drought conditions to a minimum of 10 cfs when the reservoir volume is reduced to 30 percent full or less. This is still higher than the existing 7Q10 flow of 7.7 cfs at the Randleman gage on the Deep River (see *Section 5.3.5.3, Reservoir Yield and Downstream Flow Analysis*). The normal minimal flow release of 30 cfs is expected to reduce the number and duration of downstream water quality violations by providing greater assimilative capacity for wastewater discharges to the Deep River. Gates will also be provided to enable releasing water from the proposed lake at various levels to ensure that the dissolved oxygen concentration of the released water is high enough that water quality is not adversely affected immediately below the dam (GEI, 1995). Effects of the proposed project on downstream water and wastewater facilities is discussed in the following sections.

Gulf-Goldston Water Supply. The Gulf-Goldston Sanitary District currently obtains about 135,000 gallons of water a day (0.21 cfs) from the Deep River at Gulf (Chatham County) and delivers it to a service population of 1,300. The Randleman Lake project would decrease the average flow in the Deep River at Gulf by about 60 cfs (5 percent). It would, however, increase low flows by about 12 cfs. Thus, it would not significantly impact the Gulf-Goldston Water Supply, which is located approximately 70 miles downstream from the Randleman site.

Lee County. Floyd Browne Associates owns and operates a 1.5 mgd water treatment facility for Lee County near Cumnock, about 5 miles downstream from the Gulf-Goldston intake (75 miles below Randleman). This system currently withdraws about 500,000 gallons of water per day (0.77 cfs), primarily to supply a poultry processing plant. As with the Gulf-Goldston plant, this facility would not be impacted by Randleman Lake because normal flows are reduced only slightly, and low flows would be increased by about 12 cfs.

City of Sanford. The City of Sanford currently discharges wastewater into the Deep River after treatment at its Big Buffalo WWTP, which is located about 3 miles downstream from the intake for the Lee County water system. The city recently added tertiary treatment to its wastewater plant and increased its capacity from 5.0

mgd to 6.8 mgd. The primary reason for improving the level of treatment was the low substandard dissolved oxygen concentrations in the Deep River during warm base flow periods. Sanford requested that the NCDEM determine the cause of this problem, and NCDEM in 1994 issued its "Review of Deep River/Carbonton Water Quality Investigations 1992/1993" (NCDEHNR, 1994a). The report indicated that water quality in the study area is impacted by nutrient loading from upstream sources. The elevated nutrient levels originate from the High Point Eastside WWTP, and concentrations tend to decrease as one proceeds further downstream. Flow duration curves in the NCDEM Final Environmental Impact Statement (NCDEHNR, 1991b) show that in the vicinity of the Big Buffalo WWTP (i.e., at Carbonton), base flow conditions (below 150 cfs) would improve with Randleman Lake in place. Thus, Randleman Lake would not adversely impact the City of Sanford's wastewater treatment plant, and should help improve water quality in the Carbonton impoundment.

5.3.5.8 Interbasin Transfer.

Haw River Basin. The City of Greensboro currently operates two WWTPs, both of which discharge to the Haw River basin via North and South Buffalo Creeks. The interbasin transfer of water from the Randleman Lake project would lead to **increased wastewater discharges** and higher base flow conditions in these creeks, as well as downstream in Buffalo Creek, Reedy Fork, and the Haw River. The increase would approximately equal the actual amount of water transferred minus consumptive losses. The amount would be small initially and would vary from year to year, but would probably increase gradually over a period of about 50 years, the planned life of the reservoir.

Based on information from the USGS, the average annual flow for Piedmont North Carolina streams is 0.9 cfs per square mile of drainage basin. The North and South Buffalo Creeks combine to form Buffalo Creek and, at its confluence with Reedy Fork, have a drainage area of 100.2 square miles. Therefore, the estimated average annual natural flow for this area is about 90.2 cfs (100.2 square miles x 0.9 cfs per square mile).

During periods when Greensboro fully utilizes the 36 mgd (55.8 cfs) existing safe yield from its Haw River reservoirs (*Table 2*), and assuming that a consumptive and system loss of 20 percent occurs, it is estimated that the average flow in Buffalo Creek would be 134.8 cfs (90.2 cfs + 80 percent of 55.8 cfs). If 80 percent of the 36 mgd (55.8 cfs) water supply yield **becomes** wastewater, then this would represent about 33 percent of the average flow in Buffalo Creek (44.6 cfs divided by 134.8 cfs).

At the end of the 50-year planning period when Greensboro is using its full 28.5 mgd (44.1 cfs) allocation from Randleman Lake as well as its existing 36 mgd (55.8 cfs) from the Haw River reservoirs, the average flow in Buffalo Creek is estimated to be 178.9 cfs (90.2 cfs + 80 percent of 55.8 cfs + 100 percent of 44.1), which means that about 50 percent of Buffalo Creek's average flow may be treated effluent. Approximately 25 percent of the total flow would represent water transferred from Randleman Lake (44.1 cfs divided by 178.9 cfs).

The higher flows in the Haw River basin brought about through interbasin transfer may be accompanied by corresponding ecological changes. However, **effects on maximum flows are expected to be minor because the volume of flow transferred is small compared to maximum stream flows during flood events. The amount of flow which would be transferred to the Haw River Basin is 28.5 mgd (44.1 cfs). Based on USGS streamflow data for the Haw River at the Town of Haw River, the maximum daily flows for calendar year 1994 and water year 1995 (October 1994 through September 1995) were 9,240 and 19,900**

cfs, respectively. Therefore, impacts on downstream geomorphology are also expected to be minor. The hydrologic, ecological, and water quality impacts of interbasin transfers were assessed prior to the issuance of an interbasin transfer permit by the NCEMC. In addition, the impacts of higher wastewater flows on receiving streams were assessed during the review process for obtaining state permits for expansion of the aforementioned WWTPs.

It is possible that interbasin transfers to the Haw River could affect the operation and management of B. Everett Jordan Dam and Lake, which is located on the Haw River approximately 4.2 miles upstream of its confluence with the Deep River. These transfers, which would occur in the form of treated wastewater, could affect the dependability of the water quality and water supply storage of Jordan Lake through adverse impacts on nutrient and dissolved oxygen levels in the lake. Such effects, if they occur, may not be apparent for years or decades depending upon the rate of increase in interbasin transfer. In addition, such effects could be influenced by a number of factors, such as advances in water and wastewater treatment technology, the destinations of water allocations from Randleman Lake and Jordan Lake, and hydrologic changes due to alteration of land uses in the drainage basins of the two reservoirs

NCDWR has conducted a water reallocation modeling study for Jordan Lake and the Cape Fear River downstream to U.S. Lock and Dam No. 1 (Moffatt & Nichol, 2000). The study developed a hydrologic simulation model for the lake. The model is a simple water balance model and does not address water quality in Jordan Lake, although it does have some outputs which can be used as inputs to other water quality models. There is a provision in the model to allow evaluating impacts of the proposed Randleman Lake, primarily looking at conditions with and without Randleman Lake and the impacts on downstream flows and the uses of the lake. However, since the water reallocation modeling study does not address water quality in Jordan Lake, neither does it not recommend any operational or management measures for dealing with water quality problems that may occur in Jordan Lake (regardless of whether Randleman Lake is constructed).

Water quality problems in Jordan Lake are discussed in the NCDWQ *Cape Fear River Basinwide Management Plan* (NCDEHNR, 1996a). Issues raised in the plan include excessive loadings of oxygen-demanding materials and nutrients from both point and nonpoint source discharges. It is expected that if water quality problems occur in Jordan Lake, they will be addressed by additional controls applied to point and nonpoint source discharges under the basinwide management planning process to reduce excess pollutant loadings to the Jordan Lake watershed.

Some adverse impacts on fish and recreation in Jordan Lake may occur as a result of the proposed project due to the increased discharge of nutrients to the Haw River Basin from the increased Greensboro WWTP discharges and from urban runoff associated with increased development in the Greensboro service area. These may include increased incidence of fish kills as a result of algal blooms and periodic indications of stress for some fish species in the upper portions of the lake. Point source loadings for phosphorus will be controlled by maintaining the effluent phosphorus from the Greensboro T.Z. Osborne WWTP at or below the current effluent limit of 2 mg/L on a quarterly average basis.

For its WWTP discharges to the Haw River Basin, the City of Greensboro has an ongoing program to reduce I/I (infiltration/inflow, as from extraneous sources) in the wastewater collection system and regulates its industrial users under an industrial pretreatment program. Redundant equipment,

multiple treatment trains, and redundant power supplies are also provided at the Greensboro T.Z. Osborne and North Buffalo WWTPs. Most of the increased flow associated with the additional water supply will be treated at the T.Z. Osborne WWTP. Environmental assessments for the expansions of the T.Z. Osborne WWTP to 30 mgd and 40 mgd have been submitted to and approved by the NCDWQ. Facilities to expand the T.Z. Osborne WWTP to 30 mgd are currently under construction and include capacity to treat a peak flow of 2.5 times the design average flow without overflows or bypasses.

The increased wastewater discharge from the T.Z. Osborne WWTP is not expected to have a significant effect on recreational activities, including canoeing, in the Haw River. NPDES permit effluent limits for the T.Z. Osborne Plant will be set by the NCDWQ at levels which will ensure that water quality in the Haw River will not adversely impact human health or aquatic life as a result of the increased discharge.

Effects on downstream wetlands as a result of interbasin transfer to the Haw River Basin are expected to be minimal because of limited impacts on maximum streamflows. There is only one known endangered or threatened species in the Haw River upstream of Jordan Lake. Two populations of the Cape Fear shiner are located in the Haw River above and below the reservoir at Bynum (Alderman, 1994). The population status for these populations is unknown and there is no designated critical habitat for this species on the Haw River. The Carolina darter has not been identified in the Haw River Basin downstream of the Greensboro T.Z. Osborne WWTP discharge. No adverse impacts on endangered and threatened species are expected from interbasin transfer to the Haw River Basin.

Yadkin River Basin. The City of High Point currently operates two WWTPs. The Eastside WWTP discharges to the Deep River, while the Westside WWTP discharges to Rich Fork Creek in the Yadkin River basin. The Westside plant is located just above the intersection of North Carolina SR 109 and Rich Fork Creek, and the drainage area at this location is approximately 25.1 square miles. Based on USGS estimates that the average annual flow for Piedmont North Carolina streams is 0.9 cfs per square mile of drainage basin, the current average flow in Rich Fork Creek at the Westside WWTP is 22.6 cfs (25.1 square miles x 0.9 cfs per square mile).

The Westside WWTP currently treats and discharges 3.5 mgd (5.4 cfs) (Gore, 1997). Therefore, the average annual natural flow in Rich Fork Creek (22.6 cfs) plus the treated effluent (5.4 cfs) produces an average flow of 28 cfs, which is approximately 19 percent wastewater. Assuming that 2 mgd (3.1 cfs) of water from Randleman Lake is transferred to the Yadkin River basin through this plant, the average streamflow at this site could be expected to increase to about 31.1 cfs (28 cfs + 3.1 cfs), reflecting an increase of about 11 percent (3.1 cfs divided by 28 cfs). Of this amount 8.5 cfs (5.4 cfs + 3.1 cfs), or about 27 percent (8.5 cfs divided by 31.1 cfs) would represent treated wastewater. The flow increase from Randleman Lake transfers is anticipated to take place gradually over about the next 50 years. **As in the Haw River Basin, effects on maximum flows are not expected to be significant because the volume of flow transferred is small compared to maximum stream flows during flood events. Therefore, effects on downstream geomorphology are not expected to be significant. Based on the Yadkin-Pee Dee River Basinwide Water Quality Management Plan (NCDEHNR, 1998), there are no federally-listed threatened or endangered species downstream in the Yadkin River that would be affected by the proposed interbasin transfer to the Yadkin River Basin.**

5.3.6 Air Quality. The construction of the Randleman Lake project would result in temporary increases in levels of dust, smoke, and exhaust pollutants. These impacts would be most concentrated in the immediate project area but are expected to be minor. Randleman Lake would be located within the air quality jurisdiction

of the Winston-Salem regional office of NCDENR, which covers Randolph and Guilford Counties. According to the Winston-Salem office, Randolph County is characterized as an attainment area, indicating that ambient air quality standards are being met. However, Guilford County is designated as a "maintenance area" for ozone. The State of North Carolina has a State Implementation Plan (SIP) approved or promulgated under Section 110 of the Clean Air Act. In accordance with USEPA regulation 40 CFR 93.153 for non-attainment and maintenance areas, determinations of conformity with the SIP are required for Federal actions, including the issuance of permits, if certain exemptions are not met.

Ozone is not a direct product of fossil fuel combustion, but it may be produced through the effects of sunlight on nitrogen oxides (NOx) derived from exhaust emissions. Since NOx are precursors of potential ozone formation, they are used as ozone indicators. The amount of NOx produced by construction equipment on a particular job can be calculated based upon the estimated quantity of fuel which would be consumed in the process. For Randleman Lake, clearing and construction activities in Guilford County would impact about 750 acres. The NOx emissions produced by these activities in Guilford County are estimated at less than 25 tons per year, which is less than the exemption limit of 100 tons per year. Therefore, a Clean Air Act conformity determination is not required for the proposed project. In addition, these emissions are not expected to affect the air quality status or the county air quality programs. The project is in compliance with Section 176(c) of the Clean Air Act, as amended.

The availability of a new water supply in the area would allow the continuation of urbanization, especially in Guilford County. **In terms of Indirect and cumulative Impacts, this development may contribute to increased emissions through more vehicular traffic and/or industrial expansion. The magnitude and timing of such impacts are difficult to predict due to the influence of other factors, including the number, type, size, and location of new industries.**

5.3.7 Vegetation Resources. An immediate and permanent impact of Randleman Lake construction would be the clearing and inundation of approximately 3,000 acres of plant communities located below elevation 682 feet m.s.l. Within the project's boundaries, including the reservoir and buffer areas, there are approximately 4,200 acres of forestland (*Table 16*). Much of the Piedmont Alluvial (1,057 acres - 62.7 percent of total) and Bottomland Forests (4 acres - 44.4 percent of total) would be flooded. Approximately one-half of the Mesic Mixed Hardwood (809 acres - 46.9 percent of total) and most of the Piedmont Acidic Cliff communities (5 acres - 71.4 percent of total) would also be flooded. The majority of the Dry-Mesic Oak-Hickory Forest would remain intact (498 acres - 64.6 percent), but 273 acres would be inundated. The actual surface area of the Deep River and its tributaries was included in the acreage computed for each adjacent plant community. This methodology resulted in overestimation of the impact on the Piedmont Alluvial Forest category. The alluvial and mesic mixed hardwood forest communities that would be lost represent areas of high natural productivity not encountered in the other plant communities (Carter and Associates, 1993).

Flooding upstream of the project would be in Piedmont Alluvial Forest. Flooding adjacent to the pool would impact some Dry-Mesic Forest, and may promote some shift to a more mesic forest. This is also true of all other plant communities immediately adjacent to the pool. In many parts of the reservoir, the area so affected would be confined to a relatively narrow strip around the pool due to the often steep and confining topography. A shift to a more mesic forest would likely be a beneficial impact, as it would partially replace important resources (mesic or wet community types) being inundated.

The PTRWA will take appropriate measures during construction to ensure that trees located outside of construction limits will be protected from the following kinds of damage:

- **skinning of tree trunks by construction equipment.**
- **soil compaction or root exposure or injury by construction equipment.**
- **adding layers of soil over the root systems of trees.**
- **accidental spilling of petroleum products or other substances over the root systems of trees.**

This will be accomplished by identifying appropriate protection measures and including those measures as contract requirements for construction of the proposed reservoir.

It is expected that much of the marketable timber within the proposed normal reservoir pool area would be cut and sold during the construction phase of the project. Other brush in the normal pool area would be cleared and burned.

The loss of forestlands would be partially offset by the conservation of habitats within the proposed 3,000-acre buffer. The Randleman Lake project would offer the opportunity to preserve and restore ecological integrity to a portion of this watershed that would almost certainly be lost if current urbanization trends continue. Over time, natural ecological succession would lead to reestablishment of mature plant communities which likely would not occur in the absence of the project. No timber harvesting will be allowed by the PTRWA within the buffer area except where the forestry activities are necessary for the health and viability of the forest and are consistent with the primary goal of watershed protection for the reservoir.

The proposed project would have some indirect and cumulative impacts on vegetation resources outside the immediate project area. The increased water supply is expected to allow additional industrial growth and residential development, primarily in areas that are in and adjacent to the existing urban areas in the Piedmont Triad region. Some plant communities would be cleared to accommodate new and/or expanded facilities.

Ongoing suburban development and dairy farm operations have degraded, and would continue to degrade, natural habitats in this drainage basin. Logging activities have also adversely affected natural habitats in the basin. However, logging accomplished using Best Management Practices (BMPs) for forestry operations (NCDEHNR, 1989) can reduce erosion and provide some controls on water pollution from these operations. If properly applied, these BMPs would offer some protection to the quality of waters that might be affected by these operations.

5.3.8 Wetlands. Construction and operation of Randleman Lake would impact, principally by inundation, approximately 121 acres of wetlands and 188 acres of free-flowing streams. These quantities have been verified by USACE. All affected wetlands are generally categorized as palustrine, indicating that they do not occupy marine, estuarine, riverine or lake environments (Table 17). Affected subcategories include approximately 72.0 acres of forested, broad leaf deciduous; 20.4 acres of persistent emergent; 10.4 acres of forested, scrub-shrub broad leaf deciduous; and 16.4 acres of forested broad leaf and persistent emergent

wetlands (these acreages do not total 121 due to rounding associated with the 274 wetland tracts involved). Most of the forested wetlands along the Deep River and in the proposed impoundment have experienced substantial adverse impacts in their functional values due to timber harvesting and farming practices that have altered the hydrology and characteristics of the resident plant communities. Consequently, these wetlands are relatively low in quality. The applicant has proposed to address the loss of these wetlands through the implementation of a mitigation program that includes the acquisition and permanent conservation of approximately 608 acres of swamp forest located along the Black River (a tributary of the Cape Fear River) and the creation/restoration of approximately 121 acres of forest wetlands along tributaries of Randleman Lake, or to otherwise meet Federal and State mitigation requirements. It is also anticipated that the lake margin would develop new wetland areas where the soil saturation and topography are favorable. The elements of the mitigation program are discussed in *Section 5.8*.

There would be no direct wetlands impacts associated with the proposed water treatment plant for the proposed project. The water treatment plant would be located on an upland site near the proposed lake. Wetlands impacts would be required for the proposed water transmission lines for conveying finished water from the water treatment plant to the water distribution systems of the PTRWA members. These would consist of stream crossings of the Deep River, Muddy Creek and two unnamed tributaries of the Deep River within the proposed lake, and Bob Branch and an unnamed tributary of Muddy Creek outside the proposed lake. The stream crossings within the proposed lake are included in the wetlands impacts of the proposed project. For the stream crossings outside the proposed lake, wetlands would be delineated during the design phase of the project, and the location of wetlands along the proposed water transmission main route would be shown on the construction drawings. A Section 404 permit would be required for any fill in jurisdictional waters or wetlands. Details of potential wetland impacts have not yet been determined. However, since the water transmission lines are proposed to follow existing roadways, impacts are expected to be minor, and construction of the water lines could likely be authorized by general permits. After construction, the wetlands areas would be restored to existing grade, allowing recovery of lands to their natural condition. Excess material would be moved to high ground.

Attenuation of downstream flood peaks associated with the long retention time in the proposed lake can result in reductions in overbank flooding and can have adverse impacts on downstream wetlands. The magnitude of these impacts has not been determined, although it is expected to be small because most Piedmont wetlands do not derive a significant portion of their water budget from overbank flooding of the main stream (e.g., Deep River), but rather derive water from smaller tributaries as they enter the larger floodplain. Therefore, flow attenuation from the dam should have little effect on downstream wetland function. The proposed project would also have short-term effects on downstream wetlands from construction of the proposed dam, including increased sediment and altered streamflows.

Indirect and cumulative effects of the proposed project on wetlands outside the project area would not be significant. Most developers strive to avoid wetland areas when developing residential and industrial projects. This is due to the presence of high groundwater levels and the fact that hydric soils may also have high shrink-swell potentials. Such conditions lead to soil movement, which is detrimental to building foundations. In most cases, use of wetlands would also require a permit from the U.S. Army Corps of Engineers. However, small areas of wetlands are lost as development

progresses into new areas. A cumulative estimate of this is not available, but it is not believed to represent a significant reduction of the total wetland area of the region.

5.3.9 Wildlife Resources. The inundation of 3,000 acres to create Randleman Lake would produce a corresponding loss of terrestrial wildlife habitat. This habitat loss would be particularly hard on bottomland dwellers, such as herpetofauna, and some small, slow moving mammals, such as shrews, moles, and voles, many of which will perish. Other small mammals, such as squirrels and rabbits, would move to the reservoir buffer strip or to adjacent wooded areas and open fields. Larger animals would adjust their feeding and resting habits and would relocate into buffer strip areas or adjacent similar habitat (Carter and Associates, 1993). However, since the adjacent lands have a limited carrying capacity, all displaced animals likely cannot be accommodated there. As a result, some of these animals will be lost also.

Establishment of the reservoir would bring about changes in the bird community. Bird species inhabiting river bottomlands and forested habitats would initially decrease in population or disappear due to the loss of their habitat. Once the lake is completed, the presently cut-over buffer area would gradually return to a forested condition and would then provide a stable, wooded habitat for birds and other wildlife along the lake margin. Over time, the natural reforestation of the buffer area would replace some of the inundated terrestrial habitat, although the plant communities would differ.

The loss of 121 acres of wetlands through the construction of Randleman Lake would also represent a loss of habitat for many species of wildlife, including waterfowl that utilize wetlands for feeding, resting, breeding, or over-wintering. This loss of wildlife habitat would be offset by the new lacustrine habitat and its developing marginal wetlands which would provide valuable new habitat for waterfowl, migratory birds, and birds of prey.

Indirect and cumulative effects of the proposed project on terrestrial wildlife resources will result from urbanization in newly-served areas and will consist of increased fragmentation of existing wildlife habitats. Native vegetation will be replaced with urban species, and wildlife will withdraw from the expanding urban area due to increased human disturbances and loss of suitable habitat. Increases in urban runoff will occur. During seasonal low flows, urban runoff, where it occurs, will have a more pronounced effect on aquatic habitat quality because of the low dilution capacity of the receiving streams. Control measures adopted pursuant to statewide watershed protection and urban stormwater management regulations will reduce the impact of increased urbanization in the Piedmont Triad area.

5.3.10 Fishery Resources. Impoundment of Randleman Lake would convert the present stream habitat to a lake environment, and coincident changes are anticipated in the fishery. Those species adapted only to a free-flowing stream habitat would decline in abundance and may eventually disappear from the reservoir. **Of the 34 species listed in Table 19 (Section 4.3.10), approximately one-half will be able to readily adapt to a lake environment. Most of the others will disappear from the areas inundated by the reservoir.** Largemouth bass, bluegills, crappies, and catfish experience great success in reservoirs and should develop substantial populations within a few years. Relative to the present fishery of the project area, the future fishery of the lake is expected to be a substantial improvement.

Fishery resources in Randleman Lake and in the Deep River downstream should experience benefits from water quality improvements and low-flow augmentation associated with the project. The levels of phosphorus discharged from the High Point Eastside WWTP should be reduced as a result of new permit limits established in 1999 (NC DENR, 1999), and water quality is expected to continue to improve in the Deep River (and

subsequently in the lake when it is impounded). **Based on these reduced phosphorus levels and other factors, the fishery in the proposed reservoir is expected to experience only minor adverse effects from the water quality in the reservoir. As in many reservoirs, there is always a potential for levels of eutrophication to affect fisheries. However, the NCDWQ has stated that predictions indicate that all uses will be protected in the lake. The NCDWQ and the NCEMC have taken additional steps to reduce the contribution of nutrients to the proposed lake, which will, in turn, reduce the potential that poor fishery conditions will be experienced in the lake. These steps require (1) reductions of nutrients from point sources, principally the High Point Eastside WWTP, (2) nonpoint source controls such as riparian buffer protection around streams, and (3) stormwater controls such as density limitations or stormwater treatment.**

No increases are expected in the incidence of disease or localized fish kills as a result of bacterial and nutrient levels (see Section 5.3.5.5 above). Metals and toxic chemical concentrations are also not expected to occur at levels which could lead to fish consumption advisories from bioaccumulation.

Compared to free-flowing Piedmont rivers, the water discharged from a typical reservoir in the Piedmont normally has a higher dissolved oxygen content, lower 5-day biochemical oxygen demand, and reduced turbidity due to the longer residence time which allows nutrients, sediments, metals, and toxics to settle out in the reservoir. Point and nonpoint source pollutants that would normally flow through the river would be diluted by the lake waters and would tend to settle out in the lake. Consequently, the water discharged downstream from the reservoir is expected to be of a higher quality than now exists in the river.

The multi-level outlet structure to be incorporated into the Randleman dam would also contribute to downstream water quality by allowing selective withdrawals from different water depths to provide releases of the desired temperature and dissolved oxygen content (Black & Veatch, 1991a) (see Section 5.3.11 below).

In addition, Randleman Lake will provide higher minimum flows in the Deep River downstream and, thereby, contribute to improvements in its fish habitat. The NCDWR conducted an in-stream flow analysis and determined the requirements to maintain adequate fish habitat. The NCDWR recommended a tiered minimum release program of 30-20-10 cfs flow. Under this program, the proposed project would provide a minimum downstream release of 30 cfs to augment low flow conditions and to enhance aquatic habitat value, except during severe and prolonged droughts when the two lower rates could be used. When water in the reservoir drops to 60 percent full, 20 cfs would be released. When the reservoir is depleted to 30 percent full, then 10 cfs would be released. Randleman Lake is expected to operate at a volume above 60 percent of its capacity approximately 90 percent of the time over the long term. The 30 cfs release would, therefore, also be expected to occur approximately 90 percent of the time over the long term.

5.3.11 Endangered, Threatened, and Rare Species. No species listed as endangered or threatened, or proposed for such listing by the State of North Carolina or the U.S. Fish and Wildlife Service, would be **adversely affected** by the construction of Randleman Lake (Carter and Associates, 1993). The only listed species located within the potential realm of influence of the proposed project is the endangered Cape Fear shiner (*Notropis mekistocholas*). **Habitat for this species exists** in the Deep River at Coleridge, which is approximately 22 miles downstream from the dam site. **In addition, designated areas of critical habitat for the shiner occur** in the Deep River (and Fork Creek) **near the Randolph-Moore County line** about 33 miles below the dam site **and in the Deep River (and Rocky River) in the vicinity of Moncure** over 80 miles

below the damsite. The locations on the Deep River of designated critical habitat for the Cape Fear shiner are shown on *Figure 7c*.

In order to determine impacts on the Cape Fear shiner, an evaluation of flow data for the Deep River was conducted. Daily streamflow data over a period of 62 years for the Deep River at Randieman were analyzed. The data were used to construct flow exceedance tables and chart ranking flows from low to high and calculating the cumulative frequency distribution of the percentage of times that flows are exceeded for two points downstream on the Deep River: (1) approximately 22 miles downstream of the proposed reservoir near Coleridge, and (2) approximately 33 miles downstream of the proposed reservoir near Fork Creek. These are the closest locations on the Deep River that have documented populations and habitat of the Cape Fear shiner. The daily streamflow analyses cover the period of May, June and July, which is the period of spawning and juvenile development for the shiner. Charts for the two sites which illustrate the effect of the planned reservoir filling and operation during this period are presented on *Figures 7d* and *7e*.

The above streamflow data were reviewed by the U.S. Department of the Interior, Fish and Wildlife Service (USFWS). Based on its review of the data, the USFWS summarized its comments on the potential effects of the proposed project on the Cape Fear shiner in a letter to the USACE (USFWS, 2000). This letter, which is included in *Appendix D, Section 3*, included the following conclusions of the USFWS: "From the 62-year record of daily flows during the May-July spawning and rearing window, it appeared to the Service that the projected dam-related long term alteration of the hydrograph was not significant. However, it was difficult to project the effect of reservoir filling on the Cape Fear shiner because it depends upon the flows at the time of filling (i.e., effect of withholding flow for filling could be significant if flows were low, or inconsequential if flows were high). In order to address this uncertainty, it was generally agreed that reservoir filling which maintained flows of at least 75 cfs at Coleridge (which was approximately equal to the lower 25th percentile of historic flows from the exceedance curve) (*Figure 7d*) would be acceptable. This may require an increase in the reservoir minimum release during filling over the May-July period depending upon flows that year (filling is expected to take less than one year). The applicant would not be required to maintain flows of 75 cfs at Coleridge if the flows were naturally low that year (i.e., if already less than the historic 25th percentile of historic flows), but further reductions of flows for dam filling during such an event would not be allowed." Based on the USFWS recommendation, the PTRWA has agreed to adjust the reservoir filling rates to maintain flows of at least 75 cfs at Coleridge during the May-July period, except when natural flows would be lower than this amount. Based on these additional measures, the USFWS indicated that the project "is not likely to adversely affect the Cape Fear shiner, based on the analyses of worst case scenario projected flow approximating historic norms, there being no rapid daily fluctuations, and the agreed upon maintenance of flows of 75 cfs at Coleridge during reservoir filling."

As discussed in *Section 5.3.10*, it is also anticipated that the lake would result in water quality improvements downstream in the Deep River similar to the effects of other Piedmont reservoirs. These improvements include higher dissolved oxygen (DO), lower biochemical oxygen demand (BOD), reduced turbidity, and reduced loads of nutrients, metals, and toxic compounds. No specific modeling has been conducted to determine the estimated reduction in BOD or increase in DO for the water discharged from the proposed reservoir. However, the PTRWA would monitor DO at different depths in the lake and use the reservoir's multi-level outlet structure to adjust the location of water withdrawals from the lake to maximize DO content. Control of the depth of the release water, as well as a reduction in nutrient loadings from point and

nonpoint source discharges to the proposed lake, would provide beneficial effects on downstream water quality in the Deep River. This further supports the conclusion that the Randleman Lake project would not adversely affect the Cape Fear shiner or its critical habitat.

Portions of three populations of dissected toothwort (*Cardamine dissecta*), a significantly rare plant in North Carolina, would be inundated. However, small portions of the western subpopulation on Richland Creek and a narrow band of the Hickory Creek population would be above the pool line and would not likely be destroyed by inundation (Carter and Associates, 1993). In addition, some individuals of this species would be protected in the buffer, and others would be transplanted prior to flooding. Some of these plants have already been successfully transferred by Dr. Joseph Christian to the Bog Garden owned by the City of Greensboro. No other species of concern would be adversely impacted by the proposed project.

The proposed project is not expected to have significant indirect and/or cumulative effects on endangered, threatened or rare species. Indirect and cumulative effects would be minimized by watershed protection measures required by rules for the Randleman Lake watershed adopted by the NCEMC on November 12, 1998 (see Section 5.4.2 below).

5.3.12 Unique Natural Areas and Scenic Rivers. None of the rivers and streams that would be impacted by the Randleman Lake have been designated as State Natural and Scenic Rivers. The Deep River was evaluated for possible inclusion in the State Natural and Scenic River System in 1985, but did not qualify. Some scenic stream reaches would be eliminated by the creation of a lake. **The scenic cliff along the Deep River, which is referenced in Section 4.3.12, is located above the normal pool and within the 200-foot buffer for the proposed lake. Therefore, this natural area is not expected to be significantly affected by the proposed project.**

5.3.13 Recreation. Substantial outdoor recreational opportunities could be available at this approximately 6,000-acre project. **Although the PTRWA has no specific plans to develop recreational facilities, the PTRWA would cooperate with Guilford and Randolph Counties in their plans to develop recreational facilities adjacent to the buffer area around the proposed lake. The recreational facilities would be limited to boat access and day visitor picnic facilities. Acceptable recreational activities would include boating, fishing and picnicking, as well as nature study and bird watching. The North Carolina Wildlife Resources Commission operates a fish stocking program that is available without charge for lakes and reservoirs offering public access, and the lake should provide good fishery habitat (see Section 5.3.10 above). The buffer area would not be open for hunting but could provide valuable green space in the urbanizing environment of the Piedmont Triad.**

Use of the Deep River for recreational activities, including fishing and canoeing, is dependent on stream flows in the Deep River. The proposed project would result in a reduction in flows downstream in the Deep River at average flow conditions. This reduction in flows will be greatest at the end of the 50-year planning period and will range from around 27 percent at Randleman to 3 percent at Moncure, approximately 88 miles below the dam. The proposed project will result in an increase in minimum flows because of the proposed minimum flow releases from the dam. The minimum flow releases would range from 30 cfs at normal conditions to 10 cfs when the reservoir is reduced to 30 percent full or lower. The current 7Q10 low flow at Randleman is 7.7 cfs. The reduction in average flows and the corresponding reduction in water levels may have an adverse impact on canoeing, especially near the

end of the planning period. However, the proposed increase in minimum flows will have a beneficial effect on fish species and may increase opportunities for canoeing during the summer months.

Additional information on recreational use of the Deep River was obtained from *A Paddler's Guide to Eastern North Carolina* (Benner, 1997) and from Jos Jacob of Rock Rest Adventures in Pittsboro, NC. Table 25a summarizes data from these sources, as well as projected reductions in average flow that would result from the proposed project. Based on this information, the areas below High Falls, where guided trips are currently being conducted, are generally runnable year-round and are predicted to experience relatively minor reductions in average flows as a result of the proposed project. The proposed project is expected to result in an increase in minimum flows due to the planned minimum releases from the dam. Therefore, the proposed project is not expected to significantly affect recreational use of the Deep River below High Falls.

The Deep River segments from Worthville to Ramseur are currently runnable in moderately wet weather and will experience the greatest reduction in average flows of the segments analyzed. These areas should continue to be runnable in moderately wet weather, although the amount of time that they would be runnable is expected to be less. The extent of recreational use of these segments is not known.

Conditions for recreational use of the segment of the Deep River from Coleridge to Howards Mill are expected to be improved because of the planned minimum flow releases from the proposed dam.

5.3.14 Aesthetics. The creation of Randleman Lake would result in a new and distinctive feature in the local landscape. The presence of a 3,000 acre lake would create scenic vistas not currently available in the area. Over time the forests of the buffer area would mature and contribute to a setting of serenity.

5.3.15 Floodplains. Executive Order 11988, Floodplain Management, directs that Federal activities (including permits) avoid, to the extent possible, the long and short term adverse impacts associated with occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In addition, efforts should be made to restore and preserve the natural and beneficial values of the base floodplain.

All reservoir alternatives, including Randleman Lake, would require inundation of floodplains, thereby preventing future development in the affected floodplain lands. However, natural and beneficial values of these inundated floodplains would be lost, as is described in other sections of this report that address wetlands and fish and wildlife habitat. For the Randleman Lake project, these lost floodplain values would be offset by elements of the associated compensatory wetland mitigation plan which are intended to restore wetland functions along major tributaries of the Deep River upstream of the lake. Also, habitat values for fish and wildlife would benefit from these measures. Randleman Lake would substitute for the lost floodplain in helping to attenuate flood peaks on the Deep River.

Reduced peak flows in the Deep River downstream from Randleman Lake could result in some reduction of the extent of adjacent floodplains. However, it is expected that any reductions would be small due to the steep topography in the vicinity.

5.4 COMPATIBILITY WITH STATE POLICIES AND LOCAL LAND USE PLANS

5.4.1 State Water Resource and Water Quality Management Plans. The North Carolina Administrative Code, Subchapter 2B - Surface Water Standards, Section .0100, establishes standards which pertain to the classification of water supply reservoirs, known as the "Classifications and Water Quality Standards Applicable to the Surface Waters of North Carolina." These procedures define how the NCEMC considers and assigns standards for water supply reservoirs. In determining the suitability of waters for use as a water supply, the NCEMC is guided by the physical, chemical, and bacteriological maximum contaminant levels specified by USEPA regulations, as amended by the SDWA. All local governments that have land use authority within designated water supply watersheds shall adopt and enforce ordinances that meet the requirements of this act. The NCEMC must approve local water supply protection programs if it determines that the requirements of the local program equal or exceed the minimum statewide water supply watershed management requirements.

All waters intended for water supply use shall be classified to the most appropriate water supply classification as determined by the NCEMC. Local governments requesting a future water supply classification must provide evidence of intent that may include one or more of the following: capital improvement plans, water supply plan as described in NCGS 143-355(1), bond issuance for the water treatment plant, or land acquisition records.

Randleman Lake would inundate portions of the Deep River, Muddy Creek, Richland Creek, Reddicks (Register's) Creek, Hickory Creek, and Bob Branch. The PTRWA requested the State of North Carolina to reclassify these water courses as Class WS-II in January 1989 (equivalent to Class WS-III after subsequent rule changes). This water supply classification is defined in the North Carolina Administrative Code as "waters protected as water supplies which are generally in predominantly undeveloped watersheds: point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of Subchapter 2B - Surface Water Standards; local programs to control nonpoint sources and stormwater discharges of pollution are required." The NCEMC has since reclassified the Randleman Lake watershed as **WS (Water Supply)-IV, Critical Water Supply Watershed**. **The WS-IV water supply classification is for "waters protected as water supplies which are generally in moderately to highly developed watersheds..."** **The Critical Water Supply Watershed designation is a supplemental designation for water supply watersheds for which the NCEMC may impose management requirements that are more stringent than the Statewide water supply watershed management requirements. These additional management requirements are currently in effect for the entire Randleman Lake watershed. The reclassification by the NCEMC indicates that the reservoir project is consistent with and does not conflict with any known water resource or water quality management plans or controls.**

5.4.2 Watershed Protection. Both Randolph County and Guilford County have taken measures to protect the water quality of the **proposed** Randleman Lake by adopting watershed protection ordinances that establish water critical areas. The areas are shown in *Figure 8*. The ordinances were adopted by the counties in 1987 and 1988 on the recommendation of the PTRWA, in anticipation of the State's reclassifying Reddicks (Register's) Creek, Hickory Creek, Muddy Creek, and a portion of the Deep River to a status requiring greater protection of their watersheds.

The Randolph County watershed protection ordinance adopted January 4, 1988, applies to land within one-half mile of the high water mark of a public water supply reservoir (Randolph County, 1988). Industrial uses are prohibited and the ordinance includes an 80,000 square foot minimum lot size for any permitted residential use

in the water critical area. Commercial, educational, recreational, and institutional uses must have fewer than 3,000 square feet of floor space or no more than 6 percent impervious area for the entire site. The PTRWA would also be purchasing protective buffer in Randolph County in an area measured 200 feet horizontally from the 682 foot elevation of the lake. This area far exceeds State requirements for public water supplies.

The Guilford County Water Critical Area Protection District ordinance, adopted April 22, 1987, establishes an overlay district system which consists of four tiers:

- **Tier 1** - Those lands within 200 feet of the normal pool elevation. This tier is intended for public ownership. The PTRWA would purchase the majority of these lands, which comprise approximately 900 acres in Guilford County.
- **Tier 2** - Lands beyond Tier 1, but within 750 feet of the normal pool. Development is limited to no more than one dwelling unit per 5 acres of land. Institutional, commercial, and industrial uses have a maximum impervious area limit of 2.5 percent.
- **Tier 3** - Lands lying within an area bounded by Tier 2 and a line 3,000 feet from the normal pool elevation. This tier limits residential development to no more than one dwelling unit per 3 acres of land. Institutional, commercial, and industrial uses have a maximum impervious area limit of 4 percent.
- **Tier 4** - Lands lying in the area between Tier 3 and the water critical area boundary shown on *Figure 8*. This tier allows no more than one dwelling unit per acre. Institutional, commercial, and industrial uses have a maximum impervious area limit of 12 percent. Slopes greater than 15 percent that are adjacent and parallel to natural streams and drainageways would remain natural and undisturbed.

The Guilford County Ordinance is more stringent than the State minimum for WS-IV waters.

These ordinances ensure that site plans include features to limit the amount of impervious surface or to provide retention and detention of stormwater runoff. These measures were adopted at least a decade before the reservoir is expected to be filled, and represent a major effort on behalf of local governments in the Piedmont Triad to protect the watersheds of proposed, as well as, existing water supplies.

In addition, watershed protection measures are required for the proposed Randleman Lake watershed under the Nutrient Management Strategy rules (15A NCAC 2B.0248 through .0251) adopted by the NCEMC on November 12, 1998. Under these rules, all local governments with jurisdictions in the proposed Randleman Lake watershed are required to adopt watershed protection measures stipulated under the rules. These measures include protection and maintenance of riparian buffers along perennial and intermittent streams and stormwater controls for new development. The rules require the maintenance of a 50-foot vegetative buffer between all new development activities and perennial and intermittent streams in the Randleman Lake watershed. All buffers are to remain vegetated and undeveloped, except for a 20-foot vegetated area furthest from the stream where land clearing and grading would be allowed prior to the area being revegetated. The stormwater runoff and buffer rules adopted by the NCEMC are more stringent than those applied in any other WS-IV classified waterbody in the State.

Watershed protection ordinances and ordinance changes were required to be submitted to the NCEMC for approval by January 1, 2000. All of the local governments have enacted watershed protection ordinances for the Randleman Lake watershed. In addition, all of the local governments have submitted stormwater management plans to the NCEMC for approval.

Measures to ensure that a safe raw water supply is maintained, including wastewater treatment facilities improvements and watershed protection plans, are discussed in Sections 5.3.5.4, 5.3.5.5 above. Erosion and sediment control ordinances and erosion control plans were discussed in the *Draft Nutrient Reduction Strategy and Implementation Plan* (Hazen and Sawyer, 1998), which was utilized by NCDWQ in the development of the proposed rules presented in the public hearing for reclassification of the Randleman Lake watershed for water supply. Greensboro, Guilford County, Jamestown and High Point have their own sedimentation control ordinances and provide the administration and enforcement for these ordinances. Erosion and sedimentation control measures for Archdale, Randleman and Randolph County are regulated by the regional offices of the NCDENR. Raw water quality monitoring will be conducted by the PTRWA in accordance with applicable state regulations for public water supplies. Effluent and instream monitoring for wastewater treatment plants discharging into Randleman Lake will be in accordance with NCDENR requirements contained in each treatment facility's NPDES permit.

Watershed protection measures will also reduce potential indirect and cumulative impacts that may occur in the Haw River Basin, where increases in sediment loading may result from construction activities associated with new development in the Greensboro service area due to the increased water supply from the proposed project. Control of erosion and sediment will be by the existing Guilford County Soil Erosion and Sedimentation Control Ordinance and City of Greensboro stormwater regulations.

Stream buffer requirements for streams flowing to the Haw River are contained in the Guilford County Soil Erosion and Sedimentation Control Ordinance. This ordinance includes the following provisions:

- Requires an approved erosion control plan before initiation of any land-disturbing activity which uncovers one acre or more;**
- Establishes mandatory standards for land-disturbing activities, including standards for buffer zones, graded slopes and fills, ground cover, and prior plan approval; and**
- Requires permanent downstream protection measures for stream banks and channels to protect them from increased degradation by accelerated erosion caused by increased velocity of runoff from the land-disturbing activity**

The impacts on fish and recreation in Jordan Lake associated with increased discharge of nutrients from urban runoff from new development in the Greensboro service area will also be reduced by enforcement of watershed protection and erosion and sediment control measures of the City of Greensboro and Guilford County. Drainage and stormwater management requirements for development projects contained in the City of Greensboro stormwater and subdivision regulations will also minimize adverse impacts of new development.

The City of Greensboro also has a City-wide stormwater permit, which requires stormwater controls to

reduce the discharge of pollutants to the maximum extent practicable. Additional information on existing City and County ordinances may be obtained from the City and County Planning Departments.

5.4.3 Land Use Plans. Randleman Lake was included in the Regional Development Plan prepared by the Piedmont Triad Council of Governments (1977) for the years 1989 to 2010. The project is supported by all affected local governments and complies with the future local land use plans for Guilford County and land use ordinances (zoning) in Randolph County.

5.4.4 Required Permits and Approvals. In order to proceed with the Randleman Lake project, the PTRWA has already obtained a permit from the NCEMC (effective December 12, 1991) authorizing interbasin transfer of water and acquisition of property by eminent domain. An application has been filed with the USACE to obtain a permit pursuant to Section 404 of the Clean Water Act to discharge dredged or fill material into waters of the United States for the construction of a dam on the Deep River in order to form Randleman Lake (filed on July 8, 1991). This EIS has been prepared to evaluate that application.

In addition to the requirement to obtain a Section 404 permit from the USACE, additional approvals, certifications, and permits which must be obtained from the State of North Carolina, are as follows:

- **Section 401 water quality certification (Issued on March 11, 1999)**
- sediment and erosion control plan certification
- **burning permit for burning related to land clearing activities**
- roadway modification plan approval
- dam safety permit
- water system plans and specifications approval
- impoundment permit.

Each of these requirements would be met at the appropriate step in the construction process so that needed approvals are obtained in advance of the respective work task.

5.5 ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

Associated with the development of the project would be certain unavoidable, adverse environmental and social effects. These would result from alterations in the natural and man-made environment. Impacts of the project have been described in detail in *Sections 5.2 and 5.3*. The adverse environmental impacts that cannot be avoided include both long-term impacts due to the presence of the reservoir and short-term impacts due to construction. Long-term impacts would include:

- acquisition by the PTRWA of approximately 6,000 acres of land for the project and conversion of ownership from private to public. Public ownership would remove these lands from local tax rolls.

- loss of approximately 3,000 acres of terrestrial habitat through inundation and conversion to aquatic habitat. This would include over 2,100 acres of forests, 45 acres of developed land, and approximately 868 acres of fields, pastures, and agricultural lands. Inundation would cover approximately **337** acres of prime farmland.
- direct loss of some wildlife, particularly very small and slow-moving animals, presently occupying the **approximately 3,000** acres of habitat to be inundated. These direct losses would include many amphibians, reptiles, and small mammals. Bird species inhabiting alluvial forests and associated with streams to be inundated would be displaced. Some animals would die directly from clearing activities or flooding, while others would undergo stress and possible fatality from overcrowding after moving to the buffer zone or adjacent areas.
- loss of 121 acres of wetlands and 28 miles of main stem stream segments through conversion to a lake environment. Destruction of the stream ecosystem would reduce or eliminate populations of aquatic fauna that are not adaptable to a lake environment. Habitat diversity would also be reduced.
- permanent changes in land uses of the **approximately 3,000-acre** buffer zone, resulting in the removal of over 700 acres from agriculture, **including approximately 303 acres of prime farmland**. Over 2,000 acres of existing forests will be removed from private and commercial timber production but will continue to grow.
- acquisition of portions of 16 farms, including portions of four operating dairies, and termination of farming activities on the acquired properties.
- interbasin transfer up to **30.5 mgd (47.1 cfs)** from the Deep River basin, with corresponding increases of **28.5 mgd** and **2.0 mgd** occurring in the Haw and Yadkin River basins, respectively.
- permanent reductions in average flow rates, in amounts ranging from 27 percent at Randleman to 3 percent at Moncure, in the Deep River downstream from Randleman Lake.
- alteration of traffic patterns through **removal of bridges and abandonment of the sites for 7 North Carolina secondary roads**. Longer driving distances would result for some residents. Some permanent social and economic changes would occur due to changes in the transportation avenues.
- relocation of 28 households and one business. Residents living on farms and homes in the project area would experience disruption of present family and communal ties as well as some fragmentation of human ties with the land and streams. Relocation would cause some inconvenience and hardships.

Short-term impacts would include:

- increases in sedimentation and turbidity in Muddy Creek and the Deep River during dam construction.
- reductions in air quality due to vehicle emissions, fugitive dust, and smoke during clearing activities and construction of the dam and appurtenances, project roads, and road and pipeline relocations.

- increases in noise during project construction.
- traffic disruptions and delays during roadway modifications.

5.6 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

In the absence of Randleman Lake, the **approximately 6,000** acres of project lands would continue to urbanize, and changes in land use would likely result in the gradual replacement of natural communities and farms with residential, commercial, and industrial development. Natural productivity would be replaced by growth in economic productivity.

The impoundment of Randleman Lake will require the relinquishment of the short-term and long-term productivity of **approximately 3,000** acres that currently provide terrestrial wildlife habitat, agricultural opportunities, timber production, and residential property. It will also foreclose the economic opportunities associated with future development potential of these lands. However, the productivity of the existing resources and future development potential will be replaced by the long-term productivity resulting from the establishment of a reliable water supply to provide for the needs over a two-county region. The Piedmont Triad is the only major urban center in North Carolina without a dependable future source of water to ensure its economic viability and continuation of a high quality of life. The proposed project would provide a long-term solution to this pressing need.

With the construction of the project, establishment of the **approximately 3,000-acre** buffer zone would also enhance long-term natural productivity by bringing many areas of wildlife habitat, including wetlands, into public ownership and protection. The establishment of watershed protection measures for the project is expected to contribute, over the long-term, to the quality of the water supply for the Triad area. Tax revenues generated by associated economic development opportunities in Randolph and Guilford Counties would partially offset losses in tax revenue caused by removal of project lands from the tax rolls.

5.7 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES SHOULD THE PROPOSED PROJECT BE IMPLEMENTED

Approximately 6,000 acres of land would be owned fee simple and controlled by the PTRWA. These lands would be devoted to the accomplishment of the project's purposes for the indeterminate future. Other possible uses of the lands would be deferred or effectively foreclosed throughout the physical life of the project. This commitment of resources would be uniform and permanent throughout the project, particularly as it relates to the use of the Randleman Lake as a long-term water supply for the Triad. With this commitment of resources comes the responsibility for addressing any potential issues which might emerge related to the resulting water quality and associated treatment costs. The funds, labor, and material needed to build the project, as well as energy expended, would also be committed.

About 3,000 acres of land representing soils, wildlife habitat, vegetation, animals, 121 acres of wetlands, and varying degrees of natural beauty would be lost by inundation. Twenty-eight miles of stream ecosystem would be lost along with associated plants, animals, natural beauty, and natural heritage values. About 1,636 acres

of agricultural lands, including open pastures, and harvested fields, would be incorporated in the total project. In addition, one business, 28 residences, and portions of 16 farms, including portions of four operating dairies, would be lost. Also committed would be additional land devoted to project structures, roads, and other developments. The action would facilitate minor land use changes occurring in the two-county area and cause land to be committed to urbanization near the project.

The commitment of water from the Deep River basin to sustain the water supply of Randleman Lake would reduce flow rates otherwise available to downstream hydroelectric facilities and may result in economic losses. Alteration of streamflows by the project represents an indirect commitment of resources in that changes would result in the biotic communities in and adjacent to the Deep River and to watercourses receiving interbasin transfers. Human history, natural history, and archaeological resources not documented prior to inundation or destruction would be lost.

5.8 MITIGATION OF IMPACTS

5.8.1 Requirements for Wetland Mitigation. The objective of Section 404 of the Clean Water Act (16 USC 1344) is to restore and maintain the physical, chemical, and biological integrity of the waters of the United States, including wetlands, through the control of discharges of dredged or fill material. A permit may be issued under this authority only for the least environmentally damaging practicable alternative. Projects requiring Section 404 permits are required to avoid potential impacts, to the maximum extent practicable. Any remaining unavoidable impacts must then be mitigated, to the extent appropriate and practicable, by implementing steps, first, to minimize impacts, and, second, to compensate for aquatic resource values affected. Compensatory mitigation measures, in order of preference, include wetland restoration, enhancement, creation, and preservation. Although preservation of existing wetlands may be generally considered the least desirable form of wetland mitigation, it can, in some cases, provide significant protection of wetland corridors or provide a mechanism for protecting wetlands which have very high values but which are in jeopardy from timbering or other activities.

Ideally, compensatory mitigation should be in-kind and onsite. Wetland areas at or adjacent to the project site may be restored, created, or enhanced to compensate for impacts to functions and values of the project wetland areas. However, in areas with significant topographic relief, such as Randleman Lake, opportunities for in-kind and onsite mitigation are somewhat limited in both the quantity and quality of wetlands that can be successfully restored and/or created around the periphery of the reservoir. In such cases, the second priority may be in-kind, off-site mitigation, which achieves the goal of compensating for the loss of wetland functions and values but which is accomplished at a site as close as possible to the project area. In-kind, off-site mitigation should be within the same river basin as the project.

5.8.2 Avoidance and Minimization of Impacts. The goal of impact avoidance will be addressed through the process of evaluating project alternatives and making a decision on a Section 404 permit. Subsequently, impacts associated with project construction can be avoided or minimized, to the extent practicable, through the implementation of a variety of measures. For the proposed Randleman Lake project, the applicant has proposed to implement best management practices to minimize impacts to adjacent wetlands and aquatic systems, as well as sediment and erosion control measures to protect the water quality of the Deep River downstream from construction areas. Upland siltation barriers and sediment traps, stream channel basins, and runoff diversion dikes would be utilized where applicable. Details of the sediment retention and erosion control

measures would be finalized in a state-approved Erosion and Sediment Control Plan. Impact reduction features and structures would be regularly inspected and maintained by construction contractors throughout the construction period, and additions or repairs would be made, as necessary. Additionally, an uncleared buffer strip with a minimum width of 50 feet would be maintained adjacent to the Deep River and Muddy Creek within the confines of the cleared reservoir basin to reduce impacts to water quality and stream biota during construction. Vehicular access during construction would be minimized and restricted to specific routes to minimize disturbance to wildlife and wildlife habitat. Construction roads as well as the sediment control features would be located on the site as required by the site's physical constraints and construction schedule.

5.8.3 The Applicant's Proposed Compensatory Mitigation Plan. The applicant has proposed a comprehensive plan to mitigate for unavoidable impacts of the Randleman Lake project. This plan addresses wetlands, water quality, plant communities, and fish and wildlife resources. Features of the plan include the following:

- Acquisition and preservation of approximately 608 acres of existing forested wetlands known as the Cone's Folly Ancient Cypress Swamp. The applicant would convey to an established conservation organization a sufficient interest (fee or conservation easement) to manage and protect the property. No logging, development, or other land disturbance would be permitted at the site. Located along the Black River in the lower Cape Fear Basin, this wetland has been identified by the North Carolina Natural Heritage Program as the most important swamp site in the State and, because of the great age of the trees, the extent and undisturbed character of the swamp, and its great beauty, as a national treasure. Approximately 8.5 river miles on one side of the Black River would be protected at the site. The significance of the site is discussed further in *Section 5.8.3.1*.
- Restoration and/or creation of forest wetlands along major tributaries of the Deep River upstream of Randleman Lake. Such strategically located wetlands would be very beneficial in protecting water quality of Randleman Lake from upstream sources of nonpoint pollutants. All of the proposed sites exhibit the potential for restoration of wetland functions with appropriate modifications to hydrological regimes. A summary of estimated acreages for the proposed mitigation sites is presented in *Table 26*. The sites are comprised of 31,900 linear feet of stream channel and 174 acres of floodplain/terrace. The two mitigation methods proposed, in-stream structures (Option 1) and green tree impoundments (Option 2), are expected to restore wetland hydroperiods and/or wetland functions on approximately 121 acres while maintaining existing forests or supporting the growth of shrub emergent/forested wetlands.
- The USACE does not consider the construction of these greentree impoundments to be wetland restoration, because the areas are unlikely to become jurisdictional wetlands. However, the USACE recognizes that greentree impoundments do provide some wetland functions, including providing habitat and controlling stormwater runoff.
- In controlling stormwater runoff, the restored wetlands and greentree impoundments will also reduce the force of the flowing water and reduce the concentrations of pollutants carried by the runoff. This will result in an improvement in the quality of water entering the proposed Randleman Lake. Additional information on the mitigation sites is included in *Appendix E*.

5.8.3.1 Significance of the Cone's Folly Ancient Cypress Swamp. An opportunity for off-site wetland mitigation exists at the Cone's Folly site, which is located on the Black River, a tributary of the Cape Fear River about 52 miles upstream from the Atlantic Ocean. **Located in Pender County, this site is characterized by the presence of many ancient bald cypress trees which may be among the oldest living trees in the world.** Some of the trees have been core dated to 364 AD and are the oldest known stands east of the Rocky Mountains. The ancient cypress are found in the backswamps, sloughs, swales, and floodplains of the Black River. In these areas, the cypress were spared during turn-of-the-century logging, and the old growth trees have persisted. The future of the site is currently uncertain since its timber is potentially subject to harvest or thinning. The Cone's Folly site has been rated as a highest priority for acquisition and preservation by the Nature Conservancy, **which has prepared an extensive report documenting the natural values of the Black River and its riparian wetlands.**

Several rare species and natural communities occur in and adjacent to the proposed site. Rare animal species documented by the N.C. Natural Heritage Program include the big-eared bat, red-cockaded woodpecker, American alligator, and four species of mussels. Rare plants known within the site include Sarvis holly (*Ilex amelanchier*) and water arrowhead (*Sagittaria stagnorum*, also known as *Sagittaria subulata* var. *gracillima*). Such rare species and natural communities are considered a basic unit of biological and ecological diversity by the N.C. Natural Heritage Program.

According to studies for Outstanding Resource Waters designation, the Black River from SR 1550 to NC 53 is a diverse area for mussels. This portion of the Black River has been suggested as critical habitat for two state-listed, threatened species: **Atlantic pigtoe (*Fusconaia masoni*) and yellow lampmussel (*Lampsilis cariosa*).** The shortnose sturgeon has also been reported from the Black River.

Acquisition and preservation of the Cone's Folly site will complement the natural resource and wetland values already protected by the Nature Conservancy through its purchase of approximately 686 acres (4.6 river miles) along the Black River across from the Cone's Folly site. The Nature Conservancy also has conservation easements or future ownership through wills for an additional approximately 95 acres (1.7 river miles) in this area.

5.8.4 Other Environmental Benefits. Other features of the proposed Randleman Lake project that would provide environmental benefits include:

- **Contributions to lake water quality through acquisition and preservation of a wide buffer zone. While North Carolina statutes require a margin of only 50 feet around the impoundment to be owned or controlled by the water supplier, the PTRWA expanded the reservoir buffer to 200 feet horizontally from the normal pool level. This commitment would result in fee simple ownership of approximately 3,000 acres of buffer area. Lake water quality is expected to benefit through reductions in the rate of runoff entering the lake and through the removal of sediments and pollutants from surface runoff entering from adjacent portions of the watershed.**
- **Conservation of wildlife habitat in the buffer zone. The different cover types initially present in the buffer zone, including old fields, early successional pine forest, and mature hardwood forest, would provide a diversity of habitat for upland wildlife species. Existing fields and early successional plant communities would be allowed to proceed through natural ecological succession ultimately to hardwood forest. The buffer area would not be developed for silviculture.**

No timber harvesting within the buffer area would be allowed by the PTRWA except where the forestry activities are necessary for the health and viability of the forest and are consistent with the primary goal of watershed protection for the reservoir.

- **Planting of high quality hardwoods in the lake buffer area, subject to receipt of requested funding from the North Carolina Clean Water Management Trust Fund. This measure would provide beneficial habitat for wildlife in the project area.**
- **Habitat enhancement for wood ducks. Approximately 60 nest boxes would be installed in shallow coves and near the shoreline of Randleman Lake. Within the protection of the lake buffer zone, nest boxes that are properly constructed and located should increase the population of resident wood ducks.**
- **Development of approximately 3,000 acres of aquatic habitat. Randleman Lake is expected to provide an improved and enlarged fishery habitat and, also, to attract a variety of waterfowl and other migratory bird species by providing improved feeding and resting habitat.**
- **Cooperation with Guilford and Randolph Counties to develop recreational facilities, including boat access and day visitor picnic facilities at Randleman Lake. The buffer area would not be used for development, except for limited water-dependent public recreational facilities, such as boat access facilities. Other recreational facilities may be developed by Guilford and Randolph Counties on the land adjacent to the buffer area. These may include boat access parking areas, day visitor picnic facilities, restrooms, and walking and/or bicycle trails. No overnight facilities would be allowed.**
- **Cooperation with the NC Wildlife Resources Commission (NCWRC) to promote stocking of sport fish in Randleman Lake. Stocking has long been employed successfully to establish fish species composition, enhance fisheries production, and improve angling opportunities. It is expected that the lake could support good fishery populations, including species such as the bluegill, largemouth bass, yellow perch, channel catfish, and black crappie.**
- **Cooperation with the NCWRC to develop fish attractors in Randleman Lake. Fish attractors would be designed to create habitat features that promote fish production and survival and to congregate desirable species for improved angling. Residual trees would be retained within selected coves of the lake and allowed to die from inundation. Coves would be selected that are conducive from a structural and water depth perspective to provide improved fish feeding and spawning areas. After a period of several years, the standing dead snags would fall and become partially submerged to provide further structural components. Fish attractors have been successfully utilized in other recreational impoundments and have provided the added benefit of providing perches and nesting sites for fishing raptors.**
- **Opportunity for natural generation of wetlands along approximately 100 miles of Randleman Lake shoreline and along tributaries of the reservoir. If these wetlands develop, they would provide valuable fish and wildlife habitat. Also, existing wetlands within the buffer zone would be preserved in perpetuity.**

6.0 PUBLIC INVOLVEMENT

6.1 PUBLIC AND AGENCY PARTICIPATION

Public and agency review and input for the proposed project have been ongoing since 1988. This section presents the chronological order of events related to public involvement.

On March 11, 1988, John F. Kime, Executive Director of the PTRWA, met with the USACE to request approval for the construction of Randleman Lake since planning for a proposed Federal reservoir at the Randleman site had been terminated in 1987. The USACE had previously provided technical information developed for the Randleman Lake feasibility study and had also indicated that the proposed project was subject to Section 404 of the Clean Water Act and that a Department of the Army permit would be required.

On March 29, 1988, the USACE provided copies of surveys regarding the archaeological, historical, vegetative, aquatic, and wildlife resources developed for the proposed Federal reservoir to the PTRWA. The USACE also provided a preliminary outline and a list of requirements for the environmental documentation required for the proposed project. A review meeting was held between the PTRWA, Black & Veatch (consultant for the PTRWA), and the USACE to discuss the proposed requirements. Additional investigations and potential concerns of other agencies, including the USEPA, USFWS and the NCDWR, were also discussed at the meeting. It was established that the NCDEHNR would be the lead permitting agency for the state.

As a result of this meeting, the PTRWA met with Black & Veatch and Paul Wilms, Director, NCDEM, on July 19, 1988. Mr. Wilms advised Black & Veatch and the PTRWA that NCGS 162A-7 and NCGS 153A-285 required that the PTRWA be granted a certificate by the NCEMC to use the power of eminent domain and to transfer the Greensboro water allocation of approximately 29 MGD from the Deep River to the Haw River. On August 18, 1988, the PTRWA petitioned the NCEMC for the required certificate.

On December 8, 1988, at its meeting in Raleigh, the NCEMC authorized NCDWR to conduct a public hearing on the PTRWA request.

On December 20, 1988, Mary Beth Edelman, President of the Conservation Council of N.C., on behalf of the Conservation Council, Audubon Society, Clean Water Fund, Deep River Citizens Coalition, Sierra Club, and the League of Women Voters, requested in a letter to Secretary Lofton that the N.C. Department of Administration require the PTRWA to prepare an environmental impact statement on the Randleman Lake project.

On February 28, 1989, Mr. John Morris, Director of NCDWR, outlined in a letter to John Kime, the recommended procedure for satisfying the requirements of NCGS 162A-7 and NCGS 153-285 concerning the use of the power of eminent domain and the interbasin transfer of water, and NCGS 113A-1 through 113A-10 dealing with the N.C. Environmental Policy Act.

On June 20, 1989, a Draft EIS addressing requirements of the N.C. Environmental Policy Act was presented to Mr. John Morris, along with a request that the public hearing be scheduled as soon as the document was reviewed by the NCDEHNR. The N.C. Draft EIS (NCDEIS) was circulated for review in July 1989. Comments received were addressed by the PTRWA and Black & Veatch, and the draft was subsequently recirculated for review on January 9, 1990.

At the NCEMC meeting on February 8, 1990, the NCDWR reported that additional water quality modeling would be required to complete the EIS. On March 27, 1990, additional comments were reviewed by the PTRWA concerning the **NCDEIS**. These were addressed by the PTRWA and Black & Veatch.

On June 20, 1990, the USACE informed the PTRWA by letter that a wetland delineation would be required in order to establish the Section 404 jurisdiction within the project area.

In August 1990, Black & Veatch completed Water Quality and Quantity Studies to Support Randleman Lake Environmental Impact Statement in response to the earlier NCEMC request.

At the October 11, 1990 meeting the NCEMC authorized a public hearing for the Randleman Lake project and appointed hearing officers. On February 6, 1991, the public hearing required under NCGS 162A-7 and NCGS 153-285 was held at the Randleman High School, Randleman, NC.

On May 6, 1991, Mr. John Morris informed the PTRWA that comments received from the public and other agencies had identified subjects that should be added to or expanded in the N.C. EIS. As a result of these comments, Black & Veatch was authorized to conduct a Water Supply Alternatives Assessment, which was completed in September 1991. This assessment reviewed and updated the earlier CH₂M Hill Study Water Supply Alternatives, Cape Fear Basin completed in 1985.

Additional comments received in May 1991 indicated that the Department of Cultural Resources had concluded that no further archaeological studies were needed for the purposes of the N.C. EIS but that further work might be required under Federal law in conjunction with the Section 404 permit application.

On July 8, 1991, the PTRWA filed a Section 404 permit application with the USACE for the construction of the proposed Randleman Lake.

On October 23, 1991, the NCDWR sent the N.C. Final EIS (**NCFEIS**) to the N.C. Dept. of Administration for public review. On December 12, 1991, the NCEMC granted the PTRWA petition to use the power of eminent domain and interbasin transfer of water.

In January 1992, a copy of the **NCFEIS** was sent to the USACE for review and comment. An interagency scoping meeting was held on January 22, 1992 at the USFWS office in Raleigh. Agencies represented included the **USACE**, USFWS, NCDWR, NCDEM, NCDEHNR, NCWRC, and NC Department of Cultural Resources. On February 25, 1992, a meeting was held at the USACE office at Falls Lake in Raleigh, North Carolina to allow members of the Deep River Citizens' Coalition to identify issues, additional studies needed, and alternatives to be addressed for the environmental assessment.

On February 25, 1992, the PTRWA received the final order of the NCEMC granting the right to exercise the power of eminent domain and interbasin water transfer. On March 5, 1992, a petition for judicial review was filed in Wake County Superior Court by the Deep River Citizens' Coalition; Scott Lineberry and Guy Small, petitioners vs. the NCDEHNR and NCEMC. The motion by the PTRWA to intervene in the case was granted July 20, 1992. On May 12, 1994, Judge Dexter Brooks ruled that the NCEMC had erred in granting the PTRWA the use of the power of eminent domain and interbasin water transfer, thereby reversing the decision of the NCEMC. On June 8, 1994, the PTRWA filed notice of appeal to the North Carolina Court of Appeals

(NCCA), as did the North Carolina Department of Justice, representing the NCDEHNR and NCEMC. Oral Arguments were heard before the NCCA on May 9, 1995. On June 6, 1995, the NCCA ruled that jurisdiction in the case did not lie with the Wake County Superior Court, but instead with the North Carolina Office of Administrative Hearings (NCOAH), as required by NCGS 150B023(a) of the North Carolina Administrative Procedure Act. Thus the previous ruling was reversed and the case was remanded to the NCOAH. On July 25, 1995, the PTRWA moved to intervene in the case to be heard by the NCOAH. On December 16, 1995, the Deep River Citizens' Coalition (Petitioners) filed a notice of dismissal, thereby ending the legal challenge to the permit granted to the PTRWA by the NCEMC.

On May 22, 1992, the EPA commented on the NCFEIS and raised concerns about the potential water quality in the proposed lake.

On December 23, 1993, the PTRWA submitted to the USACE, Wilmington District a preliminary review version of a DEIS for the proposed Randleman Lake project. The transmittal letter stated that several issues left unresolved at the conclusion of the NCFEIS process would be addressed through the USACE EIS process associated with the Section 404 permit. These issues included wildlife, cultural resources, water quality, purchase of water from the City of Burlington, and status of the abandoned Randleman Town Dump. Subsequent review of this preliminary DEIS by the USACE indicated that substantial revision would be required before the document would be appropriate for public coordination.

Revised versions of the preliminary DEIS were submitted periodically by the PTRWA to the USACE from January 1995 to October 1996. Each submittal represented efforts to address data deficiencies identified by the USACE that were considered important for fully addressing potential impacts of the project.

On September 11, 1996, the Wilmington District, USACE published a Notice of Intent to Prepare a Draft Environmental Impact Statement (DEIS) for the proposed project in the Federal Register. The DEIS was filed with USEPA and appeared in the Federal Register on July 11, 1997. A Section 404 public notice on the permit application and a Notice of Availability of the DEIS were circulated on July 10, 1997. The public comment period was scheduled to end on August 26, 1997, but was extended several weeks at the request of USEPA. All comments received were considered during the preparation of this FEIS.

In November of 1997, the PTRWA formally requested that the process for reclassifying the proposed Randleman Lake watershed to a water supply watershed be placed on the NCEMC Water Quality Committee agenda. In March of 1998, the Water Quality Committee was briefed on the reclassification proposal and in April, they were asked to support going forward with the request to the full NCEMC to take the issue through the rulemaking process. That approval was given and in May of 1998, the NCEMC approved initiating the process to consider the reclassification.

In early 1997 the NCDWQ staff had informed the PTRWA that they would need a "Comprehensive Watershed Management and Protection Plan" as part of the Section 401 water quality certification process. That plan was to include assurances that point and nonpoint source controls on nutrients would be established which would provide protection of the lake's initial and future water quality. The PTRWA was encouraged to develop a plan that would go beyond the minimum water supply watershed protection requirements. A draft "Nutrient Reduction Strategy and Implementation Plan" was

submitted by the PTRWA in March of 1998. Although the plan did contain many proposals which went beyond the minimum statewide requirements, it was decided that the best approach to implementing a plan for the watershed was through adoption of rules by the NCEMC.

The NCDWQ staff utilized the PTRWA Draft Plan as a basis for developing the proposed rules to be taken to public hearing. The NCDWQ also conducted additional modeling to evaluate other nutrient control options to be included in the nutrient management strategy evaluations. In June 1998, the NCDWQ held an "Information Exchange" workshop in Jamestown, N.C., which was attended by approximately 100 individuals. Two watershed management strategies were proposed by NCDWQ staff, and on July 9, 1998, the NCEMC gave permission to send the proposals out for public review and consideration. The two strategies that were proposed were presented as an Option A and an Option B. Option A represented essentially what the PTRWA had proposed in their draft March 1998 Strategy. Option B was developed by NCDWQ staff and included more stringent requirements for point sources, riparian area protection, and stormwater controls. Classifying the waters as Nutrient Sensitive was also proposed. In Option B, streams within the proposed Randleman Lake water supply watershed were proposed for reclassification from Class C to Class WS (Water Supply)-IV and Nutrient Sensitive Waters (NSW). (There was also a Class B, primary recreation stream which was proposed to be reclassified to WS-IV & B NSW.) In Option A, the proposal did not include applying the supplemental NSW classification to these streams.

In addition to the standard water supply watershed reclassification, the North Carolina Water Supply Watershed Protection Act provides that the "Commission may designate water supply watersheds or portions thereof as critical water supply watersheds and impose management requirements that are more stringent than the minimum statewide water supply watershed management requirements (G.S. 143-214.5(b))." It was proposed that the watershed be designated by the Commission as a "Critical Water Supply Watershed" in order to provide greater authorities for the development of the additional point and nonpoint source requirements as proposed in Option B.

On September 1, 1998, a public hearing was held in Jamestown, N.C. Three NCEMC members, Dr. David Moreau, Mr. Jeffrey Morse, and Mr. Robert Epting, served as hearing officers. Two-hundred and forty-six individuals attended the hearing. Fifty-two individuals provided comments at the hearing. Approximately 130 letters (including resolutions) were received during the comment period.

The hearing officers considered comments offered and recommended to the NCEMC that the reclassification to a water supply classification be approved and that certain point and nonpoint source requirements be applied in the watershed. The NCEMC approved the reclassification and adopted the proposed rules (15A NCAC 2B.0248 through .0251) on November 12, 1998. Under the rules which were adopted, the Randleman Lake watershed was designated as a Critical Water Supply Watershed, but the nutrient sensitive waters (NSW) classification was not applied.

On January 25, 1999, the NCDWQ provided the USACE with additional information on the classification and quality of the Deep River waters which would form the lake. The NCDWQ indicated that the rules which had been adopted would significantly reduce the nutrients and other pollutants to the lake and provide adequate protection of the water quality standards.

On March 11, 1999, the NCDWQ issued a 401 Water Quality Certification for the proposed lake, which indicated that the proposed development will not result in a violation of applicable water quality

standards and discharge guidelines. The NCDWQ further certified that this activity will not violate the applicable portions of Sections 301, 302, 303, 306 and 307 of PL 92-500 and PL 95-217 if conducted in accordance with the application and conditions set forth.

Remedial Investigation studies on the Seaboard Chemical Corporation and closed High Point Landfill sites were completed in March and April of 1999 and submitted to the NCDWM for review.

In early 1999 the NCDWQ provided a draft summary of DEIS comments and responses to the USEPA, and the USACE requested the USEPA to evaluate the new material. The NCDENR met with the USEPA in August 1999 and provided more technical materials.

On September 3, 1999, the NCDWM provided the USEPA with updated information on the remedial investigation of the Seaboard Chemical Corporation and closed High Point Landfill sites. The NCDWM indicated that it was confident that it was technically feasible and economically viable to achieve a drastic reduction in any pollutants leaving the site and accordingly minimize the potential of pollutants from the site causing any violations of water quality in the lake. The USEPA expressed its concurrence with the conclusions of the NCDWM in its letter to the USACE on October 19, 1999.

The USEPA, in its letter of October 19, 1999, also expressed concurrence with the NCEMC that the nutrient management rules adopted by the NCEMC should result in a lake that will support all designated uses assigned and that the reclassification action of the NCEMC would be consistent with the requirements of the Federal Clean Water Act and the State's laws and rules. The USEPA added that it considered its previous technical concerns resolved and concurred with the NCEMC conclusions.

On December 2, 1999, draft FEIS documents were prepared by Hazen and Sawyer for the PTRWA and submitted to the USACE and the NCDWQ. The NCDWQ reviewed the draft FEIS documents and indicated in its letter of March 1, 2000 to the USACE that the documents were acceptable from a water quality point of view.

6.2 COORDINATION OF THIS DOCUMENT

This FEIS is being provided to a standard list of Federal, State, and local agencies; elected officials; environmental groups; and interested individuals for review and comment. A second Section 404 public notice will be issued by the USACE, Wilmington District concurrently with issuance of this FEIS. After a 30-day review period, further coordination will be conducted, if appropriate, and all input received will be considered.

We invite your comments and suggestions regarding the proposed action. In accordance with Council on Environmental Quality regulations (40 CFR 1500-1508) for implementing the National Environmental Policy Act (NEPA), your comments should be as specific as possible and should be made with recognition that NEPA documents must focus on the issues that are truly significant to the proposed action rather than amassing needless detail. The NEPA process is intended to help public officials make decisions based upon an understanding of environmental consequences. NEPA directs that Federal activities be conducted so as to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable or unintended consequences. As individual resources and stakeholder interests increasingly compete for priority, public officials are challenged to make management decisions that reflect a balance of the overall public interest. Please respond with a

submitted by the PTRWA in March of 1998. Although the plan did contain many proposals which went beyond the minimum statewide requirements, it was decided that the best approach to implementing a plan for the watershed was through adoption of rules by the NCEMC.

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focus on essential issues that will be useful in guiding our decision regarding the requested Section 404 permit for the construction of a dam to create Randleman Lake.

6.3 MAILING LIST FOR THIS DOCUMENT

Federal Agencies

Advisory Council on Historic Preservation
Center for Disease Control, Center for Environmental Health
Federal Emergency Management Administration
Federal Highway Administration
National Park Service
U.S. Department of Agriculture, Forest Service
U.S. Department of Agriculture, Natural Resource Conservation Service
U.S. Department of Commerce, NOAA, Ecology & Environmental Conservation
U.S. Department of Energy, Office of Environmental Compliance
U.S. Department of Housing and Urban Development
U.S. Department of Interior, Office of Environmental Affairs
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

State Agencies

N.C. Department of Administration
N.C. Department of Environment and Natural Resources
 N.C. Division of Waste Management
 N.C. Division of **Water Quality**
 N.C. **Division** of Water Resources
N.C. Department of Transportation
N.C. Division of Archives and History
N.C. State Clearinghouse
N.C. State Historic Preservation Officer
N.C. Wildlife Resources Commission

Local Agencies

City and Town Managers
 City of Archdale
 City of Burlington
 City of Greensboro
 City of High Point
 Town of Jamestown
 Town of Randleman
 Town of Cary

County Managers

Alamance County
Chatham County
Forsyth County
Guilford County
Lee County
Moore County
Randolph County
Rockingham County

N.C. Council of Governments, Regions G, H, I, and J

Elected Officials

U.S. Senators

U.S. Representatives

N.C. Senators

N.C. Representatives

Chairman, Board of County Commissioners

Alamance County
Chatham County
Forsyth County
Guilford County
Lee County
Moore County
Randolph County
Rockingham County

Mayors

City of Archdale
City of Burlington
City of Graham
City of Greensboro
City of High Point
Town of Cary
Town of Jamestown
Town of Randleman
City of Sanford

Environmental Organizations

Conservation Council of North Carolina
Deep River Citizens' Coalition
National Audubon Society
North Carolina Wildlife Federation
National Wildlife Federation
North Carolina Environmental Defense Fund
North Carolina Wildlife Federation
Sierra Club

Libraries

Archdale Public Library
Asheboro Public Library
Greensboro Public Library
Guilford County Public Library
High Point Public Library
Jamestown Public Library
Lee County Public Library
Moore County Public Library
N.C. Department of Environment and Natural Resources Library
Pittsboro Memorial Library
Ramseur Public Library
Randleman Public Library
Randolph County Public Library
Southern Pines Public Library
Wren Memorial Library

Postmasters

Archdale
Asheboro
Burlington
Carthage
Cary
Graham
Greensboro
High Point
Jamestown
Pittsboro
Randleman
Reidsville
Sanford

Interested Businesses, Groups, and Individuals (not listed here individually)

6.4 POINT OF CONTACT

Written comments on this Final EIS may be submitted to the addresses shown in the Abstract at the front of this document. If you would like further information or clarification on the contents of this report, please contact Mr. John Meshaw at (910) 251-4175 for technical matters or Mr. David Franklin at (910) 251-4952 regarding permit actions.

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Dr. Gerald McCrain	EcoScience Corporation	Wetlands Mitigation Development
Loretta Lautzenheiser	Coastal Carolina Research, Inc., Tarboro, NC	Archaeological Survey Principal Investigator

8.0 REFERENCES

- Alderman, J. 1994. Annual Performance Report for Section 6 Endangered Species Surveys, Project E-3, Segment 11. N.C. Wildlife Resources Commission. pp. 25-34.
- American Water Works Association. 1991. "AWWA Makes Strong Pitch for Conservation Aspects in Legislation," *AWWA Main Stream*, August 1991.
- Andrews, J., P. Wiatt, D. Hopkins, and A. Walker. 1991. USDA Soil Conservation Service-Guilford, Randolph, Rockingham, Alamance Counties, personal communication to Mary Norman, August 15, 1991.
- Benner, B. and T. McCloud. 1997. *A Paddler's Guide to Eastern North Carolina*, Menasha Ridge Press, pp. 91-100.**
- Biggins, R. G. 1988. *Cape Fear Shiner Recovery Plan*, U.S. Fish and Wildlife Service.
- Black & Veatch. 1988. *Randleman Lake Safe Yield Analysis*, Prepared for the Piedmont Triad Regional Water Authority.
- Black & Veatch. 1990. *Water Quality and Quantity Studies to Support Randleman Lake Environmental Impact Statement*, Prepared for the Piedmont Triad Regional Water Authority.
- Black & Veatch. 1991a. *Water Supply Alternatives Assessment*, Prepared for the Piedmont Triad Regional Water Authority.
- Black & Veatch. 1991b. Letter to John Kime, PTRWA, from Beth Quinlan, summarizing the results of Reassessment of Chemical Contamination at the High Point Landfill and Its Effect on Randleman Lake Water Quality, July 23, 1991.
- Black & Veatch. 1993. *Randleman Lake 1993 Update to the Environmental Impact Statement*, Prepared for the Piedmont Triad Regional Water Authority.
- Black & Veatch. 1994a. *Alternative Site Assessment for the Randleman Water Treatment Plant*, Prepared for the Piedmont Triad Regional Water Authority, December 1994.
- Black & Veatch. 1994b. *Randleman Lake 1994 Update to the Environmental Impact Statement*, Prepared for the Piedmont Triad Regional Water Authority, December 1994.
- Black & Veatch. 1995. *Randleman Lake 1995 Update to the Environmental Impact Statement*, Prepared for the Piedmont Triad Regional Water Authority.
- Blasland, Bouck & Lee, Inc. 1999. *Former Seaboard Chemical Corporation and Riverdale Drive Landfill, Remedial Investigation Report, Jamestown, North Carolina, Volumes 1, 2 and 3*. Merch 17, 1999.**

Brezonik, P. L. 1995. *Water Quality and Predictive Modeling Studies on the Proposed Randleman Reservoir, High Point, North Carolina*, Prepared for the Piedmont Triad Regional Water Authority. 11 pp.

Bruvold, W. H. and P. R. Mitchell. 1993. "Evaluating the Effect of Residential Water Audits," *AWWA Journal*, 85:8, August 1993.

Bryant, S. and L. Warlick. 1991. District 5 Fishery and Wildlife Biologists, N.C. Wildlife Resources Commission, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Carter, J. H., III and **Associates**. 1993. *Biological Assessment for Randleman Lake, Randolph and Guilford Counties, North Carolina*, Prepared for the Piedmont Triad Regional Water Authority. 69 pp.

Carter, J. H., III. 1995. Letter to John F. Kime, January 25, 1995.

CH2M Hill. 1985. *Water Supply Alternatives, Study for the Upper Cape Fear River Basin*.

Claggett, S. 1991. State Archaeologist, N.C. Department of Cultural Resources, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Coe, J. L. and J. H. Wilson, Jr. 1976. Final Report, *An Archaeological Survey of Randleman and Howard Mills Reservoirs*, prepared for the National Park Service. Research Laboratories of Anthropology, University of North Carolina at Chapel Hill.

Collette, B. B. 1962. "The swamp darters of the subgenus *Hololepis* (Pisces, Percidae)." *Tulane Stud. Zool.* 9(4): 115-211, 1962.

Employment Security of North Carolina. 1994. "Insured Employment and Wages in North Carolina by 2-digit SIC Industry for Year 1994."

Environmental Investigations. 1992. *Groundwater and Surface Water Investigation, Riverdale Road Landfill, High Point, North Carolina*.

Environmental Resources Management. 1999a. *Seaboard Chemical Company and City of High Point Riverdale Drive Landfill, Jamestown, North Carolina, Human Health and Ecological Risk Assessment. March 1999.*

Environmental Resources Management. 1999b. *Draft Seaboard Group II and the City of High Point, Feasibility Study (FS) for the Former Seaboard Chemical Corporation Facility and the City of High Point Riverdale Drive Landfill, Jamestown, North Carolina. April 30, 1999.*

Federal Interagency Committee for Wetland Delineation. 1989. *Federal Manual for Identifying and Delineating Jurisdiction Wetlands*, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and USDA Soil Conservation Service, Cooperative Technical Publication.

Fox, H. 1991. USDA Soil Conservation Service, Raleigh, personal communication to Mary Norman, Black & Veatch, August 15, 1991.

Fransen, T. 1998. North Carolina Division of Water Resources, personal communication to Robert A. Berndt, Hazen and Sawyer, April 14, 1998.

Frezell, J. 1991. City Manager, Town of Jamestown, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Frezell, J. 1993. City Manager, Town of Jamestown, personal communication to John Kime, Piedmont Triad Regional Water Authority, November 30, 1993.

Frezell, J. 1998. City Manager, Town of Jamestown, personal communication to Andrea Spangier, Piedmont Triad Regional Water Authority, January 1998.

Fuller, S. L. H. 1977. "Freshwater and Terrestrial Mollusks," In: *Endangered and Threatened Plants and Animals of North Carolina*. J.E. Cooper et al. (eds.), N. C. State Museum of Natural History, Raleigh, N.C. pp. 143-194.

Garrow & Associates, Inc. 1993. *Randleman Reservoir Cultural Resources Inventory Plan*.

GEI Consultants, Inc. 1995. "Phase I Hydrologic and Hydraulic Analyses and Conceptual Design Alternatives for the Proposed Randleman Lake Dam," Volume I, prepared for the Piedmont Triad Regional Water Authority, **April 25, 1995.**

GEI Consultants, Inc. 1996a. "Former Dump Area, J.L. Coble Property, Randleman, North Carolina," prepared for the Piedmont Triad Regional Water Authority, **February 28, 1996.**

GEI Consultants, Inc. 1996b. "Phase II Supplemental Geology Report, Randleman Lake Dam, Randleman, North Carolina", prepared for the Piedmont Triad Regional Water Authority, March 29, 1996.

Geraghty & Miller, Inc. 1993. *Final Report on the Remedial Site Inspection: Seaboard Chemical Corporation, Jamestown, N.C.*, Raleigh, N.C.

Geraghty & Miller, Inc. 1995. *Work Plan for the Remedial Investigation at the Former Seaboard Chemical Corporation Facility and the City of High Point Riverdale Drive Landfill*, June 1995.

Gore, T. 1997. City of High Point, personal communication to Dr. Newt Colston, Black & Veatch, May 12, 1997.

Grayboal, K. 1997. *Phase II Intensive Historic Architectural Survey and Historic Evaluations of Eligibility for the Randleman Lake Project Area, Randolph and Guilford Counties*, prepared for the Piedmont Triad Regional Water Authority. DS Atlantic Corporation. May 27, 1997.

Grisham, A. and W. M. Fleming. 1989. "Long-Term Options for Municipal Water Conservation," *Management and Operations AWWA Journal*, March 1989.

Guilford County. 1987. Department of Planning and Development, *Watershed Protection Ordinance*, adopted January 22, 1987.

Hardin, R. 1991. City Manager, **Town of Randleman**, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Hardin, R. 1998. City Manager, Town of Randleman, personal communication to Andrea Spangler, Piedmont Triad Regional Water Authority, January 1998.

Hazen and Sawyer, P.C. 1988. Consulting Engineers, *Safe Yield Evaluation - Lakes Townsend, Brandt, and Higgins*, letter report prepared for the City of Greensboro Public Works Department, December 6, 1988.

Hazen and Sawyer, P.C. 1991. T.Z. Osborne Wastewater Treatment Plant Expansion Environmental Assessment, prepared for the City of Greensboro, August 1991.

Hazen and Sawyer, P.C. 1995. Consulting Engineers, *T. Z. Osborne Wastewater Treatment Plant 40 MGD Expansion, Environmental Assessment*, prepared for the City of Greensboro Public Works Department.

Hazen and Sawyer, P.C. 1997. Draft Randleman Water Treatment Plant, Environmental Assessment, prepared for the Piedmont Triad Regional Water Authority, July 1997.

Hazen and Sawyer, P.C. 1998. Draft Nutrient Reduction Strategy and implementation Plan, Randleman Lake, prepared for the Piedmont Triad Regional Water Authority, March 1998.

Holcomb, P. 1993. *Alternatives to Randleman Lake: A Sierra Club Report Presented to the U.S. Army Corps of Engineers and the Environmental Protection Agency.*

Huband, R. K. 1991. Park and Recreation Planner, Division of Parks and Recreation, personal communication to Mary Norman, Black & Veatch, August 13, 1991.

Ingram, B. F. 1982. Chief of Planning Division, U.S. Army Corps of Engineers, Wilmington District., personal communication to John N. Morris, N.C. Division of Water Resources, December 16, 1982.

Kairis, P. 1998. Public Services Director, City of High Point, personal communication to Andrea Spangler, Piedmont Triad Regional Water Authority, January 1998.

Lautzenheiser, L., J. Eastman, K. Seramur, and M. Holm. 1997. Archaeological Survey, Proposed Randleman Reservoir, Randolph and Guilford Counties, North Carolina, prepared for the Piedmont Triad Regional Water Authority. Coastal Carolina Research, Inc. April 1997.

Lautzenheiser, L. and D. Lynch. 1998. Archaeological Testing, Proposed Randleman Reservoir, Randolph and Guilford Counties, North Carolina, Volume I, The Historic Sites, prepared for the Piedmont Triad Regional Water Authority. Coastal Carolina Research, Inc. January 1998.

Lautzenheiser, L. and J. Lovett, Jr. 1998. *Data Recovery at Freeman's Mill, Site 31GF373, Gullford County, North Carolina*, prepared for the Piedmont Triad Regional Water Authority. Coastal Carolina Research, Inc. December 1998.

Lautzenheiser, L., M. Holm, S. Bamann, J. Eastman, and S. Petersen. 1999. *Archaeological Data Recovery, Sites 31RD1166, 31RD1192, 31GF376, Proposed Randleman Reservoir, Randolph and Gullford Counties, North Carolina*, prepared for the Piedmont Triad Regional Water Authority. Coastal Carolina Research, Inc. May 1999.

Lewarch, D., I. Essen, and T. H. Hargrove. 1985. *An Archaeological Investigation of the Site of the Proposed Randleman Reservoir Dam, Randolph County, North Carolina*, prepared for the U.S. Army Corps of Engineers, Wilmington District. Archaeological Research Consultants, Inc.

Menhinick, E.F. 1991. *The Freshwater Fishes of North Carolina*. N.C. Wildlife Resources Commission, Raleigh, N.C. 227 pp.

Moffatt & Nichol, Engineers. 2000. *Cape Fear River Basin Study*, prepared for the North Carolina Department of Environment and Natural Resources, Division of Water Resources. May 2000.

Moore, J. H. and S. W. Leonard. 1973. *Pre-Impoundment Studies: Randleman Project, A Survey of the Vascular Plants*. Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill.

Moreau, D. H. 1992. *Declining Rates of Expansion of Reservoir Capacity in North Carolina*. Water Resources Research Institute of the University of North Carolina.

Morris, J. N. 1993. "Memorandum to Steven J. Levitas, Deputy Secretary, N.C. Department of Environment, Health and Natural Resources, about the Effect of the Proposed Randleman Lake on Water Quality in the Deep River," June 16, 1993.

North Carolina Department of Cultural Resources. 1997. Letter from David Brook, Deputy State Historic Preservation Officer, to Andrea M. Spangler, Piedmont Triad Regional Water Authority. July 29, 1997.

North Carolina Department of Cultural Resources. 1998. Letter from David Brook, Deputy State Historic Preservation Officer, to Andrea M. Spangler, Environmental and Special Projects Manager, Piedmont Triad Regional Water Authority. June 2, 1998.

North Carolina Department of Cultural Resources. 1999. Letter from David Brook, Deputy State Historic Preservation Officer, to Andrea M. Spangler, Environmental and Special Projects Manager, Piedmont Triad Regional Water Authority. February 2, 1999.

North Carolina Department of Cultural Resources. 2000a. Letter from David Brook, Deputy State Historic Preservation Officer, to Andrea M. Spangler, Piedmont Triad Regional Water Authority. May 12, 2000.

North Carolina Department of Cultural Resources. 2000b. Letter from David Brook, Deputy State Historic Preservation Officer, to Andrea M. Spangler, Environmental and Special Projects Manager, Piedmont Triad Regional Water Authority. August 14, 2000.

North Carolina Department of Environment, Health and Natural Resources. 1981-1990. Division of Environmental Health, Public Water Supply Records.

North Carolina Department of Environment, Health and Natural Resources. 1989. *Forestry Best Management Practices Manual*. Division of Forest Resources. September 1989.

North Carolina Department of Environment, Health and Natural Resources. 1991. *G.S. 162A-7 and 153A-285 Review Document and Final Environmental Impact Statement, Randleman Lake, Randolph and Guilford Counties, North Carolina*. Division of Water Resources, Raleigh, N.C.

North Carolina Department of Environment, Health and Natural Resources. 1992. *Water Supply System Reports (for Greensboro, High Point, Jamestown, Archdale, and Randleman)*, Division of Environmental Health, Raleigh, N.C..

North Carolina Department of Environment, Health and Natural Resources. 1994a. *Review of Deep River/Carbonton Water Quality Investigations, 1992-1993*. Division of Environmental Management, Water Quality Section. Raleigh, N.C.

North Carolina Department of Environment, Health and Natural Resources. 1994b. *Water Quality Monitoring Data for Waters in the Upper Deep River Area, July 28, 1992- October 7, 1993*. Division of Environmental Management, Water Quality Section.

North Carolina Department of Environment, Health and Natural Resources. 1994c. *North Carolina Dam Safety Act Amendments, Rules for Minimum Flows to Maintain Aquatic Habitat, Background Information*. Division of Water Resources, Raleigh, N.C.

North Carolina Department of Environment, Health and Natural Resources. 1995. Letter from S. W. Tedder, Water Quality Section Chief, to L. E. O'Neal, Director of Public Utilities, High Point, September 18, 1995.

North Carolina Department of Environment, Health and Natural Resources. 1996a. *Cape Fear River Basinwide Water Quality Management Plan*. Division of Water Quality, Raleigh, N.C., October 1996.

North Carolina Department of Environment, Health and Natural Resources. 1996b. Letter from W. L. Yonts, Water Supply Assistance Section, to D. Franklin, Regulatory Branch, U.S. Army Corps of Engineers, Wilmington District.

North Carolina Department of Environment, Health and Natural Resources. 1997. *Inactive Hazardous Waste Sites Program, Guidelines for Assessment and Cleanup*. Division of Waste Management, Superfund Section. July 1997.

North Carolina Department of Environment, Health and Natural Resources. 1998. *Yadkin – Pee Dee River Basinwide Water Quality Management Plan*. Division of Water Quality. May 1998.

North Carolina Department of Environment and Natural Resources. 1998a. *Water Quality Monitoring Data for Waters in the Upper Deep River Area, May 5, 1997 – September 3, 1997*. Division of Water Quality. March 1998.

North Carolina Department of Environment and Natural Resources. 1998b. *Report of Proceedings, Proposed Reclassification of Segments of the Deep River (Proposed Randleman Reservoir)*. Environmental Management Commission Meeting, November 12, 1998.

North Carolina Department of Environment and Natural Resources. 1998c. *Statewide Wetland Map*. Division of Water Quality, Non-Discharge Branch, Wetlands/401 Unit. December 1998.

North Carolina Department of Environment and Natural Resources. 1999a. Letter to Dr. G. Wayne Wright, USACE, from A. Preston Howard, Jr., Director, NCDWQ, summarizing the Reclassification of the Proposed Lake to a Water Supply Classification (WS-IV), January 25, 1999.

North Carolina Department of Environment and Natural Resources. 1999b. Letter from David A. Goodrich, Supervisor, NPDES Unit to Thomas P. Gore, Plants Manager, High Point, N.C. February 24, 1999.

North Carolina Department of Environment and Natural Resources. 1999c. Letter to John Kime, PTRWA, from A. Preston Howard, Jr., Director, NCDWQ, transmitting the 401 Water Quality Certification, March 11, 1999.

North Carolina Department of Environment and Natural Resources. 1999d. Letter to Robert F. McGhee, USEPA, from William L. Meyer, Director, Division of Waste Management, summarizing Updated Information on the Remedial Investigation of the Seaboard Chemical Corporation and High Point Landfill Sites, September 3, 1999.

North Carolina Department of Environment and Natural Resources. 2000a. *Draft Cape Fear River Basinwide Water Quality Plan*. Division of Water Quality. February 2000.

North Carolina Department of Environment and Natural Resources. 2000b. Letter to David Franklin, USACE, from Colleen Sullins, Chief, Division of Water Quality, Water Quality Section, summarizing NCDWQ Review of the December 1999 USACE Draft FEIS and Water Quality Evaluations conducted since the DEIS was Published, March 1, 2000.

North Carolina Department of Natural Resources and Community Development and U.S. Water Resources Council. 1983. *Cape Fear River Basin Study - Ground Water Supply Potential and Procedures for Well-Site Selection*.

North Carolina Department of Natural Resources and Community Development. 1988a. *Biological Assessment of the Deep River, 1983-1987, Report No. 88-01*, Division of Environmental Management, Water Quality Section. February 1988.

North Carolina Department of Natural Resources and Community Development. 1988b. *Chemical and Biological Monitoring of the Deep River, 1983-1987*, Appendix G of an unspecified report, Division of Environmental Management, Water Quality Section. February 9, 1988.

North Carolina Environmental Management Commission. 1991. *Proposed Reclassifications and Amendments to Rules for Surface Water Supply Pursuant to the Requirements of House Bill 156*.

North Carolina Environmental Management Commission. 1992. Permit for Interbasin Transfer and Eminent Domain, February 6, 1992.

North Carolina Office of State Planning. 1995. Certified Population Projections from the State Demographer's Office.

North Carolina State Demographer. 1991. *Population Projections for Piedmont Triad Council of Governments*, August 28, 1991.

Ogburn, J. 1991. Operations Manager, City of Archdale, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Ogburn, J. 1998. Operations Manager, City of Archdale, personal communication to Andrea Spangler, Piedmont Triad Regional Water Authority, January 1998.

Piedmont Triad Council of Governments. 1977. Regional Development Plan.

Piedmont Triad Regional Water Authority. 1990. *Draft G.S. 162A-7 and 153A - 285 Review Document and Environmental Impact Statement*.

Pottem, G.B. and M. T. Huish. 1985. "Status survey of the Cape Fear shiner *Notropis mekistocholas*." Report to U.S. Fish and Wildlife Service. 44 pp.

Pottem, G.B. and M. T. Huish. 1986. "Supplement to the status survey of the Cape Fear shiner *Notropis mekistocholas*." Report to U.S. Fish and Wildlife Service. 11 pp.

Randolph County. 1988. *Watershed Protection Ordinance*, Department of Planning, adopted January 4, 1988.

Reid, W.H., K. Seramur, and L. Lautzenheiser. 1998. *Archaeological Testing, Proposed Randleman Reservoir, Randolph and Guilford Counties, North Carolina, Volume II, The Prehistoric Sites*, prepared for the Piedmont Triad Regional Water Authority. Coastal Carolina Research, Inc. April 1998.

Research Triangle Institute. 1998. *Eutrophication Modeling for the Randleman Lake Project, Final Report*, submitted to the North Carolina Department of Environment and Natural Resources, Division of Water Quality, September 30, 1998.

Schafale, M. P. and A. S. Weakley 1990. *Classification of the Natural Communities of North Carolina, Third Approximation*, published by North Carolina Department of Environment, Health, and Natural Resources.

Seaboard Group II and City of High Point. 1997. Agreement regarding joint efforts to implement a Remedial Investigation of the former Seaboard Chemical facility and the Riverdale Drive Landfill, as set forth in the Remedial Investigation Work Plan dated June 1995. 7 pp.

Shaw, R. 1995. Personal communication to John Kime, Piedmont Triad Regional Water Authority.

Sheer, D. P. 1985. "Managing Water Supplies to Increase Water Availability," *National Water Summary*, U.S. Geological Survey.

Sitex Environmental, Inc. 1989. *Review and Evaluation of Seaboard Chemical Corporation Closure and Post Closure Plan*.

Smith, H.M. 1979. Architectural Resources: An Inventory of Historic Architecture, High Point, Jamestown, Gibsonville, Gullford County. Published by the North Carolina Department of Cultural Resources, Division of Archives and History.

Snelson, F.F., Jr. 1971. " *Notropis mekistocholas*, a New Herbivorous Cyprinid Fish Endemic to the Cape Fear River Basin, North Carolina." *Copeia* (3): 449-462. 1971.

Stancil, R. 1991. Review Specialist, N.C. Department of Cultural Resources, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Synesis Environmental, Inc. (SEI). 1999. Seaboard Chemical Corporation Facility and City of High Point Former Riverdale Drive Landfill, Groundwater Flow and Transport Model Report. April 30, 1999.

U.S. Army Corps of Engineers. 1972-1984a. Randleman Lake, Cape Fear River Basin, North Carolina, *Design Memoranda (I-IX)*. *Design Memorandum No. 1 - Site Selection*, August 1972; *Design Memorandum No. 2 - Hydrology and Hydraulic Analysis*, June 1975; *Design Memorandum No. 3 - General Design Memorandum, Phase I, Plan Formulation*, October 1976 (a); *Design Memorandum No. 4 - Real Estate*, March 1979; *Design Memorandum No. 5 - General Design Memorandum, Phase II, Project Design*, September 1980 (a); *Design Memorandum No. 6 - Access Road*, March 1981; *Design Memorandum No. 7 - Master Plan*, April 1983 (a); *Design Memorandum 8 - Geology*, December 1983 (b); *Design Memorandum No. 9 - Necessity and Plan for Relocation of N.C. Secondary Roads Including NC 62*, November 1984. Wilmington District.

U.S. Army Corps of Engineers. 1976 (b). *Draft Environmental Impact Statement: Randleman Lake, Cape Fear River Basin, North Carolina*. Wilmington District.

U.S. Army Corps of Engineers. 1980 (b). *Final Environmental Impact Statement: Randleman Lake, Cape Fear River Basin, North Carolina*. Wilmington District.

U.S. Army Corps of Engineers. 1982(b). *Final Environmental Impact Statement: Randleman Lake, Cape Fear River Basin, North Carolina*. Wilmington District.

U.S. Army Corps of Engineers. 1993. Letter from G. W. Wright, Chief, Regulatory Branch, to John F. Kime, Piedmont Triad Regional water Authority, July 22, 1993.

U.S. Army Corps of Engineers. 1999. *Review Draft, Final Environmental Impact Statement, Randleman Lake, Guilford and Randolph Counties, North Carolina. Prepared for the Piedmont Triad Regional Water Authority. Hazen and Sawyer, P.C. December 1999.*

U.S. Department of Agriculture. 1976. *Upper Cape Fear River Basin Interim Report, Appendix D. Soil Conservation Service.*

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2000. Letter to David Franklin, USACE, from Garland B. Pardue, Ecological Services Supervisor, USFWS, summarizing USFWS Assessment of Project impacts on the Cape Fear shiner, March 7, 2000.

U.S. Environmental Protection Agency. 1999. Letter to Dr. G. Wayne Wright, USACE, from Robert F. McGhee, Director, Water Management Division, summarizing the EPA's Conclusions on Water Quality Issues for Randleman Lake, October 19, 1999.

U.S. Geological Survey. 1997. National Water Summary on Wetland Resources. Water supply Paper 2425. 431 pp.

Virginia State Water Control Board. 1983. *Water Conservation Projection Methodology.* Office of Water Resources Planning.

Warlick, L. 1991. Wildlife Biologist, N.C. Wildlife Resources Commission, District 5, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Whatley, Jr., L.M. 1985. *The Architectural History of Randolph County, North Carolina.* Published by the City of Asheboro, County of Randolph, and North Carolina Division of Archives and History.

Williams, A. 1998. Water Resources Director, City of Greensboro, personal communication to Andrea Spangler, Piedmont Triad Regional Water Authority, January 1998.

Williams, A. 1999. Water Resources Director, City of Greensboro, personal communication to Don Cordell, Hazen and Sawyer, October 4, 1999.

Willis, F. 1991. Randolph County Manager, personal communication to Diane Tolleson, Black & Veatch, August 15, 1991.

Woodall, J. N., A. N. Snavely, and T. L. Armistead. 1977. *Final Report of an Archeological Reconnaissance of the Randleman Reservoir Area.* Submitted to the National Park Service, Atlanta. Archeology Laboratories, Wake Forest University, Winston-Salem. p. 91.

Wray, D. 2000. Personal communication to Andrea Spangler, Piedmont Triad Regional Water Authority.

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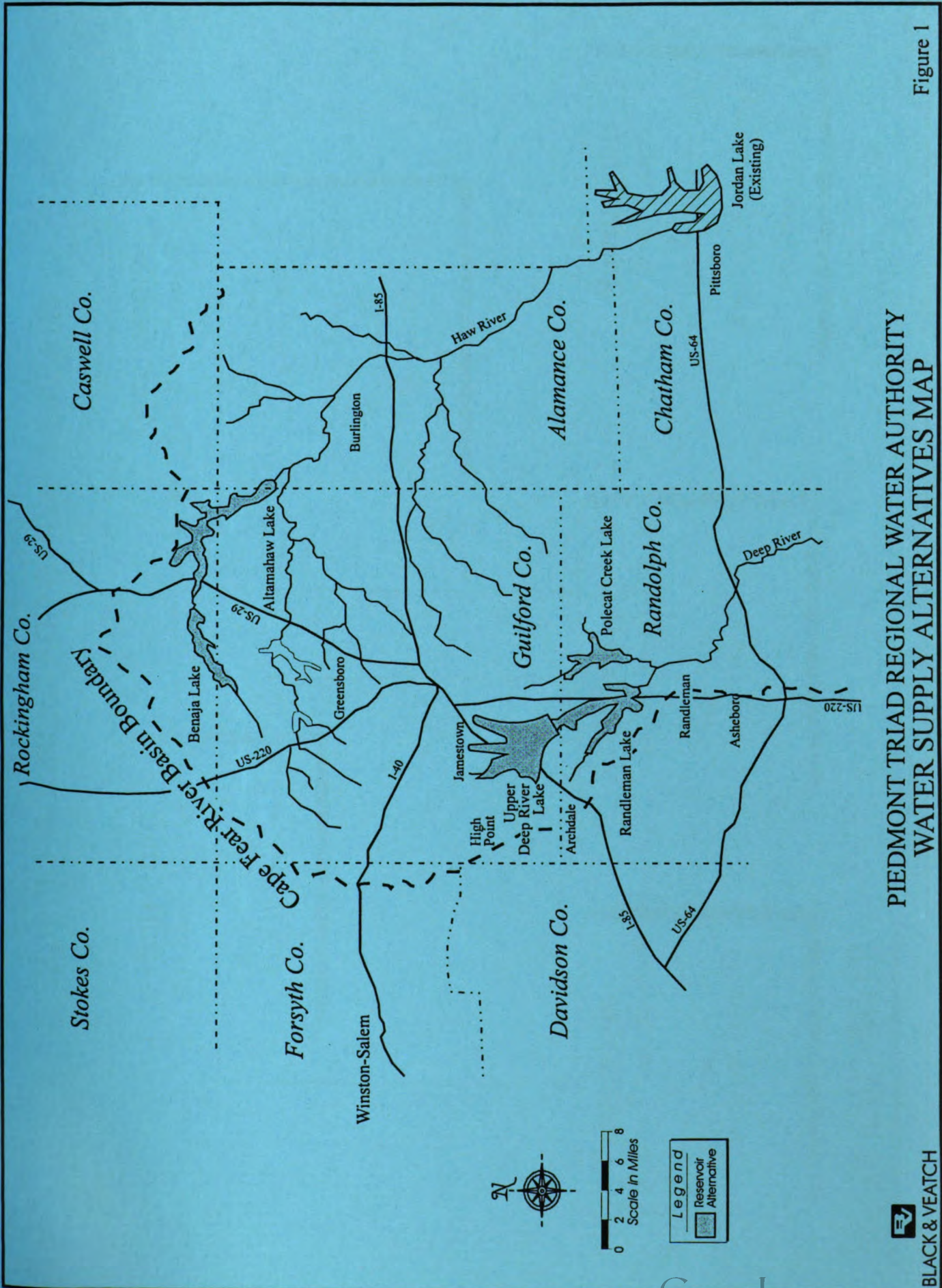
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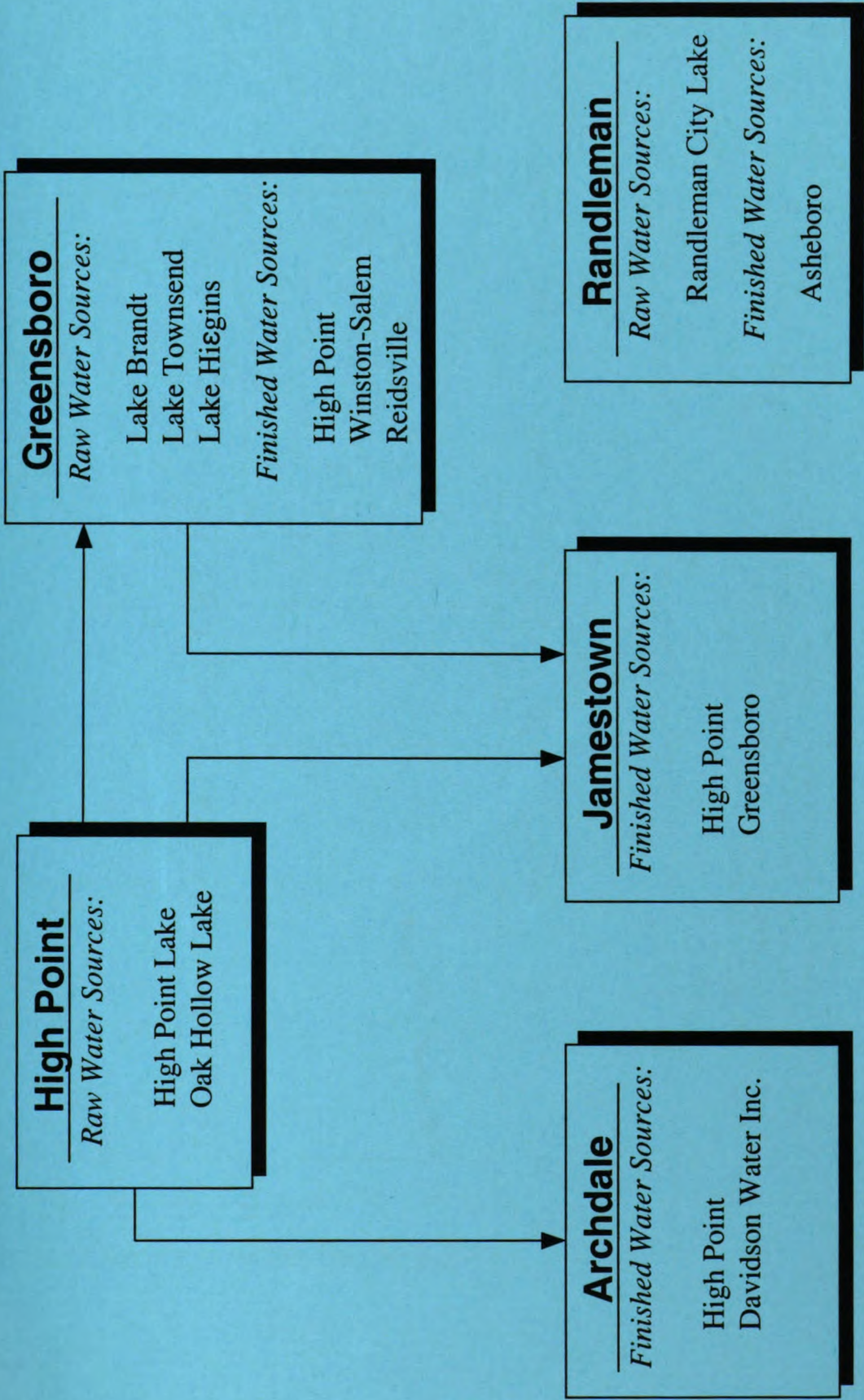
10.0 FIGURES



PIEDMONT TRIAD REGIONAL WATER AUTHORITY
 WATER SUPPLY ALTERNATIVES MAP

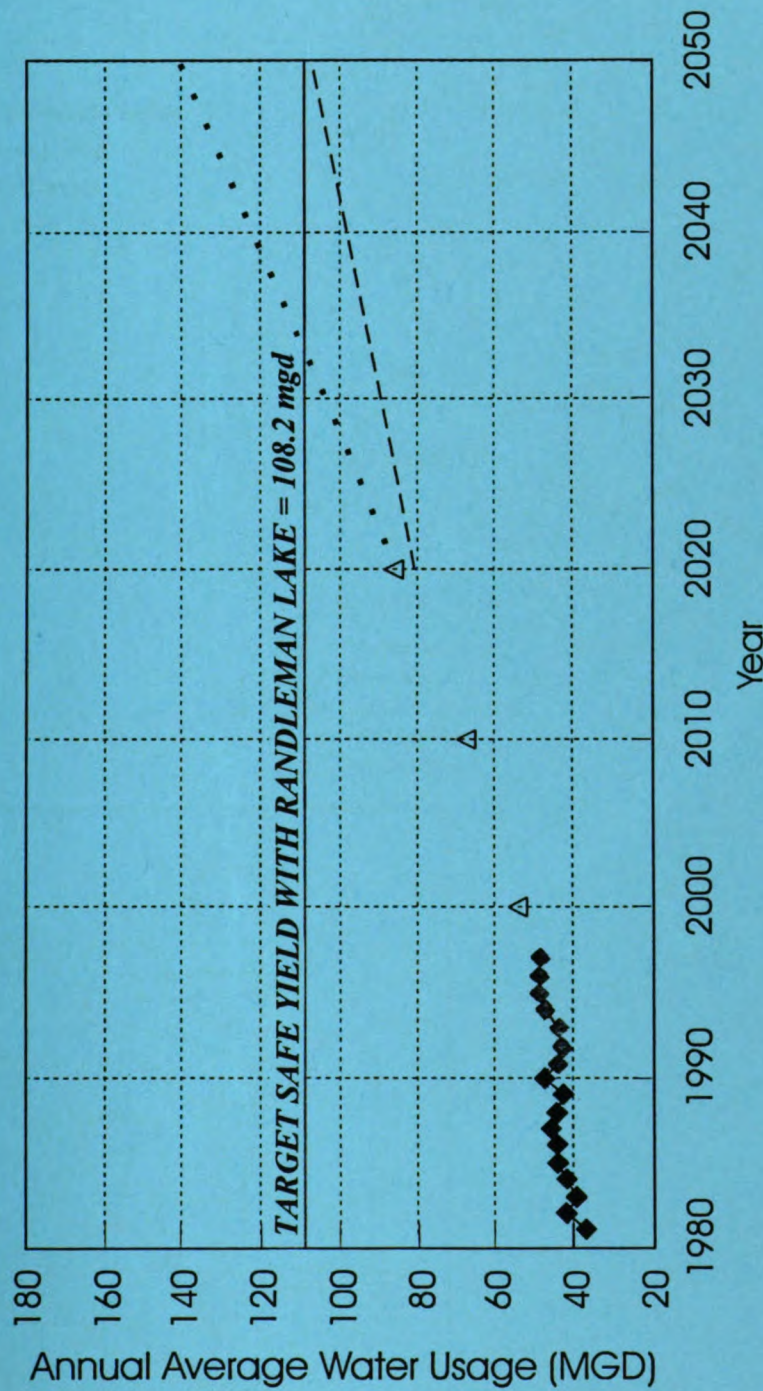
Figure 1

PIEDMONT TRIAD REGIONAL WATER AUTHORITY
**EXISTING RAW AND FINISHED WATER
SUPPLY SOURCES FOR PTRWA MEMBERS**



HAZEN AND SAWYER
Environmental Engineers & Scientists

Figure 2



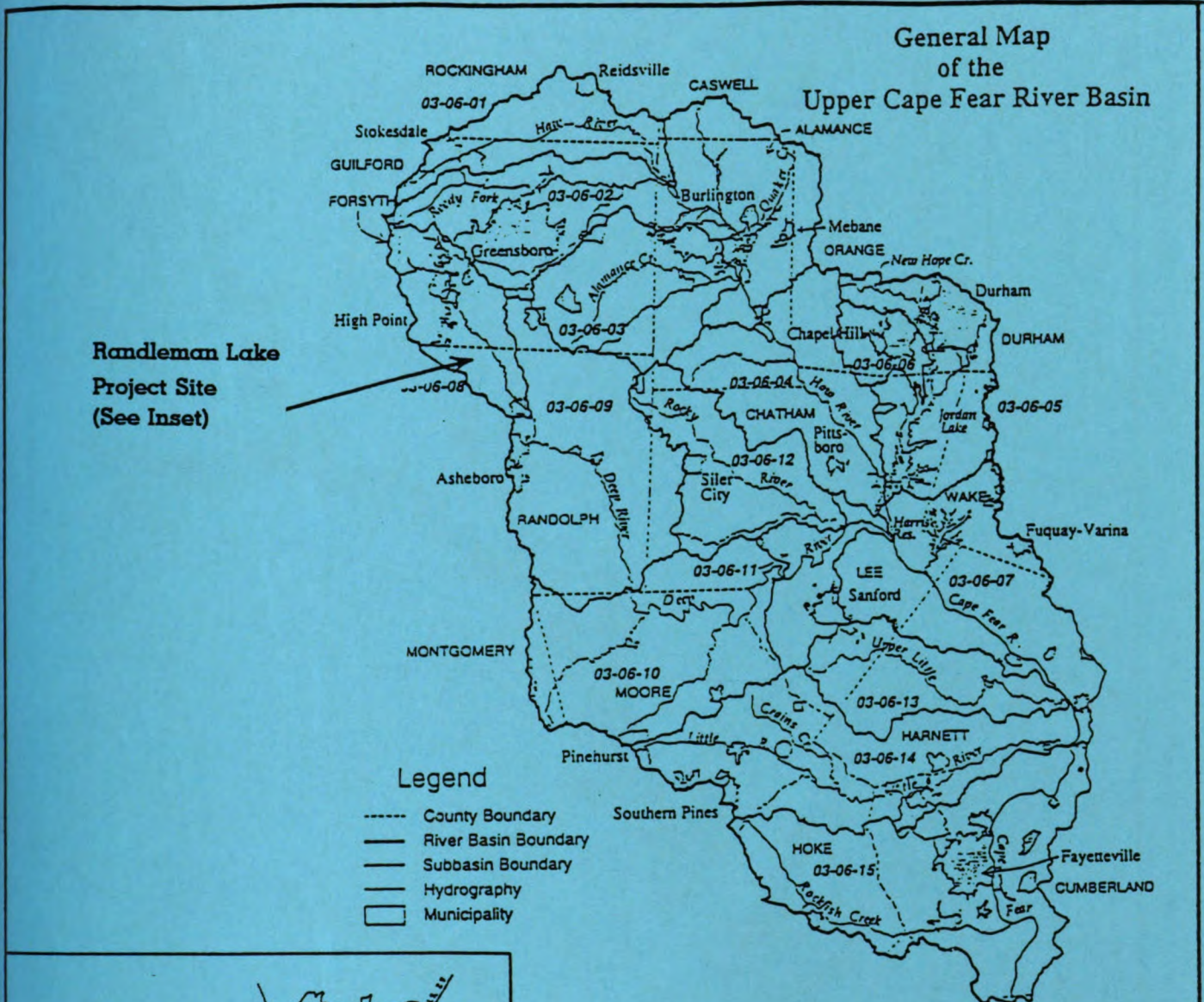
Legend

- (◆) = Documented past usage.
- (△) = Projected usage based on water supply system reports (NCDEHNR, 1996).
- (•••) = Extrapolation 1 = Based on projected usage for fastest 10-year growth rate (2010 to 2020).
- (---) = Extrapolation 2 = Based on projected usage for 1990 to 2020 with conservation.

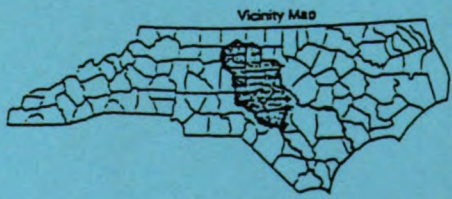
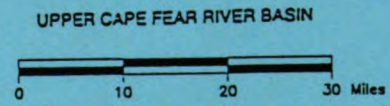
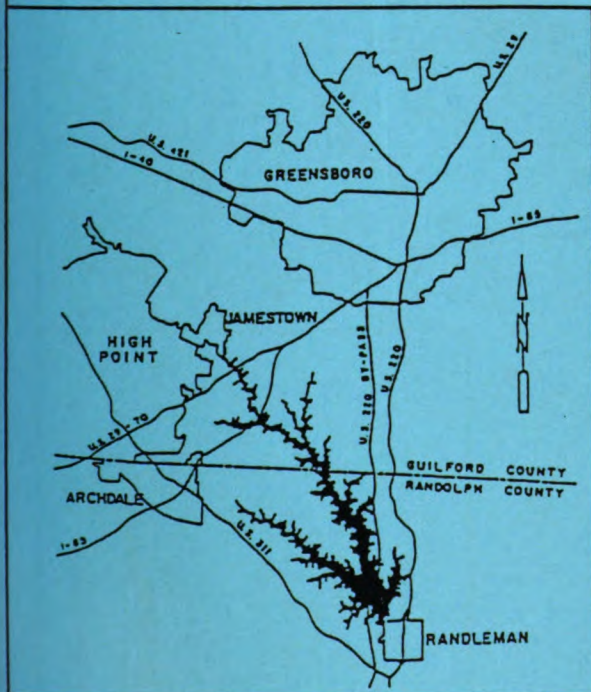
**PIEDMONT TRIAD REGIONAL WATER AUTHORITY
ANNUAL AVERAGE WATER USAGE**

Figure 3

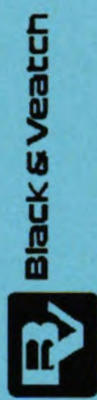
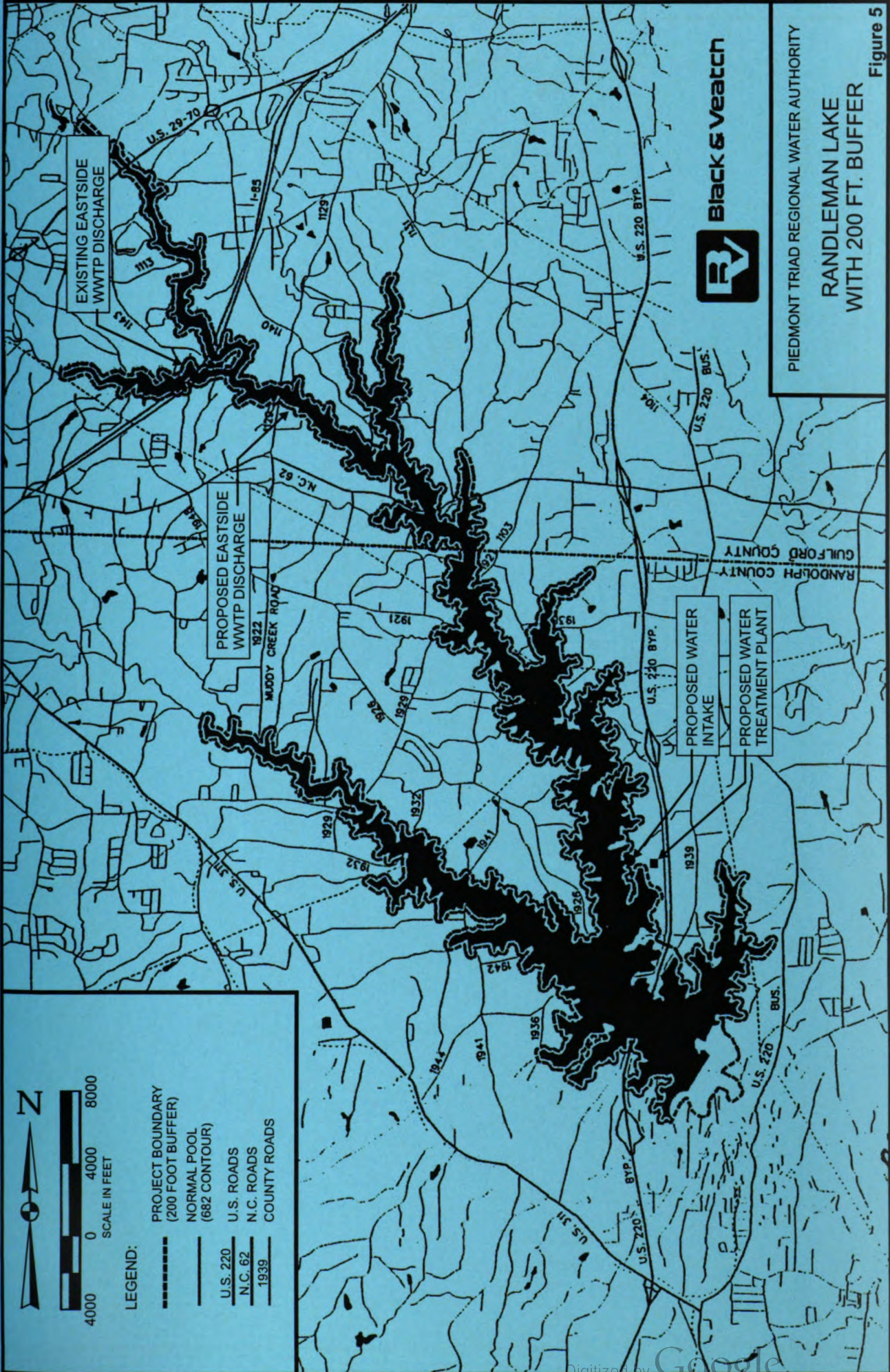
General Map of the Upper Cape Fear River Basin



**Randleman Lake
Project Site
(See Inset)**



PIEDMONT TRIAD REGIONAL WATER AUTHORITY
LOCATION OF PROPOSED
RANDLEMAN LAKE



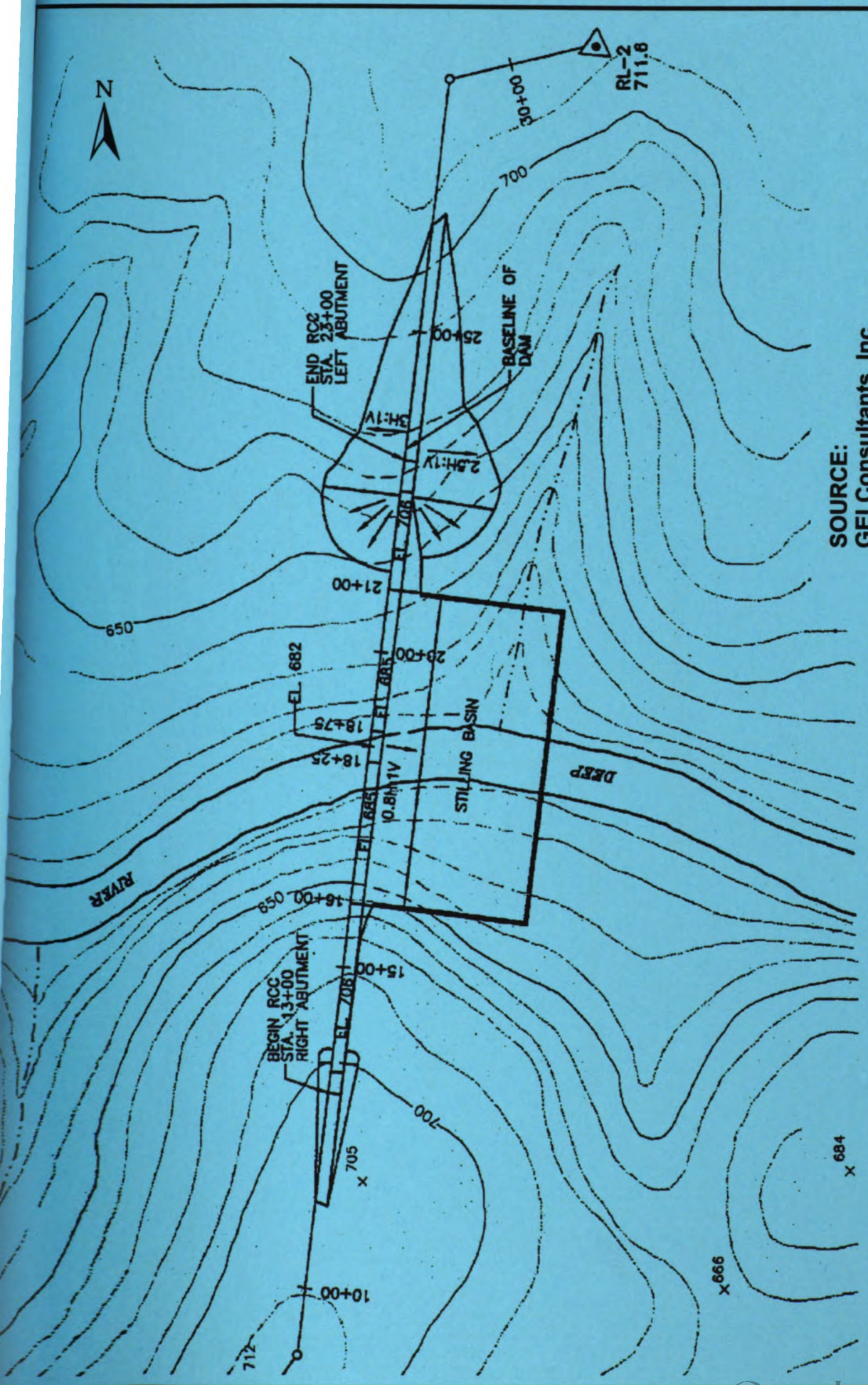
PIEDMONT TRIAD REGIONAL WATER AUTHORITY
 RANDLEMAN LAKE
 WITH 200 FT. BUFFER

Figure 5



LEGEND:

- PROJECT BOUNDARY (200 FOOT BUFFER)
- NORMAL POOL (682 CONTOUR)
- U.S. 220
- N.C. 62
- 1939
- COUNTY ROADS



SOURCE:
 GEI Consultants, Inc.

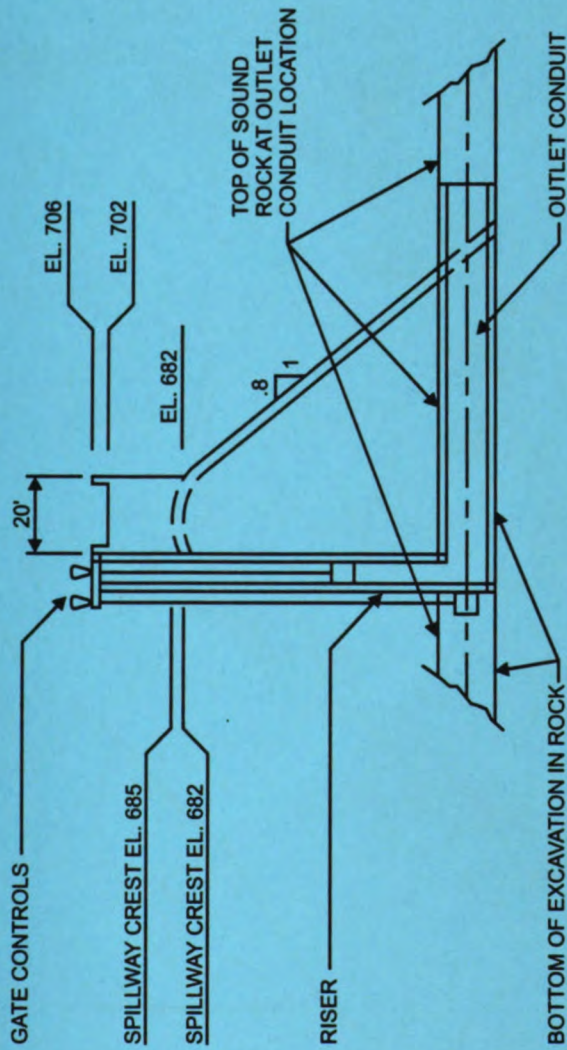
Phase I Hydrologic and Hydraulic Analyses
 and Conceptual Design Alternatives for
 the Proposed Randleman Lake Dam, April 1995

Piedmont Triad Regional Water Authority

Plan of RCC Dam

Figure 5a

Hazen and Sawyer
 Environmental Engineers & Scientists



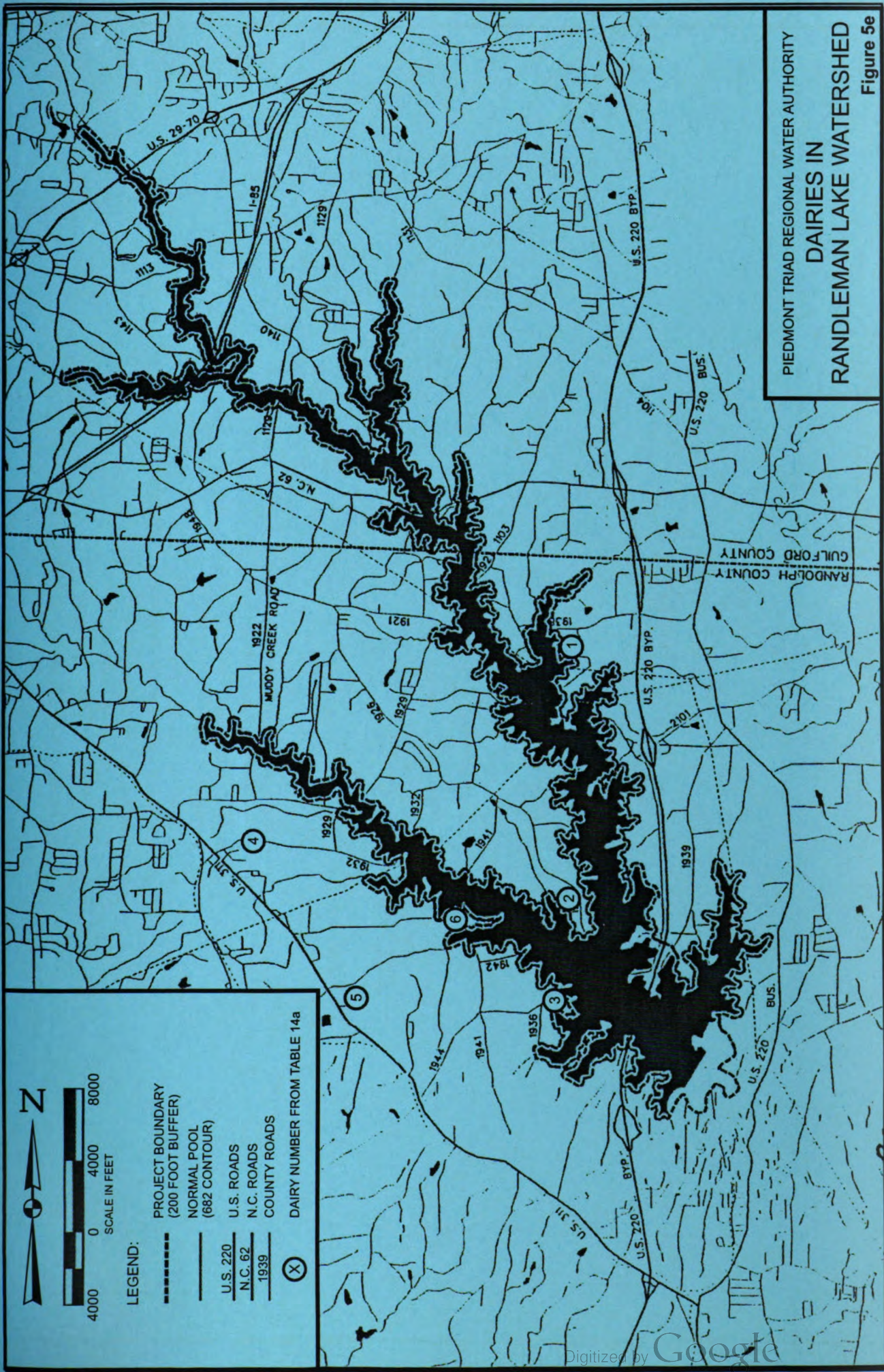
RCC DAM ALTERNATIVE

SOURCE:
 GEI Consultants, Inc.
 Phase I Hydrologic and Hydraulic Analyses
 and Conceptual Design Alternatives for
 the Proposed Randleman Lake Dam, April 1995

**Piedmont Triad Regional Water Authority
 Cross Section of RCC Dam**

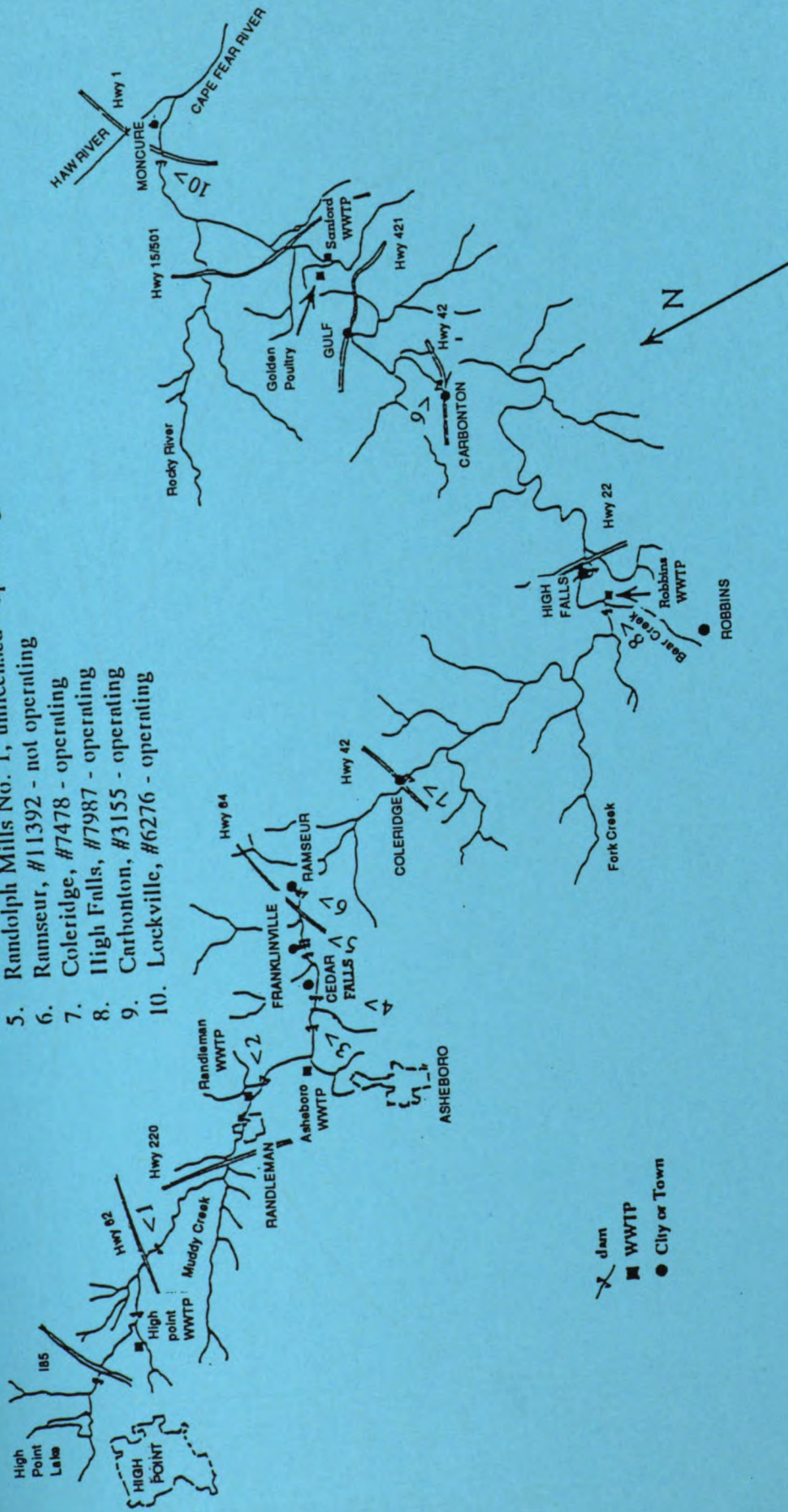
Figure 5b

PIEDMONT TRIAD REGIONAL WATER AUTHORITY
**DAIRIES IN
 RANDLEMAN LAKE WATERSHED**
 Figure 5e



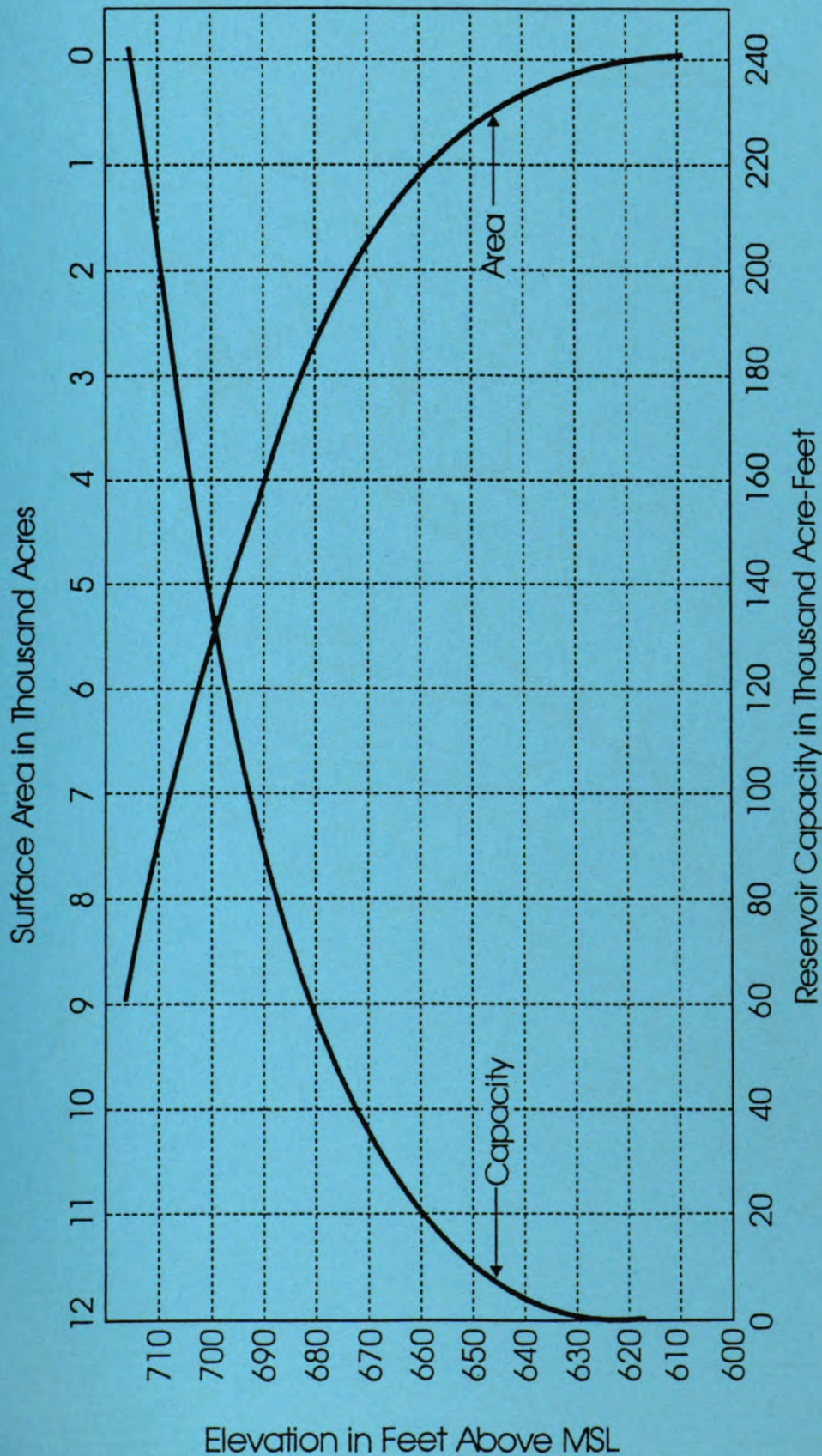
DEEP RIVER HYDROELECTRIC FACILITIES

1. Coltrane Mill, license denied - not operating
2. Worthville, #3156 - operating
3. Cox Lake, #6559 - operating
4. Cedar Falls, #7783 - operating
5. Randolph Mills No. 1, unlicensed - not operating
6. Ramseur, #11392 - not operating
7. Coleridge, #7478 - not operating
8. High Falls, #7987 - operating
9. Carabonton, #3155 - operating
10. Lockville, #6276 - operating



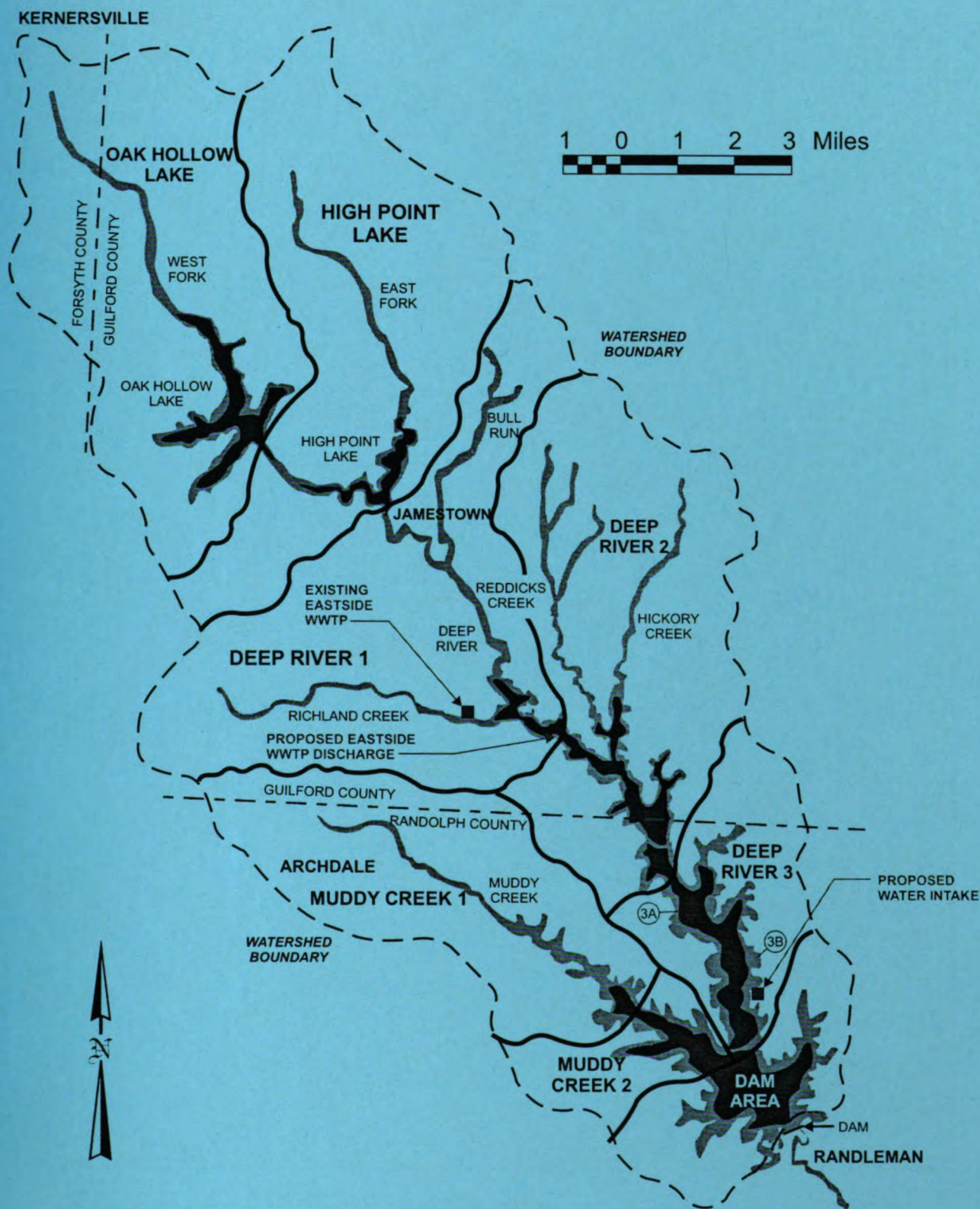
PIEDMONT TRIAD REGIONAL WATER AUTHORITY
DEEP RIVER HYDROELECTRIC FACILITIES

Figure 6

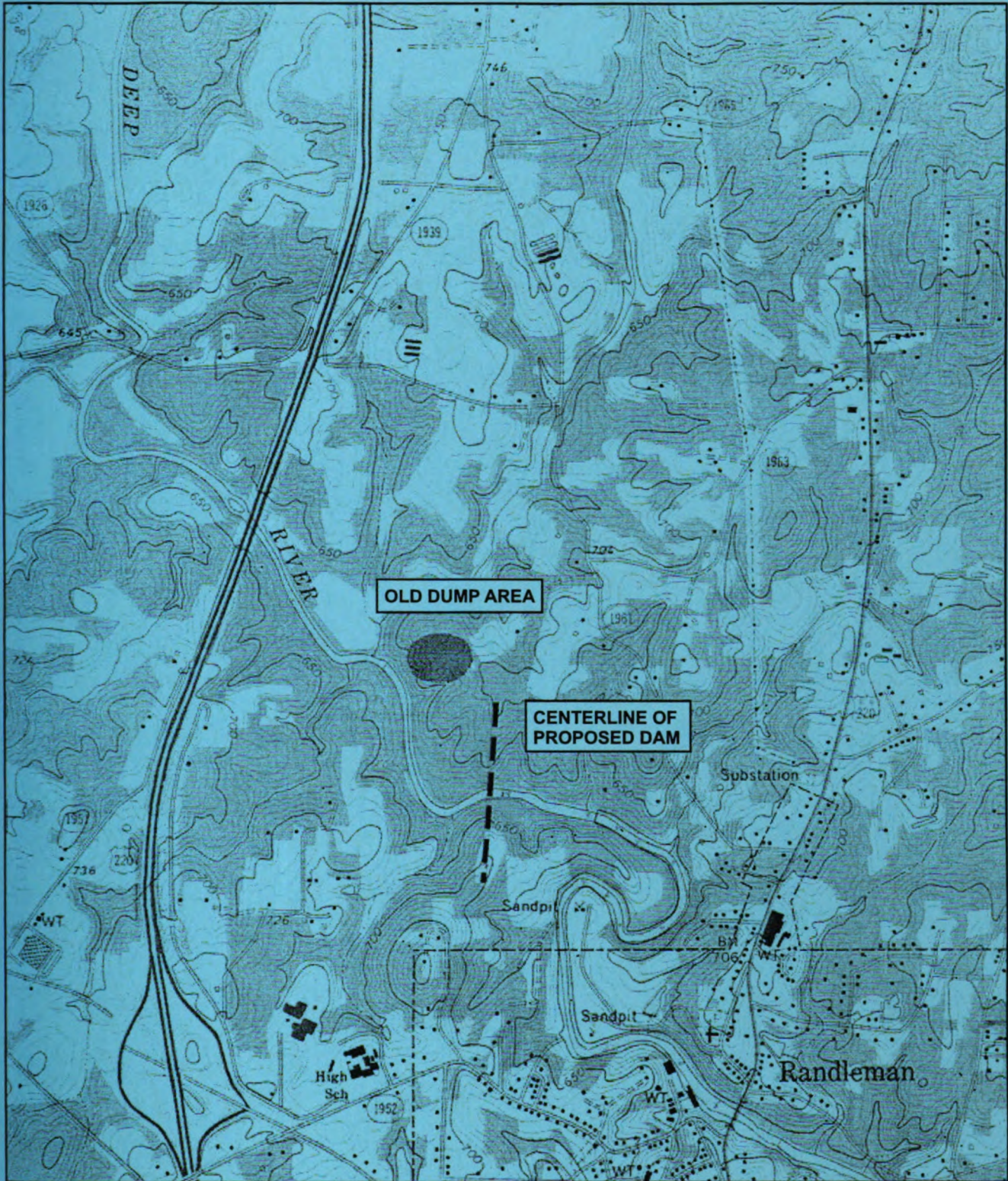


PIEDMONT TRIAD REGIONAL WATER AUTHORITY
SURFACE AREA AND STORAGE CURVES FOR RANDELMAN LAKE

Figure 7



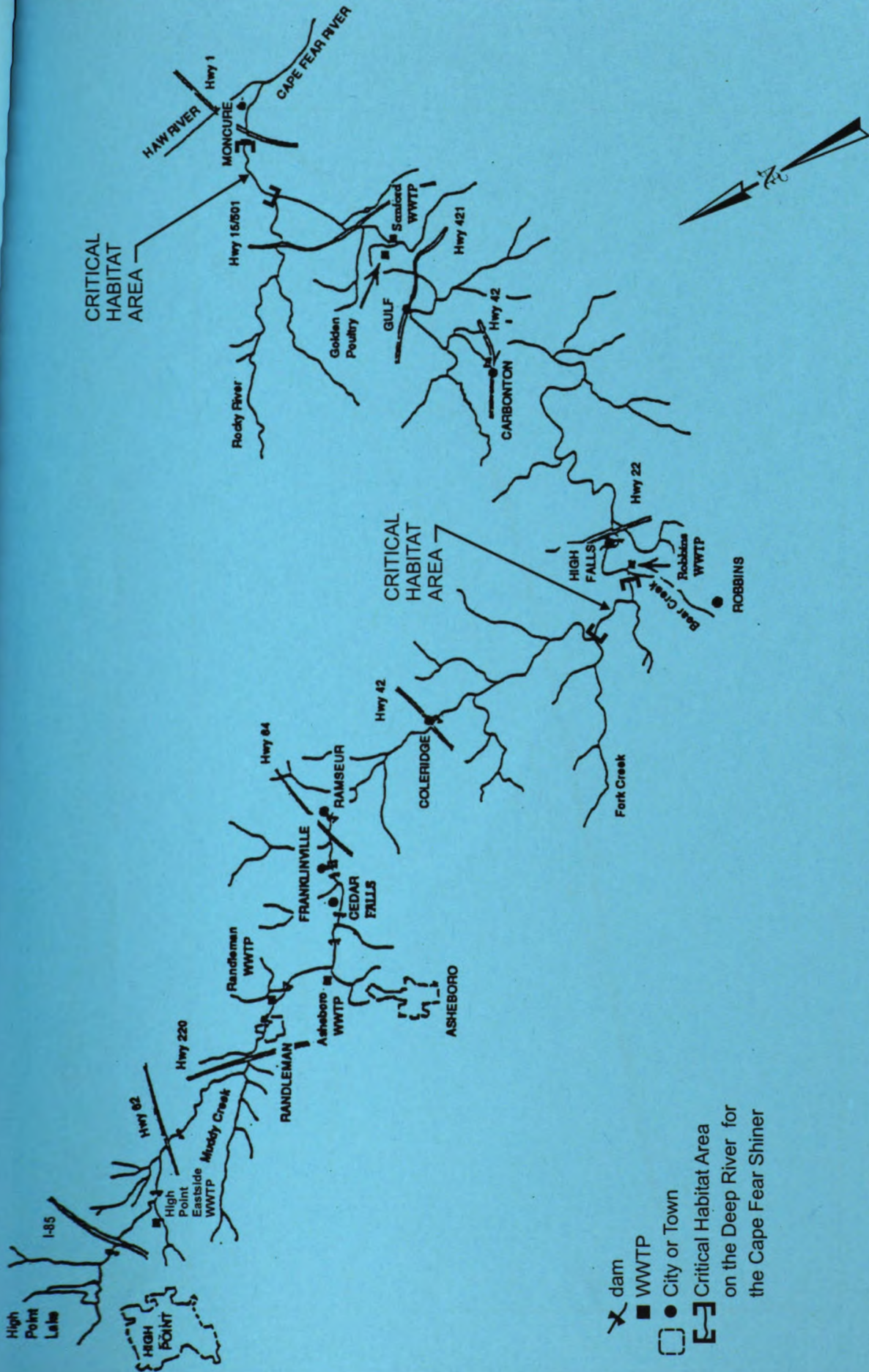
Piedmont Triad Regional Water Authority
 Randleman Lake Watershed
 Model Segmentation



SOURCE:
 GEI Consultants, Inc.
 Former Dump Area, J.L. Coble Property,
 Randleman, North Carolina, February 1996

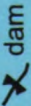



**Piedmont Triad Regional Water Authority
 Randleman Town Dump - Location Plan**

Figure 7b

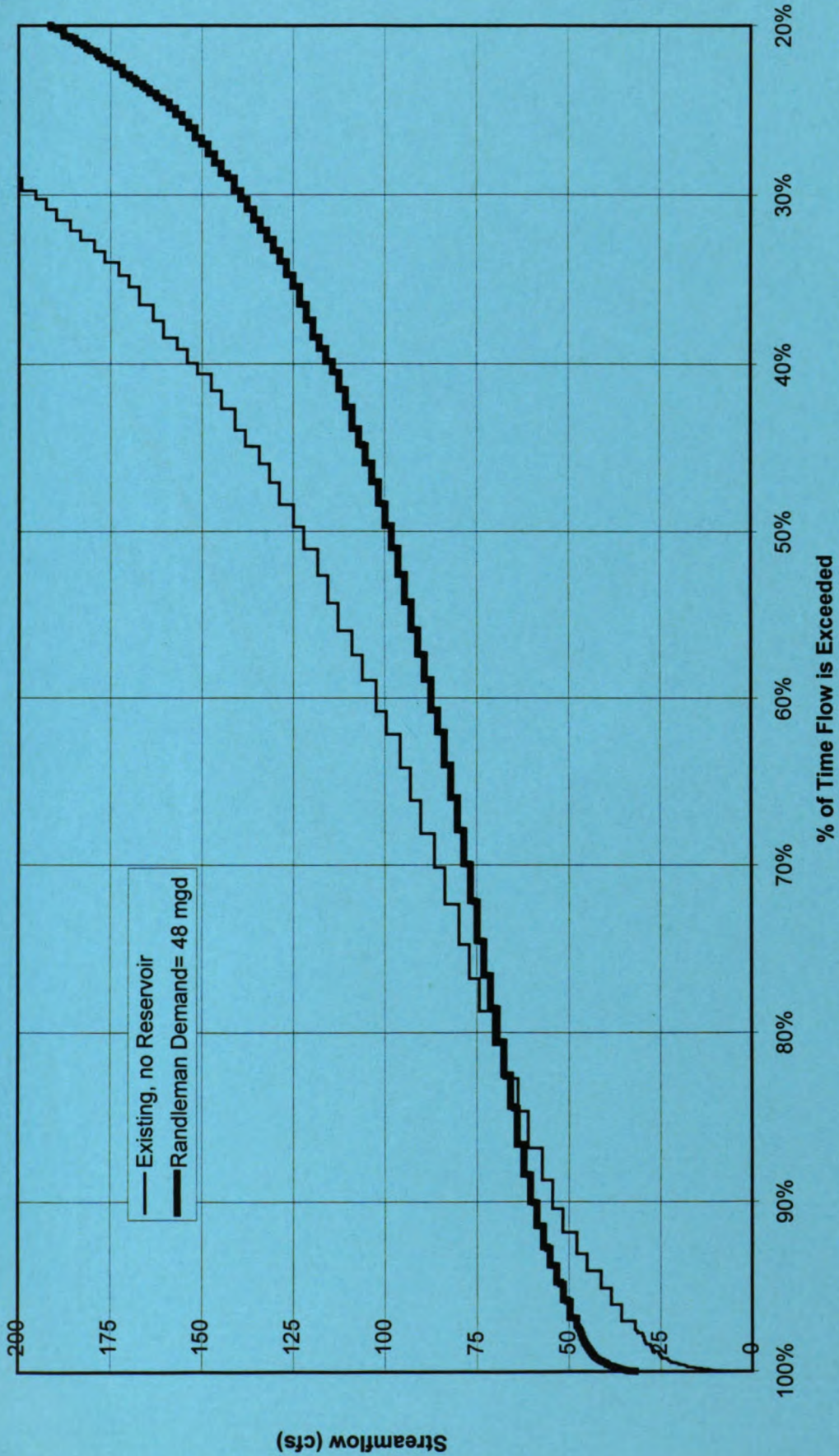


Piedmont Triad Regional Water Authority
Cape Fear Shiner Critical Habitat Areas

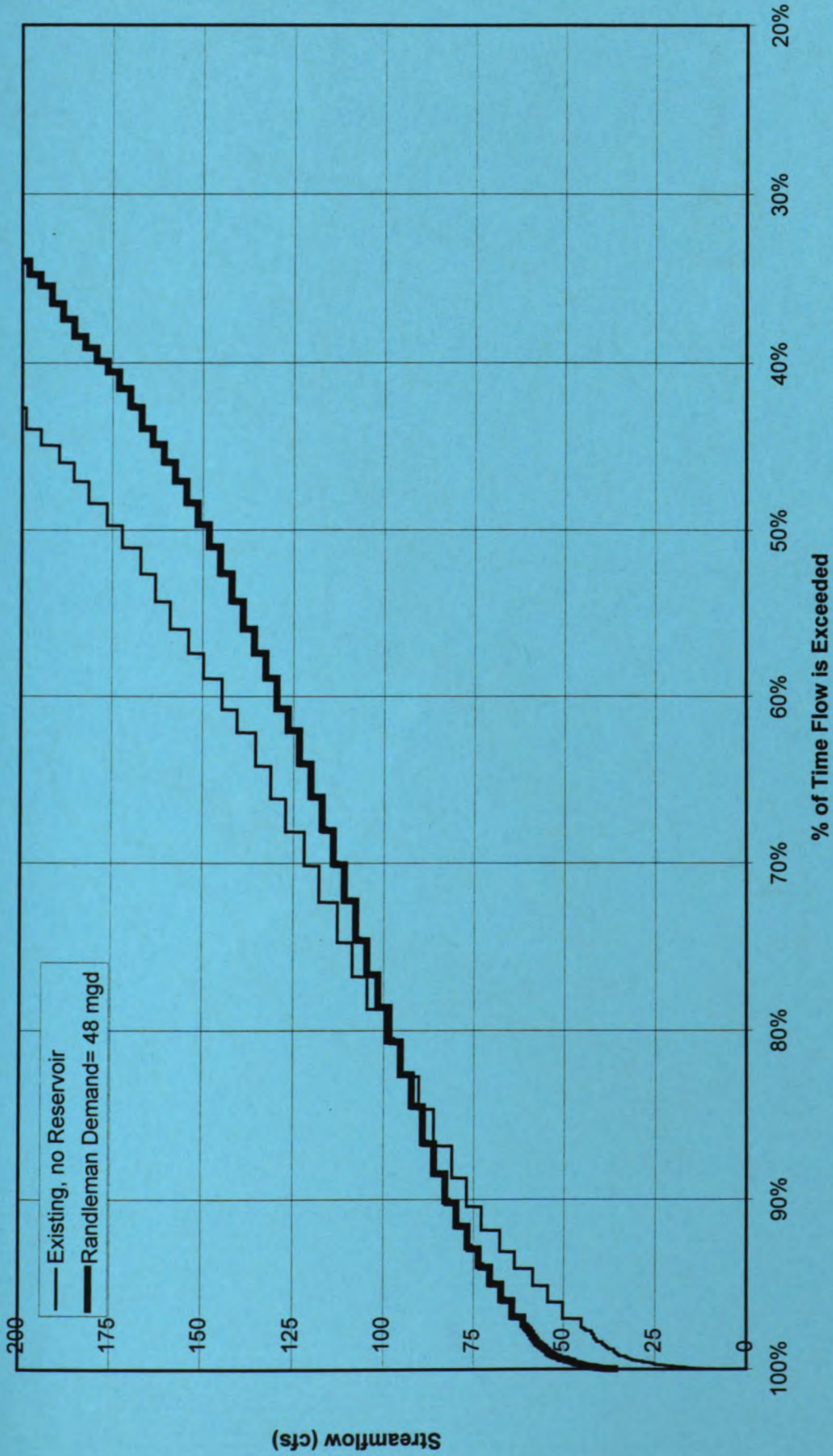
Figure 7c

 dam
 WWTP
 City or Town
 Critical Habitat Area
 on the Deep River for
 the Cape Fear Shiner

Streamflow Impacts 22 Miles Downstream From Randleman Lake
 (Based on daily streamflow data May~July)

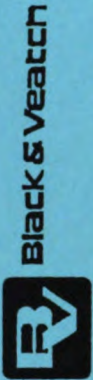
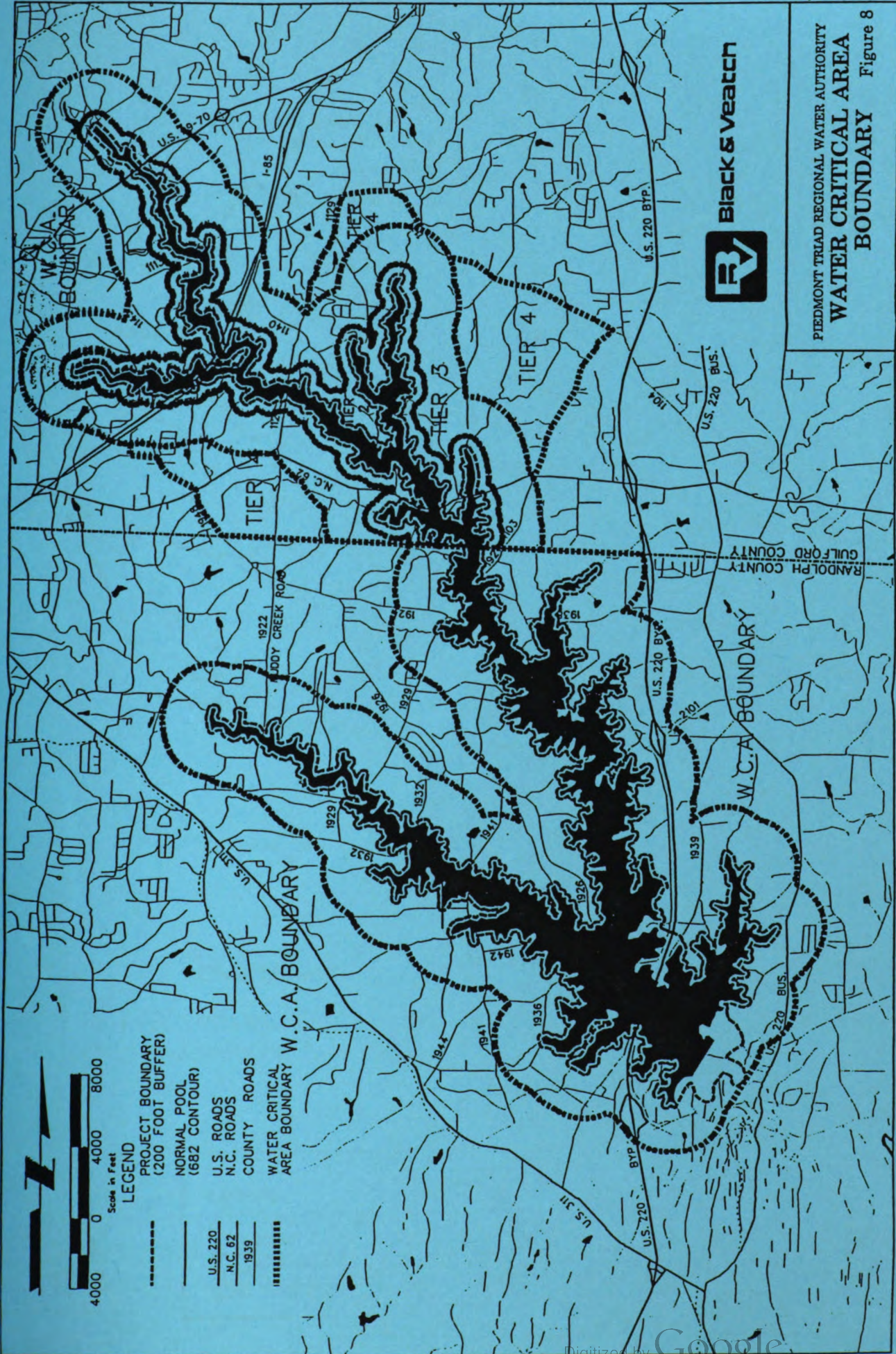


**Streamflow Impacts 33 Miles Downstream From Randleman Lake
(Based on daily streamflow data May~July)**

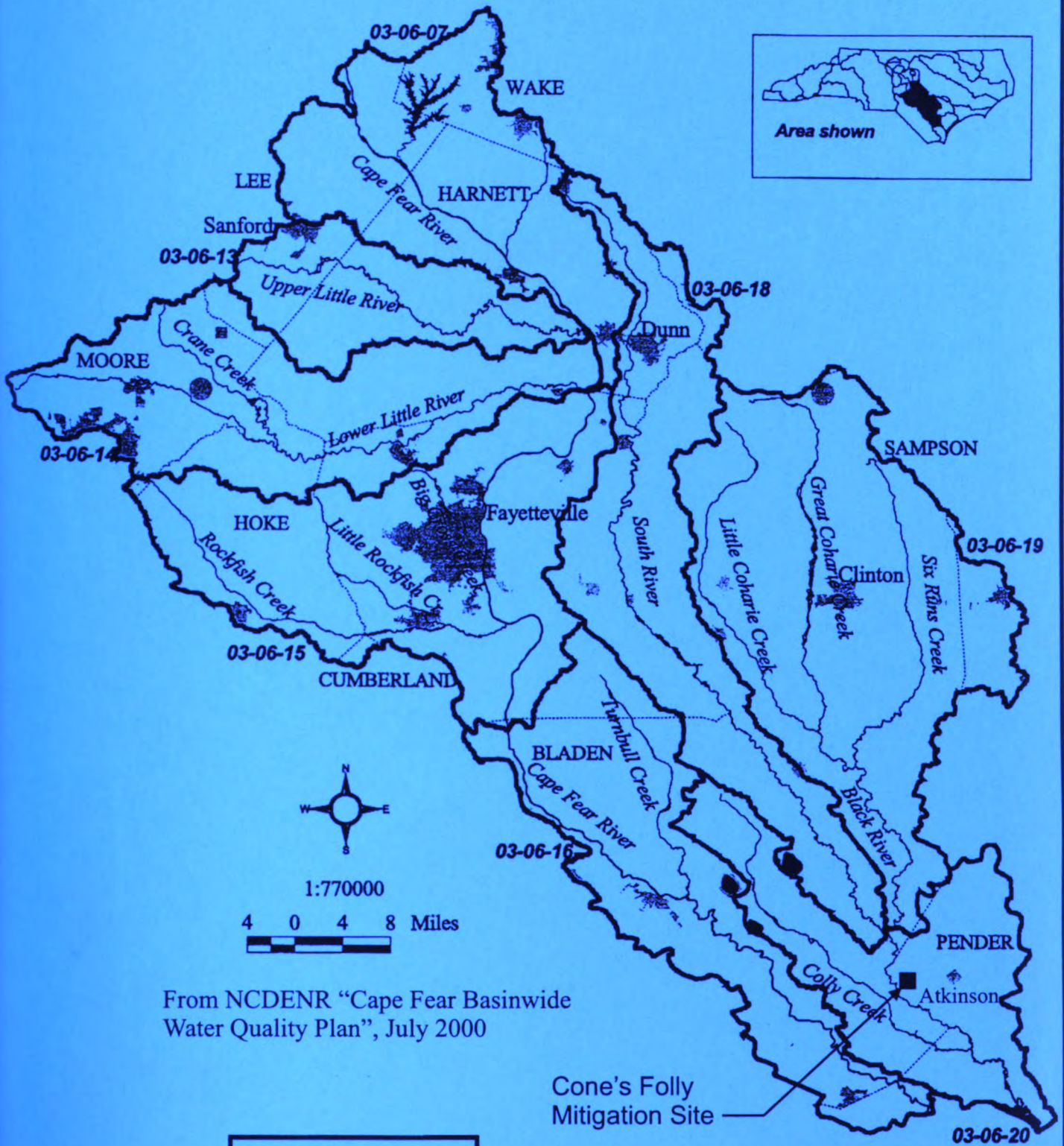


Piedmont Triad Regional Water Authority

Figure 7e



PIEDMONT TRIAD REGIONAL WATER AUTHORITY
**WATER CRITICAL AREA
 BOUNDARY** Figure 8



From NCDENR "Cape Fear Basinwide Water Quality Plan", July 2000

LEGEND

- County boundary
- River
- Subbasin boundary
- Municipality



Piedmont Triad Regional Water Authority
Location of Cone's Folly Mitigation Site

Digitized by Google

Figure 9

11.0 TABLES

**Table 1
Summary Comparison of Reservoir Project Alternatives**

Evaluation Criteria	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
PROJECT CHARACTERISTICS					
SAFE YIELD (SY₅₀) Adequacy to Meet 50-year Needs	48 mgd 100%	40 mgd 80%	48 mgd 100%	40.3 mgd 80%	48 mgd 100%
PROJECT COST, TOTAL 1996 \$	\$140 million	\$192 million	\$169 million	\$178 million	\$187 million
PROJECT SIZE Approximate Total Acreage Approximate Acres of Reservoir Pool Approximate Acres of Buffer Zone	6,000 3,000 3,000	4,880 2,440 2,440	7,280 3,640 3,640	9,960 4,960 4,960	7,660 + well fields 3,830 3,830
WATERSHED CHARACTERISTICS Size in Square Miles Level of Development Areas of Concentrated Development	171 moderately developed High Point and Jamestown	127.5 moderately developed High Point and Jamestown	136 primarily undeveloped Reidsville	124 (total) primarily undeveloped Pleasant Garden	69 Benaja + 75 well field primarily undeveloped, well field location unknown None
DIRECT PROJECT IMPACTS ON THE MAN-MADE ENVIRONMENT					
LAND USE Total Lands to be Acquired (approximate) Properties/Land Tracts to be Acquired Residences to be Acquired Other Facilities Affected	6,000 acres 237 properties 28 residences 1 business	4,880 acres 215 properties 41 residences 1 business, 1 WWTP	7,280 acres 254 properties 7 residences 1 business	9,960 acres 219 properties 29 residences 1 business	7,660 acres + well fields 59 properties + well fields 2 residences + well fields 0 business + well fields
TRANSPORTATION Roadways Impacted by Reservoir Railroads Impacted by Reservoir	15 (1 highway) 0	15 (3 highways) 0	10 (3 highways) 1	11 (0 highways) 0	5 (0 highways) 0

**Table 1 - Continued
Summary Comparison of Reservoir Project Alternatives**

Evaluation Criteria	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
DIRECT PROJECT IMPACTS ON THE NATURAL ENVIRONMENT					
WATER RESOURCES Groundwater Surface Waters Miles of Streams Inundated Acres of Lake Created* Downstream Average Flows Downstream Low Flows Interbasin Transfer	Minor fluctuations near lake 28 3,000 Permanent reduction Slight increase 30.5 mgd	Minor fluctuations near lake 20 2,440 Permanent reduction Slight increase 25.4 mgd	Minor fluctuations near lake 25 3,640 Permanent reduction Slight increase 19.5 mgd	Minor fluctuations near lake 26 4,980 Permanent reduction Slight increase 3.8 mgd	Minor fluctuations near lake; substantial near wells 14 3,830 Permanent reduction Slight increase 19.5 mgd
VEGETATION RESOURCES*	Inundation of 3,000 acres Protection of 3,000 acres in buffer zone	Inundation of 2,440 acres Protection of 2,440 acres in buffer zone	Inundation of 3,640 acres Protection of 3,640 acres in buffer zone	Inundation of 4,980 acres Protection of 4,980 acres in buffer zone	Inundation of 3,830 acres Protection of 3,830 acres in buffer zone
WETLANDS IN RESERVOIR Wetland loss - field verified Hydric soils Soils with potential hydric inclusions	121 acres 37 acres 706 acres	not evaluated in detail 7 acres 706 acres	not evaluated in detail 470 acres 725 acres	not evaluated in detail 735 845	not evaluated in detail 735 645
AQUATIC HABITAT Stream Habitat in Reservoir Area Lake Habitat*	28 miles lost 3,000 acres created	20 miles lost 2,440 acres created	25 miles lost 3,640 acres created	26 miles lost 4,980 acres created	14 miles lost 3,830 acres created
THREATENED SPECIES Federal and State listed species Other Significant Species	None 6 rare unprotected plant species	None 2 rare unprotected plant species	None None	None 1 rare unprotected plant species	None 1 rare unprotected plant species
NATURAL AND SCENIC AREAS	2 unprotected areas of general interest in Guilford County	2 unprotected areas of general interest in Guilford County	1 unprotected area of county significance in Guilford County	1 unprotected area of regional significance in Guilford County	1 unprotected area of regional significance in Guilford County

*Acres are approximate for all alternatives.

Table 2
Safe Yields of
Raw Water and Finished Water Sources

PTRWA Member	Water Source	Existing SY₂₀ (mgd)	Existing SY₅₀ (mgd)	Projected 2050 SY₅₀ (mgd)
Greensboro	Lake Brandt, Lake Townsend, Lake Higgins High Point ⁽¹⁾	39.6 ⁽¹⁾	36.0 ⁽¹⁾	35.2 ⁽⁷⁾
	Winston-Salem ⁽²⁾	2.0	2.0	-
	Reidsville ⁽³⁾	5.0	5.0	-
High Point	High Point Lake, Oak Hollow Lake	25.0 ⁽²⁾	22.7 ⁽⁷⁾	22.2 ⁽⁷⁾
Jamestown	High Point, Greensboro	X	X	X
Archdale	High Point, Davidson Water, Inc. ⁽⁴⁾	0.5	0.5	0.5
Randleman	Randleman City Lake Asheboro ⁽⁵⁾ ⁽⁶⁾	1.5 ⁽²⁾ 1.0	1.4 ⁽⁷⁾ 1.0	1.3 ⁽⁷⁾ 1.0
TOTAL Safe Yield of All Sources		74.6	68.6	60.2

⁽¹⁾ Hazen and Sawyer, 1988.

⁽²⁾ NCDEHNR, 1992.

⁽³⁾ Frezell, 1993.

⁽⁴⁾ Ogburn, 1991. Includes amount from Davidson Water, Inc. only.

⁽⁵⁾ Hardin, 1991.

⁽⁶⁾ Contract maximum withdrawal is 7.0 MG per week.

⁽⁷⁾ Estimated.

⁽⁸⁾ Williams, 1999.

Table 3
Annual Average Daily Water Use
of PTRWA Members, 1981 - 1990

Water Sources	Annual Average Daily Water Use (mgd)									
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Greensboro Lake Townsend WTP ⁽¹⁾	13.9	11.8	12.4	12.3	12.7	13.2	13.7	13.9	14.1	17.3
N.L. Mitchell WTP ⁽¹⁾	10.4	13.3	13.4	14.3	15.4	15.5	15.6	16.0	15.1	16.4
High Point Kearns WTP ⁽¹⁾	11.4	5.9	1.18	1.05	1.08	1.22	1.00	1.09	0.93	1.15
Frank L. Ward WTP ⁽¹⁾	--	10.6	10.95	11.91	12.38	12.53	13.16	11.06	10.75	10.75
Jamestown Oakdale Cotton Mill ⁽²⁾	0.36	0.35	0.36	0.37	0.38	0.36	0.33	0.34	0.29	0.24
Archdale Davidson Water, Inc. ⁽³⁾⁽⁴⁾	0.30	0.31	0.38	0.46	0.66	0.46	0.49	0.28	0.32	0.30
Randleman Randleman WTP ⁽¹⁾	0.581	0.642	0.766	0.876	1.066	1.093	1.043	1.053	1.109	1.100
Asheboro ⁽⁵⁾	--	--	--	--	--	0.013	0.03	0.024	0.015	0.027
TOTAL ANNUAL AVERAGE	36.94	41.90	39.44	41.27	43.67	44.38	45.35	43.75	42.61	47.27

⁽¹⁾ NCDEHNR, 1981-1990.

⁽²⁾ Frezell, August 1991.

⁽³⁾ Ogburn, August 1991.

⁽⁴⁾ Water received from High Point included in High Point quantities.

⁽⁵⁾ Hardin, 1991.

Table 3a
Annual Average Daily Water Use
of PTRWA Members, 1991 - 1997

Water Sources	Annual Average Daily Water Use (mgd)						
	1991	1992	1993	1994	1995	1996	1997
Greensboro							
Lake Townsend WTP ⁽¹⁾	16.90	15.64	15.43	15.82	18.26	21.44	20.70
N.L. Mitchell WTP ⁰⁽¹⁾	14.80	15.38	15.95	17.28	16.20	12.67	13.20
High Point							
Kearns WTP ⁽²⁾	NA	NA	NA	NA	NA	NA	NA
Frank L. Ward WTP ⁽²⁾	10.61	10.89	10.92	12.30	12.21	12.73	12.80
Jamestown							
Oakdale Cotton Mill ⁽³⁾	0.20	0.15	NA	NA	NA	NA	NA
Archdale							
Davidson Water, Inc. ⁽⁴⁾	-	-	-	0.20	0.18	0.22	0.14*
Randleman							
Randleman WTP ⁽⁵⁾	1.031	0.954	0.958	1.054	0.995	1.097	1.150
Asheboro ⁽⁵⁾	0.021	0.025	0.035	0.049	0.040	0.046	0.076
TOTAL ANNUAL AVERAGE	43.56	43.04	43.29	48.70	47.89	48.20	48.07

(1) Williams, January 1998.

(2) Kairis, January 1998.

(3) Frezeil, January 1998; water received from Greensboro and High Point included in Greensboro and High Point quantities, respectively.

(4) Ogburn, January 1998; water received from High Point included in High Point quantities.

(5) Hardin, January 1998.

NA Not Applicable

* Number is low due to malfunction of meter.

**Table 4
Documented Population and Projections**

PTRWA Member	1970⁽¹⁾	1980⁽¹⁾	1990⁽¹⁾	2000⁽²⁾	2010⁽²⁾	2020⁽²⁾
GUILFORD COUNTY	288,645	317,154	347,420	384,289	402,460	419,022
Greensboro	144,245	155,684	183,521	--	--	--
High Point	63,105	63,355	69,496	--	--	--
Jamestown	1,297	2,148	2,600	--	--	--
RANDOLPH COUNTY	76,358	91,300	106,546	121,652	134,939	148,064
Archdale	5,937	5,747	6,913	--	--	--
Randleman	2,312	2,156	2,612	--	--	--
TOTAL POPULATION	365,003	408,454	453,966	505,941	537,399	567,086

⁽¹⁾ Population data from N.C. State Demographer, 1991.

⁽²⁾ Population projections from N.C. Office of State Planning, 1995.

**Table 5
Representative Per Capita Water Consumption in
North Carolina
Total Water Production Divided by Population Served**

Metro Area	(GPCD)
Asheville	363
Burlington	257
Charlotte	172
Durham	160
Greensboro	152
High Point	147
Raleigh	160
Winston-Salem	250

Source: Bruvold and Mitchell, 1993.

PTRWA Member	Projected 2050 SY₅₀¹	Projected Demand 2000²	Projected Demand 2010²	Projected Demand 2020²
Greensboro	35.2	37.6	44.2	51.9
High Point	22.2	13.8	17.0	21.0
Jamestown	0.0	0.5	0.7	0.9
Archdale	0.5	0.9	1.4	1.9
Randleman	2.3	1.1	1.3	1.5
Randolph County	0.0	0.0	2.0	7.8
TOTAL	60.2	53.9	66.6	85.0

⁽¹⁾ Data from Table 2.

⁽²⁾ Data from NCDEHNR, 1996b.

PTRWA Member	Percent	Allocation (mgd)
Greensboro	59.4	28.51
High Point	21.0	10.08
Jamestown	2.5	1.20
Archdale	2.5	1.20
Randleman	2.1	1.01
Randolph County⁽¹⁾	12.5	6.00
TOTAL	100.0	48.00

⁽¹⁾ Additional Randolph County water demands would be addressed by other Randolph County finished water purveyors.

Table 7a
Summary of Water Supply Alternatives from 1985 CH2M Hill Study

Alternative	Description	50-year Safe Yield (mgd)	Recommended Alternative	Reason for Eliminating from Consideration
1.1, 1.2*	Randleman Lake, Multipurpose (USACE)	48	Yes	—
2.1, 2.2*	Randleman Lake, Water Supply Only	48	No	More expensive than non-Federal water supply portion of cost for Alternative 1.1, 1.2.
3.1, 3.2*	Upper Deep River Lakes	46	No	More expensive than recommended alternatives.
4	Upper Deep River Lakes - Lower Pool Only	40	Yes	—
5.1, 5.2*	Altamahaw Lake	48	Yes	—
6.1, 6.2*	Benaja Lake	26	No	Inadequate safe yield. Would not meet long-term water demand.
7	Upper Haw River Lake	11.6	No	Inadequate safe yield. Would not meet long-term water demand.
8.1, 8.2*	Polecat Creek Lake	14.3	No	Inadequate safe yield. Would not meet long-term water demand.
9	Benaja Lake and Polecat Creek Lake	40.3	Yes	—
10	Benaja Lake, Polecat Creek Lake and Upper Deep River Lake - Lower Pool Only	80.3	No	More expensive than recommended alternatives. Would require construction of three separate reservoirs.
11	Purchase from Winston-Salem	NA	No	Inadequate safe yield. Would not meet long-term water demand.
12.1, 12.2*	Purchase from Jordan Lake	25	No	Inadequate safe yield. Long transmission pipeline would make it vulnerable to water supply interruptions. High pumping head would make it more sensitive to escalation in energy prices and inflation.
13	Purchase from Lake Reese	1.2	No	Inadequate safe yield. Would not meet long-term water demand.
14	Purchase from Lake Mackintosh	13.6	No	Inadequate safe yield. Would not meet long-term water demand.
15	Purchase from Reidsville Reservoir	13.3	No	Inadequate safe yield. Would not meet long-term water demand.
16	High Point to Greensboro Temporary Exchange	NA	No	Short-term solution only.
17	High Point - High Rock Reservoir Exchange	NA	No	Inadequate safe yield. Other economic considerations.
18	Yadkin River to Reedy Fork Creek	11	No	Inadequate safe yield. Would not meet long-term water demand.
19	Yadkin River to Upper Deep River	5	No	Inadequate safe yield. Would not meet long-term water demand.

Table 7a (continued)
Summary of Water Supply Alternatives from 1985 CH2M Hill Study

Alternative	Description	50-year Safe Yield (mgd)	Recommended Alternative	Reason for Eliminating from Consideration
20	Dan River to Reedy Fork Creek	11	No	Inadequate safe yield. Would not meet long-term water demand.
21	Dan River to Reedy Fork Creek via Belews Lake	11	No	Inadequate safe yield. Would not meet long-term water demand.
22	Mayo River to Reedy Fork Creek	11	No	Inadequate safe yield. Would not meet long-term water demand.
23	Yadkin River to Cape Fear River Basin	18.8	No	Inadequate safe yield. Long transmission pipeline would increase energy/inflation sensitivity and vulnerability to interruptions from line breakage.
24	Haw River Diversion	11	No	Inadequate safe yield. Would not meet long-term water demand.
25	Deep River Diversion	5	No	Inadequate safe yield. Would not meet long-term water demand.
26	Groundwater	NA	No	Limited viability as an interim or supplemental supply only. Not viable as a long-term supply.
27	High Point / Greensboro Effluent Recycle (Treat to drinking water standards)	NA	No	Inadequate safe yield. Would not meet long-term water demand.
28	Treated Wastewater for Irrigation Reuse	NA	No	Inadequate safe yield. Would not meet long-term water demand.
29	Treated Wastewater for Industrial Water Supply	NA	No	Minimal potential reduction in potable water use; cannot eliminate the need for further water supply sources.
30	Structural Conservation (Modified shower heads and toilets)	NA	No	Can reduce the rate of water consumption. Not considered as complete alternative; cannot eliminate the need for additional water supply sources.
31	Economic Conservation (Water rate adjustments)	NA	No	Can reduce the rate of water consumption. Not considered as complete alternative; cannot eliminate the need for additional water supply sources.
32	Ordinances Conservation (Prohibit certain uses during drought)	NA	No	Can reduce the rate of water consumption. Not considered as complete alternative; cannot eliminate the need for additional water supply sources.
33	Risk Management (Interconnect systems to reduce risk)	NA	No	May increase annual yield available while increasing risk. Not considered as complete alternative; cannot eliminate the need for further water supply sources.

* Alternatives with two numbers include two treatment options, delivery of raw water to the demand centers for local treatment and distribution (e.g., 1.1) and central (regional) water treatment owned and operated by all the study participants (e.g., 1.2). In each case, local treatment was estimated to be more expensive. Recommended alternatives, therefore, are represented by the central treatment alternative.

NA Not a significant source of supply for meeting long-term water demands.

NOTE: Long-term water supply was evaluated in the CH2M Hill Study based upon (1) projected water demands to year 2020 and (2) ultimate water supply capability.

Table 8
Summary of Pertinent Data
Randleman Lake

PROJECT LOCATION			
Miles above mouth of Cape Fear River			288
Miles above mouth of Deep River			91
Miles above Moncure, NC			88
Miles above Ramseur, NC			15
Miles above Randleman, NC			2
DRAINAGE AREA⁽¹⁾ (square miles)			
Above Randleman damsite			171
Above mouth of Deep River			1,422
Above mouth of Cape Fear River			8,570
ESTIMATED NATURAL STREAMFLOW AT DAM SITE (cubic feet per second)			
Average annual discharge			163
Minimum monthly discharge			8
Maximum instantaneous discharge (1947 flood)			27,000
Bankfull capacity below Randleman damsite			4,000
Probable Maximum Flood ⁽²⁾			294,000
SEDIMENT DATA			
Erosion rate (acre-feet per square mile per year)			3.86
Sediment trapped (%)			11.9
Sediment loading (acre-feet per square mile per year)			0.461
Approximate number of years of sediment storage			100
Reservoir Physical Characteristics	Elev. (feet m.s.l.)	Surface Area (acres)	Volume (acre-feet)
Maximum Pool (probable maximum flood) ⁽²⁾	705.3	6,200	160,000
100-year Flood	688.2	--	--
Top of Conservation Pool	682.0	3,200	62,000
Top of Sediment Pool	647.0	600	8,000

**Table 8 – Continued
Summary of Pertinent Data
Randleman Lake**

PROJECT FEATURE	
Dam	
Type	Roller-Compacted Concrete (RCC)
Top Elevation (feet m.s.l.)	706
Maximum Height above Streambed (feet)	102
Streambed Elevation (feet m.s.l.)	604
Length (feet)	
RCC Section	1,000
North Abutment (soil)	615
South Abutment (soil)	<u>475</u>
TOTAL	2,090
Spillway	
Type	Ogee
Crest Elevation (feet m.s.l.)	682
Length (feet)	500
STORAGE (acre-feet)	
Water Supply	54,000
Sediment	<u>8,000</u>
TOTAL	62,000
SAFE YIELD / INSTREAM FLOW	
Minimum 50-Year Safe Yield (SY-50) (mgd)	48
Instream Flow Requirement (mgd)⁽³⁾	19.4

(1) Data from USACE, 1980b.

(2) The probable maximum flood (PMF) is the upper limit of flooding produced by the greatest amount of precipitation for a given duration that is physically possible, as determined by the National Weather Service. The PMF is significantly higher than the 100-year flood.

(3) Minimum instream flow required will be based on a three-tiered release beginning at 19.4 mgd (30 cfs).

**Table 9
Summary Descriptions of Project Alternatives**

Evaluation Criteria	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
PROJECT CHARACTERISTICS					
PROJECT SIZE Approximate Total Acreage	6,000	4,880	7,280	9,980	7,660 + well fields
Approximate Acres of Reservoir Pool	3,000	2,440	3,640	4,980	3,830
Approximate Acres of Buffer Zone	3,000	2,440	3,640	4,980	3,830
SAFE YIELD (SY₉₅)	48 mgd	40 mgd	48 mgd	40.3 mgd	48 mgd
Adequacy to Meet 50-year Needs	100%	80%	100%	80%	100%
PROJECT COST, TOTAL 1996 \$	\$140 million	\$182 million	\$169 million	\$178 million	\$187 million

FACTORS AFFECTING SUITABILITY AS A WATER SUPPLY

WATERSHED Size in Square Miles	171	127.5	136	124 (total)	69 Benaja + 75 well field
Level of Development	moderately developed	moderately developed	primarily undeveloped	primarily undeveloped	primarily undeveloped, well field location unknown
Areas of Concentrated Development	High Point and Jamestown	High Point and Jamestown	Reidsville	Pleasant Garden	None
NC STREAM CLASSIFICATIONS	WS IV, CWSW	WS IV, CWSW	WS-III NSW, Class C NSW	Benaja, C-NSW, Polecat, WS-III	Benaja, C-NSW
STREAM USE SUPPORT RATINGS Overall Rating	support-threatened	partially-supported	supported, partially-supported	support-threatened, supported	support-threatened
Chemical Rating	partially-supported	partially-supported	partially-supported	supported	supported
Biological Rating	good-fair	fair	good, good-fair	good-fair, good	good-fair

**Table 10
Summary of Direct Environmental Impacts of Project Alternatives**

EVALUATION CRITERIA	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
MAN-MADE ENVIRONMENT					
POPULATION Effects during Project Construction Effects over Longer Term	Temporary increase Higher growth potential	Temporary increase Higher growth potential	Temporary increase Higher growth potential	Temporary increase Higher growth potential	Temporary increase Higher growth potential
LAND USE Approximate Total Lands to be Acquired Features to be Impacted Properties/Land Tracts Residences Other	6,000 acres 237 properties 28 residences 1 business	4,880 acres 215 properties 41 residences 1 business, 1 WWTP	7,280 acres 254 properties 7 residences 1 business	9,980 acres 219 properties 29 residences 1 business	7,660 acres + well fields 59 properties 2 residences + well fields 0 business + well fields
ECONOMICS Cost of Project (Total in 1996 \$) Effects during Project Construction Effects over Longer Term Effects on Tax Revenues	\$140 million Additional short-term jobs Increased potential for economic growth Loss from land removal from tax rolls	\$192 million Additional short-term jobs Increased potential for economic growth Loss from land removal from tax rolls	\$169 million Additional short-term jobs Increased potential for economic growth Loss from land removal from tax rolls	\$178 million Additional short-term jobs Increased potential for economic growth Loss from land removal from tax rolls	\$187 million Additional short-term jobs Increased potential for economic growth Loss from land removal from tax rolls
MUNICIPAL & COUNTY SERVICES Water Service Wastewater Service	Adequate, reliable water supply available Expanding service areas will reach more customers	Adequate, reliable water supply available Expanding service areas will reach more customers	Adequate, reliable water supply available Expanding service areas will reach more customers	Adequate, reliable water supply available Expanding service areas will reach more customers	Adequate, reliable water supply available Expanding service areas will reach more customers
TRANSPORTATION & UTILITIES Roadways Impacted by Reservoir Number of Miles of Roadways Impacted by Reservoir Railroads Impacted by Reservoir Number of Miles of Railroads Impacted by Reservoir Impacts on Utilities	15 (1 highway) 6.3 0 0 Temporary disruptions for relocations	15 (3 highways) 4.2 0 0 Temporary disruptions for relocations	10 (3 highways) 2.5 1 1.1 Temporary disruptions for relocations	11 (0 highways) 3.3 0 0 Temporary disruptions for relocations	5 (0 highways) 1.3 0 0 Temporary disruptions for relocations

Table 10 – Continued
Summary of Direct Environmental Impacts of Project Alternatives

EVALUATION CRITERIA	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
ENERGY Impacts during Construction Impacts while Filling Reservoir Impacts over Longer Term	Consumption of electricity and diesel fuel Major flow reductions at downstream hydroelectric plants Moderate to minor flow reductions at downstream hydroelectric plants	Consumption of electricity and diesel fuel Major flow reductions at downstream hydroelectric plants Moderate to minor flow reductions at downstream hydroelectric plants	Consumption of electricity and diesel fuel Major flow reductions at downstream hydroelectric plants Moderate to minor flow reductions at downstream hydroelectric plants	Consumption of electricity and diesel fuel Major flow reductions at downstream hydroelectric plants Moderate to minor flow reductions at downstream hydroelectric plants	Consumption of electricity and diesel fuel Major flow reductions at downstream hydroelectric plants Moderate to minor flow reductions at downstream hydroelectric plants
SOCIAL EFFECTS Family & Community Interactions Personal Hardships	Changes due to physical barriers and road closures Relocations and longer driving distances for some residents	Changes due to physical barriers and road closures Relocations and longer driving distances for some residents	Changes due to physical barriers and road closures Relocations and longer driving distances for some residents	Changes due to physical barriers and road closures Relocations and longer driving distances for some residents	Changes due to physical barriers and road closures Relocations and longer driving distances for some residents
CULTURAL RESOURCES National Register Sites Archaeologic Sites	1 historic, 3 prehistoric High potential	1 historic High potential	0 High potential	0 High potential	0 High potential
NATURAL ENVIRONMENT					
CLIMATE	No significant effects	No significant effects	No significant effects	No significant effects	No significant effects
TOPOGRAPHY Addition of New Features Approximate Addition of New Water Surface Changes to Existing Features	Placement of fill for dam New 3,000-acre lake surface Roadway modifications	Placement of fill for dam New 2,440-acre lake surface Roadway modifications	Placement of fill for dam New 3,640-acre lake surface Roadway modifications	Placement of fill for dam New 4,980-acre lake surface Roadway modifications	Placement of fill for dam New 3,830-acre lake surface Roadway modifications
GEOLOGY Seismic Activity Valuable Mineral Resources	No significant effects No significant effects	No significant effects No significant effects	No significant effects No significant effects	No significant effects No significant effects	No significant effects No significant effects

Table 10 – Continued
Summary of Direct Environmental Impacts of Project Alternatives

EVALUATION CRITERIA	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
SOILS Effects during Project Construction Longer Term effects (approximate acres) Effects on Prime Farmland (approximate acres)	Temporary erosion and sedimentation Inundation of 3,000 acres Inundation of 337 acres	Temporary erosion and sedimentation Inundation of 2,440 acres Inundation of unknown acreage	Temporary erosion and sedimentation Inundation of 3,640 acres Inundation of unknown acreage	Temporary erosion and sedimentation Inundation of 4,980 acres Inundation of unknown acreage	Temporary erosion and sedimentation Inundation of 3,830 acres Inundation of unknown acreage
WATER RESOURCES Groundwater Surface Waters Miles of Streams Inundated Approximate Acres of Lake Created Impacts on Downstream Flows Average Flows Low Flows Interbasin Transfer	Minor fluctuations near lake 28 3,000 Permanent reduction Slight increase 30.5 mgd	Minor fluctuations near lake 20 2,440 Permanent reduction Slight increase 25.4 mgd	Minor fluctuations near lake 25 3,640 Permanent reduction Slight increase 19.5 mgd	Minor fluctuations near lake 26 4,980 Permanent reduction Slight increase 3.8 mgd	Minor fluctuations near lake; substantial for wells 14 3,830 Permanent reduction Slight increase 19.5 mgd
AIR QUALITY	Temporary decreases during construction	Temporary decreases during construction	Temporary decreases during construction	Temporary decreases during construction	Temporary decreases during construction
NOISE	Temporary increases during construction	Temporary increases during construction	Temporary increases during construction	Temporary increases during construction	Temporary increases during construction
VEGETATION RESOURCES Approximate area inundated Approximate area protected in buffer zone	3,000 acres 3,000 acres	2,440 acres 2,440 acres	3,640 acres 3,640 acres	4,980 acres 4,980 acres	3,830 acres 3,830 acres

Table 10 - Continued
Summary of Direct Environmental Impacts of Project Alternatives

EVALUATION CRITERIA	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Polecat Creek Lake	Combination - Benaja Lake + Groundwater
WETLANDS Wetland loss - field verified Hydric soils in reservoir Soils with potential hydric inclusions in reservoir Other Impacts	121 acres 37 acres 706 acres Short-term effects on downstream wetlands from construction activity, including increased sediment and altered streamflows	Not evaluated* 7 acres 706 acres Short-term effects on downstream wetlands from construction activity, including increased sediment and altered streamflows	Not evaluated* 470 acres 725 acres Short-term effects on downstream wetlands from construction activity, including increased sediment and altered streamflows	Not evaluated* 735 645 Short-term effects on downstream wetlands from construction activity, including increased sediment and altered streamflows	Not evaluated* 735 645 Short-term effects on downstream wetlands from construction activity, including increased sediment and altered streamflows
TERRESTRIAL WILDLIFE RESOURCES Terrestrial Habitat Terrestrial Species	Permanent loss of terrestrial habitat in reservoir area; Protection of habitat in buffer zone Direct mortality of small, slow-moving animals of reservoir area; displacement of other animals from reservoir area; overcrowding stress in peripheral areas; decline in reptile, and bird species of alluvial forest; increase in waterfowl	Permanent loss of terrestrial habitat in reservoir area; Protection of habitat in buffer zone Direct mortality of small, slow-moving animals of reservoir area; displacement of other animals from reservoir area; overcrowding stress in peripheral areas; decline in amphibian, reptile, and bird species of alluvial forest; increase in waterfowl	Permanent loss of terrestrial habitat in reservoir area; Protection of habitat in buffer zone Direct mortality of small, slow-moving animals of reservoir area; displacement of other animals from reservoir area; overcrowding stress in peripheral areas; decline in amphibian, reptile, and bird species of alluvial forest; increase in waterfowl	Permanent loss of terrestrial habitat in reservoir area; Protection of habitat in buffer zone Direct mortality of small, slow-moving animals of reservoir area; displacement of other animals from reservoir area; overcrowding stress in peripheral areas; decline in amphibian, reptile, and bird species of alluvial forest; increase in waterfowl	Permanent loss of terrestrial habitat in reservoir area; Protection of habitat in buffer zone Direct mortality of small, slow-moving animals of reservoir area; displacement of other animals from reservoir area; overcrowding stress in peripheral areas; decline in amphibian, reptile, and bird species of alluvial forest; increase in waterfowl
AQUATIC WILDLIFE RESOURCES Stream Habitat in Reservoir Area Stream Species Approximate Lake Habitat Lake Species Shoreline Species Downstream Habitat Conditions	28 miles lost Decline in stream species 3,000 acres created Good lake fishery created More amphibians and reptiles Minor adverse impacts during construction; improved low flows after project completion	20 miles lost Decline in stream species 2,440 acres created Good lake fishery created More amphibians and reptiles Minor adverse impacts during construction; improved low flows after project completion	25 miles lost Decline in stream species 3,640 acres created Good lake fishery created More amphibians and reptiles Minor adverse impacts during construction; improved low flows after project completion	26 miles lost Decline in stream species 4,980 acres created Good lake fishery created More amphibians and reptiles Minor adverse impacts during construction; improved low flows after project completion	14 miles lost Decline in stream species 3,830 acres created Good lake fishery created More amphibians and reptiles Minor adverse impacts during construction; improved low flows after project completion

Table 10 – Continued
Summary of Direct Environmental Impacts of Project Alternatives

EVALUATION CRITERIA	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja Lake and Potocat Creek Lake	Combination - Benaja Lake + Groundwater
ENDANGERED (E) & THREATENED (T) SPECIES Federally-listed E&T species State-listed E&T species Other	None None None 6 rare unprotected plant species	None None None 2 rare unprotected plant species	None None None None	None None None None 1 rare unprotected plant species	None None None None 1 rare unprotected plant species
NATURAL AND SCENIC AREAS State-Protected Areas Areas of General/Regional Interest	None 2 unprotected areas; general interest in Guilford County	None 2 unprotected areas; general interest in Guilford County	None 1 unprotected area; county significance in Guilford County	None 1 unprotected area; Piedmont regional significance in Guilford County	None 1 unprotected area; Piedmont regional significance in Guilford County
OUTDOOR RECREATION	Boating access could be provided; fish stocking is anticipated	Boating access could be provided; fish stocking is anticipated	Boating access could be provided; fish stocking is anticipated	Boating access could be provided; fish stocking is anticipated	Boating access could be provided; fish stocking is anticipated
AESTHETICS	Loss of stream environment; creation of new scenic vistas associated with lake	Loss of stream environment; creation of new scenic vistas associated with lake	Loss of stream environment; creation of new scenic vistas associated with lake	Loss of stream environment; creation of new scenic vistas associated with lake	Loss of stream environment; creation of new scenic vistas associated with lake

Not evaluated* = Detailed, site-specific wetland delineation was not conducted for this alternative.

**Table 11
Interbasin Water Transfer for Project Alternatives**

		Amounts (mgd) of Interbasin Transfer by Destination			
Project Alternative	River Basin of Project	Deep River Basin	Haw River Basin	Yadkin River Basin	Total Transfer
Randleman Lake	Deep River	-	28.5	2.0	30.5
Upper Deep River Lake	Deep River	-	23.7	1.7	25.4
Altamahaw Lake	Haw River	17.5	-	2.0	19.5
Benaja/Polecat Creek Lakes	Haw/Deep Rivers	2.1	-	1.7	3.8
Combination - Benaja Lake + Wells	Haw River	17.5	-	2.0	19.5

**Table 12
Reservoir Development Cost for Randleman Lake**

Item	Description	Unit Cost	Units	Subtotal
Land	Acres	\$2,000	6,000	\$12,000,000
Clearing	Acres	\$933	3,000	\$2,800,000
Road Modifications	All	Lump Sum	—	\$17,000,000 ⁽¹⁾
RCC Dam	One	Lump Sum	—	\$16,650,000 ⁽²⁾
Environmental	EIS, Permit, etc.		X	\$3,000,000
Wetlands Mitigation	Acres	\$4,440 ⁽³⁾	729	\$3,240,000
Subtotal				\$55,290,000
Contingencies & Engineering @ 20%				\$11,060,000
TOTAL PROJECT COST ESTIMATE				\$66,350,000

Notes:

- (1) From Table 12a.
- (2) From Table 12b.
- (3) Average cost per acre for Cone's Folly site and wetlands restoration sites.

Table 12a
Estimated Costs for Randleman Lake Road Modifications and Abandonments

Route	Location	Treatment	Estimated Cost
NC 62	0.4 mile west of junction with SR 1137	replace structure and raise roadway	\$1,570,000
SR 1132	1.2 miles west of junction with SR 1137	replace structure and raise roadway	1,140,000
SR 1129	0.7 mile north of junction with NC 62	replace structure and raise roadway	1,645,000
SR 1138	0.1 mile south of junction with NC 62	remove structure and abandon site	50,000
SR 1140	1.0 mile west of junction with SR 1137	replace structure at new location	1,091,000
NC 62	0.15 mile east of junction with SR 1137	replace structure and raise roadway	791,000
SR 1928	0.17 mile east of junction with SR 1927	replace structure and raise roadway	1,097,000
SR 1936	0.1 mile east of junction with SR 1926	remove structure and abandon site	119,000
SR 1944	0.15 mile south of junction with SR 1931	replace structure and raise roadway	823,000
SR 1944	0.22 mile north of junction with SR 1931	replace structure and raise roadway	1,300,000
SR 1936	0.2 mile west of junction with SR 1926	remove structure and abandon site	65,000
SR 1921	0.1 mile southwest of junction with SR 1935	replace structure at new location	2,640,000
SR 1938	0.38 mile east of junction with SR 1936	raise roadway	742,000
SR 1936	0.6 mile south of junction with SR 1938	replace structure and raise roadway	2,466,000
SR 1961	0.64 mile south of junction with SR 1965	remove structure and abandon site	521,000
SR 1929	1.85 mile south of junction with SR 1926	remove structure and abandon site	28,000
SR 1927	0.15 mile north of junction with SR 1928	replace structure and raise roadway	537,000
SR 1932	200 feet south of junction with SR 1928	remove structure and abandon site	478,000
SR 1989	0.4 mile north of junction with SR 1958	add pipe and raise roadway	381,000
SR 1965	0.85 mile west of junction with US 220 Business	add pipe and raise roadway	91,000
SR 1936	0.8 mile north of junction with SR 1987	abandon site	20,000
Total			\$17,595,000

Table 12b

**Randleman Lake Dam Conceptual Design
Estimated Construction Cost, RCC Dam - 500-Foot Wide Spillway on Dam**

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount
Mobilization	1	JOB	L.S.	\$650,000
Clear and Grub	65	AC	\$2,000.00	\$130,000
Strip and Stockpile	30,000	CY	\$3.50	\$105,000
Dewatering Excavations	1	JOB	L.S.	\$500,000
Foundation and Stilling Basin Excavation Common	123,500	CY	\$6.00	\$741,000
Rock Excavation	40,000	CY	\$30.00	\$1,200,000
Dental Excavation	1,000	CY	\$10.00	\$10,000
Dental/Level Concrete and Grout Cap	3,000	CY	\$100.00	\$300,000
Foundation Grouting	1	JOB	L.S.	\$1,200,000
RCC Dam	149,700	CY	\$45.00	\$6,736,500
Formed Concrete & Steel	1,700	CY	\$515.00	\$875,500
Concrete Spillway Crest	1,120	CY	\$200.00	\$224,000
Facing Concrete	6,370	CY	\$200.00	\$1,274,000
River Diversion	1	JOB	L.S.	\$500,000
Earth Embankment	98,800	CY	\$4.00	\$395,200
Earth Embankment Drain	20,000	CY	\$35.00	\$700,000
RCC Drain (Dam and Foundation)	1	JOB	L.S.	\$250,000
Toe Drain	620	LF	\$10.00	\$6,200
Riprap	4,300	CY	\$40.00	\$172,000
Riprap Bedding	1,075	CY	\$40.00	\$43,000
Spread Topsoil and Seeding	1	JOB	L.S.	\$20,000
Drainage Gallery	1	JOB	L.S.	\$150,000
Ventilation System	1	JOB	L.S.	\$20,000
Gates	1	JOB	L.S.	\$200,000
Hydraulic Controls	1	JOB	L.S.	\$50,000
Stoplogs	1	JOB	L.S.	\$100,000
Electrical Systems	1	JOB	L.S.	\$100,000
TOTAL				\$16,652,400

Source: Phase 1 Hydrologic and Hydraulic Analyses and Conceptual Alternatives for the Proposed Randleman Lake Dam, GEI Consultants, April 25, 1995.

**Table 12c
Reservoir Development Cost for Upper Deep River Lake**

Item	Description	Unit Cost	Units	Subtotal
Land	Acres	\$2,000	4,880	\$9,760,000
Clearing	Acres	\$933	2,440	\$2,260,000
Road Relocations	All	Lump Sum	1	\$20,090,000
RCC Dam	One	Lump Sum	1	\$21,820,000
Environmental	EIS, Permit, etc.		X	\$3,000,000
Wetlands Mitigation	Acres	\$4,440 ⁽¹⁾	651 ⁽²⁾	\$2,890,000
Subtotal				\$59,840,000
Contingencies & Engineering @ 20%				\$11,970,000
TOTAL PROJECT COST ESTIMATE				\$71,810,000

Notes: (1) The wetlands mitigation unit cost (dollars per acre) for project alternatives was assumed to be the same as the projected wetlands mitigation unit cost for Randleman Lake.

(2) The estimate of units (acres) was developed from 1998 state wetland maps (NCDENR, 1998c) which are based on National Wetland Inventory maps (that include substantial errors due to mapping procedures). Mapped wetland acres for alternatives were adjusted by a factor identical to that for Randleman Lake, which was 121 acres field delineated wetlands to 100 acres of mapped wetlands, or a mapping ratio of 1.21:1. Wetlands mitigation units (acres) for the alternative reservoir sites were then estimated based on the ratio of required mitigation acres (729) to wetlands acres lost (121) for Randleman Lake, or a mitigation ratio of 6.0:1. This procedure provides consistency for estimation purposes and is believed to yield estimates of mitigation costs which are within reason. The ranking of alternatives by total project cost is the same whether the mitigation costs are estimated by this procedure or mitigation costs are assumed to be zero.

**Table 12d
Reservoir Development Cost for Altamahaw Lake**

Item	Description	Unit Cost	Units	Subtotal
Land	Acres	\$2,000	7,280	\$14,560,000
Clearing	Acres	\$933	3,640	\$3,400,000
Road Relocations	All	Lump Sum	1	\$16,530,000
RCC Dam	One	Lump Sum	1	\$15,660,000
Environmental	EIS, Permit, etc.		X	\$3,000,000
Wetlands Mitigation	Acres	\$4,440 ⁽¹⁾	5,067 ⁽¹⁾	\$22,500,000
Subtotal				\$75,650,000
Contingencies & Engineering @ 20%				\$15,130,000
Total Project Cost Estimate				\$90,780,000

Notes: (1) Estimated based on values for Randleman Lake (See Footnote (1) in Table 12c).

**Table 12e
Reservoir Development Cost for Benaja Lake**

Item	Description	Unit Cost	Units	Subtotal
Land	Acres	\$2,000	7,660	\$15,320,000
Clearing	Acres	\$933	3,830	\$3,570,000
Road Relocations	All	Lump Sum	1	\$5,720,000
RCC Dam	One	Lump Sum	1	\$15,750,000
Environmental	EIS, Permit, etc.		X	\$1,500,000
Wetlands Mitigation	Acres	\$4,440 ⁽¹⁾	5,621 ⁽¹⁾	\$24,960,000
Subtotal				\$66,820,000
Contingencies & Engineering @ 20%				\$13,360,000
Total Project Cost Estimate				\$80,180,000
Notes:				
(1) Estimated based on values for Randleman Lake (See Footnote (1) in Table 12c).				

**Table 12f
Reservoir Development Cost for Polecat Creek Lake**

Item	Description	Unit Cost	Units	Subtotal
Land	Acres	\$2,000	2,300	\$4,600,000
Clearing	Acres	\$933	1,150	\$1,070,000
Road Relocations	All	Lump Sum	1	\$8,660,000
RCC Dam	One	Lump Sum	1	\$15,900,000
Environmental	EIS, Permit, etc.		X	\$1,500,000
Wetlands Mitigation	Acres	\$4,440 ⁽¹⁾	350 ⁽¹⁾	\$1,550,000
Subtotal				\$33,280,000
Contingencies & Engineering @ 20%				\$8,660,000
Total Project Cost Estimate				\$39,940,000
Notes:				
(1) Estimated based on values for Randleman Lake (See Footnote (1) in Table 12c).				

**Table 13
Estimated Capital Cost of Project Alternatives**

Alternative	Randleman Lake	Upper Deep River Lake	Altamahaw Lake	Benaja and Polecat Creek Lake Alternative		Combined Alternative(2)
				Benaja	Polecat Creek	
Lake Area (Acres)	3,000	2,440	3,640	3,830	1,150	3,830
50 Yr. Safe Yield (mgd)	48	40	48	26	14	48
Pool Elevation (MSL)	682	715	655	712	700	712
Pipeline Length (Miles) (Note 1)	29	29	53	8	14	8
WTP Construction Cost (Note 3)	\$35,074,621	\$30,314,331	\$35,074,621	\$21,477,250	\$13,088,878	\$35,074,621
Reservoir Development	\$66,350,000	\$71,810,000	\$90,780,000	\$80,180,000	\$39,940,000	\$80,180,000
Intake Cost (Note 3)	\$9,820,894	\$8,488,013	\$9,820,894	\$6,013,630	\$3,664,886	\$6,013,630
Transmission Cost (Note 3)	\$17,608,800	\$17,608,800	\$32,181,600	\$4,857,600	\$8,500,800	\$4,857,600
Relocate Eastside WWTP Discharge (Note 5)	\$10,750,000					
Replace Eastside WWTP (Note 4)		\$64,000,000				
Well Development Costs (Note 2)						\$61,000,000
Cleanup Randleman Dump Site	\$225,400					
Upgrade Reidsville WWTP			\$1,000,000			
ESTIMATED PROJECT COST	\$139,829,715	\$192,221,144	\$168,857,115	\$112,528,480	\$65,194,564	\$187,125,851
Cost Per mgd of Safe Yield	\$2,913,000	\$4,806,000	\$3,518,000	\$4,328,000	\$4,657,000	\$3,898,000

Notes:

- (1) Pipeline lengths are from the 1985 CH₂M Hill report.
- (2) Well development cost of \$200,000 per well includes drilling, casing, pump, pump house, land telemetry, SCADA system, site development, engineering, access road and piping to central water treatment plant.
- (3) Formulas are from Black & Veatch's historic plant/line/intake costs. Costs are for the ultimate development of the safe yield.
 Water Treatment Plant Construction Cost = $((\text{mgd}/10) \wedge 0.8 \cdot 10,000,000)$
 Per Foot Pipeline Costs = \$115
 Intake Construction Cost = $(\text{mgd}/10) \wedge 0.8 \cdot 2,800,000$
- (4) The cost for a new tertiary waste treatment plant is estimated at \$4.00 per gallon.
- (5) Including capital cost and present worth of O&M cost.

**Table 14
Existing Land Use Distribution
For The Randleman Lake Watershed**

Land Use Category	Total (acres)	% of Total
Forest	57,541	52.5
Open	2,167	2.0
Pasture	13,035	11.9
Conservation Tillage	7,895	7.2
Conventional Tillage	877	0.8
Single Family Residential Large Lot	3,677	3.3
Low Density	3,223	2.9
Low-Medium Density	3,566	3.2
Medium Density	4,754	4.3
Institutional	1,910	1.7
Townhouse/Apartment	1,757	1.6
Commercial/Office	2,225	2.0
Heavy Industry	2,953	2.7
Water	4,230	3.9
Totals	109,810	100.0

Source: Black & Veatch, 1990

**Table 14a
Dairies In the Randleman Lake Watershed**

Map No.	Dairy Name	Average Number of Milking Cattle	Acres for Land Application of Waste
1	Green Valley Farms	250	Approx. 600
2	Cashatt Dairy	150-200	350
3	Buttke Dairy	1,200	600
4	W.R. Farlow & Sons	175	300
5	Loflin Dairy	300	170
6	Robbins Dairy	98	*

* This dairy is not required to have an approved animal waste management plan.

Table 15
Insured Employment for 1994⁽¹⁾
Guilford and Randolph Counties

Industry	Guilford Co. Annual Average Employment ⁽²⁾	Randolph Co. Annual Average Employment ⁽²⁾
TOTAL ALL INDUSTRIES	245,575	45,884
PRIVATE TOTAL	219,549	40,788
AGRICULTURE, FORESTRY AND FISHING	1,232	361
Agricultural Production-Crops	138	*
Agricultural Production-Livestock	25	129
Agricultural Services	1,069	154
Forestry	0	*
Fishing, Hunting and Trapping	0	0
MINING	133	*
Metal Mining	0	0
Coal Mining	0	0
Oil and Gas Extraction	0	0
Nonmetallic Minerals, Except Fuels	133	*
CONSTRUCTION	11,504	1,522
General Building Contractors	2,200	318
Heavy Construction, Except Building	1,219	300
Special Trade Contractors	8,085	904
MANUFACTURING	57,602	24,555
Food and Kindred Products	1,469	440
Tobacco Products	*	0
Textile Mill Products	12,048	5,203
Apparel and Other Finished Products	2,563	1,745
Lumber and Wood Products	2,053	1,396
Furniture and Fixtures	6,890	6,829
Paper and Allied Products	1,566	613
Printing and Publishing	4,628	351
Chemicals and Allied Products	5,040	733
Petroleum and Related Industries	*	*
Rubber and Misc. Plastics Products	2,064	1,412
Leather and leather Products	31	535
Stone, Clay, Glass, and Concrete Prod.	733	212
Primary Metal Industries	363	493
Fabricated Metal Products	2,581	853
Industrial Machinery and Equipment	3,601	531
Electronic & Other Electrical Equipment	4,973	2,145
Transportation Equipment	2,670	*
Instruments and Related Products	1,823	919
Miscellaneous Manufacturing Industries	630	92

**Table 15 - Continued
Insured Employment for 1994⁽¹⁾
Guilford and Randolph Counties**

Industry	Guilford Co. Annual Average Employment ⁽²⁾	Randolph Co. Annual Average Employment ⁽²⁾
TRANSPORTATION	14,467	1,109
Local and Interurban Passenger Transit	*	53
Trucking and Warehousing	7,851	728
Water Transportation	0	0
Transportation by Air	1,784	8
Pipelines, Except Natural Gas	*	0
Transportation Services	419	18
Communications	3,228	189
Electric, Gas, and Sanitary Services	1,008	114
WHOLESALE	18,911	1,719
Wholesale Trade-Durable Goods	11,571	1,187
Wholesale Trade-Nondurable Goods	7,340	532
RETAIL TRADE	43,561	6,078
Building Materials & Garden Supplies	2,029	360
General Merchandise	6,083	821
Food Stores	5,416	1,032
Automotive Dealers & Service Stations	3,770	838
Apparel & Accessory Stores	2,118	169
Furniture and Home Furnishings Stores	3,402	294
Eating & Drinking Places	15,004	1,979
Miscellaneous Retail	5,740	584
SERVICES	57,580	4,691
Hotels and Other Lodging Places	2,484	97
Personal Services	2,281	234
Business Services	19,250	803
Auto Repair, Services and Parking	1,650	274
Miscellaneous Repair Services	1,241	132
Motion Pictures	503	81
Amusement & Recreation Services	1,955	301
Health Services	16,128	1,785
Legal Services	1,308	74
Educational Services	2,708	5
Social Services	2,994	552
Museums, Botanical & Zoological Garden	*	0
Membership Organizations		
Engineering & Management Services	1,252	106
Private Households	3,033	188
Miscellaneous Services	718	39
Nonclassifiable Establishments	*	20

**Table 15 – Continued
Insured Employment for 1994⁽¹⁾
Guilford and Randolph Counties**

Industry	Guilford Co. Annual Average Employment ⁽²⁾	Randolph Co. Annual Average Employment ⁽²⁾
FINANCE, INSURANCE AND REAL ESTATE	14,560	727
Depository Institutions	3,375	468
Nondepository Institutions	1,507	49
Security and Commodity Brokers	586	*
Insurance Carriers	5,323	22
Insurance Agents, Brokers & Service	1,424	77
Real Estate	2,193	103
Holding and Other Investment Offices	152	*
GOVERNMENT	26,026	5,096
Federal Government	4,000	176
State Government	5,688	1,106
Local Government	16,338	3,814

⁽¹⁾ Insured employment includes only employees covered by unemployment insurance through the NC Employment Security Commission.

⁽²⁾ Numbers are rounded to nearest whole number. Due to rounding and disclosure suppression, sums of categories and totals may be different.

* Indicates Disclosure Suppression.

Source: Employment Security Commission of North Carolina, 1994.

**Table 15a
Existing Permitted Mining Operations in Guilford County**

Name	Location	Permit Expiration Date	Permitted Area, Acres
Groome Sandrock Pit	4608 Groometown Rd. Greensboro, NC 27407	May 2004	35
A-1 Sandrock Pit	2132 Bishop Rd Greensboro, NC 27406	October 2001	60

**Table 15b
NPDES Dischargers in the Randleman Lake Watershed**

Discharger	NPDES Permit Number	Discharge Location	Permitted Flow, mgd*	Type of Discharge
Amerada Hess Corporation	NC0069256	UT East Fork Deep River	NL	Stormwater**
Ashland Petroleum Company	NC0065803	UT East Fork Deep River	NL	Stormwater**
Carolina Steel Corporation	NC0084492	UT West Fork Deep River	0.0144	Groundwater Remediation
Colonial Pipeline Company	NC0031046	UT East Fork Deep River	NL	Stormwater**
Crown Mobile Home Park (MHP)	NC0055255	UT Hickory Creek	0.042	Domestic
NCDOC - Sandy Ridge Corr. Ctr.	NC0027758	UT West Fork Deep River	0.0175	Domestic
Exxon Company	NC0000795	UT East Fork Deep River	NL	Stormwater**
Exxon Company, USA	NC0084522	UT Jenny Branch	0.0216	Groundwater Remediation
S. Guilford High School	NC0038229	UT Hickory Creek	0.012	Domestic
Southern Elementary School	NC0038091	UT Hickory Creek	0.0075	Domestic
Sumner Elementary School	NC0037117	UT Hickory Creek	0.009	Domestic
Hidden Forest Estates MHP	NC0065358	UT Deep River	0.027	Domestic
High Point Ward WTP	NC0081256	UT Richland Creek	10	Municipal WTP Solids Handling
High Point Eastside WWTP	NC0024210	Richland Creek	16	Municipal WWTP
HRS Terminals, Inc. (GNC Energy Corporation)	NC0074241	UT East Fork Deep River	NL	Stormwater**
Hickory Run Mobile Home Park (Huntington Properties, LLC)	NC0041505	UT Bull Run Creek	0.035	Domestic
Louis Dreyfus Energy Corporation	NC0026247	UT East Fork Deep River	NL	Stormwater**
National Pipa and Plastics, inc. (LCP National Plastics, Inc.)	NC0036366	UT West Fork Deep River	NL	Cooling Water, Cooling Tower Blowdown
Plantation Pipeline Company	NC0051161	UT East Fork Deep River	NL	Stormwater**
Plaza Mobile Home Park	NC0041483	UT Hickory Creek	0.003	Domestic

Table 15b (continued)
NPDES Dischargers in the Randleman Lake Watershed

Discharger	NPDES Permit Number	Discharge Location	Permitted Flow, mgd*	Type of Discharge
National Pipe and Plastics, Inc. (LCP National Plastics, Inc.)	NC0036366	UT West Fork Deep River	NL	Cooling Water, Cooling Tower Blowdown
Plantation Pipeline Company	NC0051161	UT East Fork Deep River	NL	Stormwater**
Plaza Mobile Home Park	NC0041483	UT Hickory Creek	0.003	Domestic
Rayco Utilities, Melblille Heights	NC0050792	Muddy Creek	0.0315	Domestic
Rayco Utilities, Penman Heights	NC0055191	UT Muddy Creek	0.025	Domestic
Star Enterprise	NC0022209	UT Long Branch	NL	Stormwater**
Triad Terminal Company	NC0042501	UT East Fork Deep River	NL	Stormwater**
William Energy Ventures (Conoco, Inc.)	NC0074578	UT Long Branch	NL	Stormwater**
TOTAL			26.245	
Total, Excluding High Point Ward WTP and Eastside WWTP			0.245	
* NL = no flow limit; UT = unnamed tributary				
** Located at the "tank farm" along I-40.				

Table 16
Acreege of Habitat within Pool Line and Buffer Zone
Randleman Lake Project, Randolph and Guilford Counties⁽¹⁾

Community or Use	Acres within Pool	Acres in Buffer	Total Acres
Piedmont/Low Mountain Alluvial Forest	1,057	630	1,687
Piedmont/Mountain Bottomland Forest	4	5	9
Mesic Mixed Hardwood Forest, Piedmont Subtype	809	923	1,732
Dry-Mesic Oak-Hickory Forest	273	498	771
FOREST COMMUNITIES – SUBTOTAL	2,143	2,056	4,199
Piedmont/Coastal Plain Acidic Cliff	5	2	7
Low Elevation Seeps	15	1	16
Developed Areas, Industrial, Houses, Ponds, Powerlines	45	24	69
Open Pastures, Fields, other Agriculture	868	768	1,636
TOTALS	3,076	2,851	5,927

Source: Carter and Associates, 1993.

Table 17
Categories and Acreeges⁽¹⁾ of Wetlands to be Impacted by Randleman Lake

Wetland Types	Total Acrea	Number of Sites	Average Acres per Site
Palustrine forested, broad leaf deciduous wetlands	72.0	251	0.29
Palustrine persistent emergent wetlands	20.4	10	2.04
Palustrine forested, scrub-shrub broad leaf deciduous wetlands	10.4	3	3.47
Palustrine forested broad leaf and persistent emergent wetlands	16.4	10	1.64
TOTAL	119.2	274	0.44

⁽¹⁾ Acreeges total 119.2 rather than 121 due to rounding differences associated with dividing the 274 total wetland sites into the four categories shown.

Table 18
Amphibians and Reptiles Observed
in the Proposed Randleman Lake Area,
Randolph and Guilford Counties, North Carolina

Spotted Salamander (*Ambystoma maculatum*)
 Northern Dusky Salamander (*Desmognathus fuscus*)
 Three-lined Salamander (*Eurycea [longicauda] guttolineata*)
 American Toad (*Bufo americanus*)
 Fowler's Toad (*Bufo woodhousii fowleri*)
 Northern Cricket Frog (*Acris crepitans*)
 Cope's Gray Treefrog (*Hyla chrysoscelis*)
 Spring Peeper (*Pseudacris crucifer*)
 Bullfrog (*Rana catesbeiana*)
 Green Frog (*Rana clamitans*)
 Pickerel Frog (*Rana palustris*)
 Southern Leopard Frog (*Rana utricularia*)¹
 Common Snapping Turtle (*Chelydra serpentina*)
 Eastern Musk Turtle (*Stemotherus odoratus*)
 Eastern Painted Turtle (*Chrysemys picta*)
 Yellowbelly Slider (*Trachemys s. scripta*)²
 Eastern Box Turtle (*Terrapene carolina*)¹
 Northern Fence Lizard (*Sceloporus undulatus hyacinthinus*)
 Skinks (*Eumeces* sp.)
 Ground Skink (*Scincella lateralis*)
 Worm Snake (*Carphophis amoenus*)
 Black Racer (*Coluber constrictor*)
 Ringneck Snake (*Diadophis punctatus*)
 Black Rat Snake (*Elaphe o. obsoleta*)
 Northern Water Snake (*Nerodia sipedon*)

¹ supported by NC State Museum voucher specimens

² recorded in fish survey

Source: Carter and Associates, 1993

Table 19
Species of Freshwater Fish Collected in 1992 and 1993
From the Deep River and Its Tributaries

In the Area of the Proposed Randleman Lake Project, Randolph and Guilford Counties, N.C.

Gizzard shad (<i>Dorosoma cepedianum</i>)	Flat bullhead (<i>Ameiurus platycephalus</i>)
Rosyside dace (<i>Clinostomus funduloides</i>)	Margined madtom (<i>Noturus insignis</i>)
Satinfin shiner (<i>Cyprinella analostana</i>)	Redfin pickerel (<i>Esox americanus</i>)
Carp (<i>Cyprinus carpio</i>)*	Speckled killifish (<i>Fundulus rathbuni</i>)
Bluehead chub (<i>Nocomis leptoccephalus</i>)	Mosquitofish (<i>Gambusia holbrooki</i>)
Golden shiner (<i>Notemigonus crysoleucas</i>)	Tessellated darter (<i>Etheostoma olmstedii</i>)
Whitemouth shiner (<i>Notropis alborus</i>)	Piedmont darter (<i>Percina crassa</i>)
Highfin shiner (<i>Notropis altipinnis</i>)	Redbreast sunfish (<i>Lepomis auritus</i>)
Redlip shiner (<i>Notropis chiliticus</i>)	Green sunfish (<i>Lepomis cyanellus</i>)
Spottail shiner (<i>Notropis hudsonius</i>)	Warmouth (<i>Lepomis gulosus</i>)
Swallowtail shiner (<i>Notropis procne</i>)	Bluegill (<i>Lepomis macrochirus</i>)
Sandbar shiner (<i>Notropis scepticus</i>)	Redear sunfish (<i>Lepomis microlophus</i>)
Creek chub (<i>Semotilus atromaculatus</i>)	Sunfish hybrid? (<i>Lepomis</i> sp.)
White sucker (<i>Catostomus commersoni</i>)	Largemouth bass (<i>Micropterus salmoides</i>)
Creek chubsucker (<i>Erimyzon oblongus</i>)	White crappie (<i>Pomoxis annularis</i>)
Smallfin redhorse (<i>Moxostoma robustum</i>)	Black crappie (<i>Pomoxis nigromaculatus</i>)
Snail bullhead (<i>Ameiurus brunneus</i>)	
White catfish (<i>Ameiurus catus</i>)	* = seen; not collected

Source: Carter and Associates, 1993

Table 20
Endangered, Threatened, and Rare Animals of Guilford and Randolph Counties

Species	Status	
	State	Federal
Four-toed Salamander (<i>Hemidactylium scutatum</i>)	SC	
Carolina Darter (<i>Etheostoma collis</i>)	PSC	
Cape Fear Shiner (<i>Notropis meskistocholas</i>)	E	LE
American Bittern (<i>Podilymbus podiceps</i>)	SR	
Black Vulture (<i>Coragyps atratus</i>)	SC	
Sharp-Shinned Hawk (<i>Accipiter striatus</i>)	SR	
Coopers Hawk (<i>Accipiter cooperii</i>)	SC	
Yellow-Bellied Sapsucker (<i>Sphyrapicus varius</i>)	SR	
Bank Swallow (<i>Riparia riparia</i>)	SR	
Golden-Crowned Kinglet (<i>Regulus satrapa</i>)	SC	
Hermit Thrush (<i>Catharus guttatus</i>)	SR	
Loggerhead Shrike (<i>Lanius ludovicianus</i>)	SC	
Magnolia Warbler (<i>Dendroica magnolia</i>)	SR	
Greensboro Burrowing Crayfish (<i>Cambarus catagius</i>)	SR	C2
Leonard's Skipper (<i>Hesperia leonardus</i>)	UNK	
Notched Rainbow (<i>Villosa constricta</i>)	SR	
E = Endangered	SC = Special Concern	
LE = Listed Endangered	PSC = Proposed Special Concern	
C1 = Category 1 (sufficient information to support listing)	SR = Significantly Rare	
C2 = Category 2 (insufficient information to support listing)	UNK = Undetermined	
C = Candidate		

Source: N. C. Nongame and Endangered Wildlife Program, Wildlife Resources Commission

**Table 21
Randleman Lake Road Modifications and Abandonments**

County	Route	Estimated Miles Impacted	Intersecting Feature	Location	Treatment	Estimated Acres of Wetlands Impacted
Guilford	NC 62	0.35	Deep River	0.4 mile west of junction with SR 1137	replace structure and raise roadway	0.40
Guilford	SR 1132	0.19	Hickory Creek	1.2 miles west of junction with SR 1137	replace structure and raise roadway	0.43
Guilford	SR 1129	0.19	Deep River	0.7 mile north of junction with NC 62	replace structure and raise roadway	0.09
Guilford	SR 1138	0.12	Branch of Deep River	0.1 mile south of junction with NC 62	remove structure and abandon site	0.00
Guilford	SR 1140	0.22	Register's Creek	1.0 mile west of junction with SR 1137	replace structure at new location	0.05
Guilford	NC 62	0.19	Two Mile Creek	0.15 mile east of junction with SR 1137	replace structure and raise roadway	0.15
Randolph	SR 1928	0.16	Muddy Creek	0.17 mile east of junction with SR 1927	replace structure and raise roadway	0.00
Randolph	SR 1936	1.10	Deep River	0.1 mile east of junction with SR 1926	remove structure and abandon site	0.00
Randolph	SR 1944	0.22	Bob Branch	0.15 mile south of junction with SR 1931	replace structure and raise roadway	unknown
Randolph	SR 1944	0.45	Muddy Creek	0.22 mile north of junction with SR 1931	replace structure and raise roadway	0.05
Randolph	SR 1936	0.50	Muddy Creek	0.2 mile west of junction with SR 1926	remove structure and abandon site	0.00
Randolph	SR 1921	0.50	Deep River	0.1 mile southwest of junction with SR 1935	replace structure at new location	0.00
Randolph	SR 1938	0.19	Sam's Creek	0.38 mile east of junction with SR 1936	raise roadway	0.01
Randolph	SR 1936	0.37	Sam's Creek	0.6 mile south of junction with SR 1938	replace structure and raise roadway	0.05
Randolph	SR 1961	0.96	Tributary of Deep River	0.64 mile south of junction with SR 1965	remove structure and abandon site	0.00
Randolph	SR 1929	0.27	Muddy Creek	1.85 mile south of junction with SR 1926	remove structure and abandon site	0.00
Randolph	SR 1927	0.23	Muddy Creek	0.15 mile north of junction with SR 1928	replace structure and raise roadway	1.23
Randolph	SR 1932	0.11	Tributary of Muddy Creek	200 feet south of junction with SR 1928	remove structure and abandon site	0.00
Randolph	SR 1989	0.16	Tributary of Deep River	0.4 mile north of junction with SR 1958	add pipe and raise roadway	0.00
Randolph	SR 1965	0.11	Tributary of Deep River	0.85 mile west of junction with US 220 Business	add pipe and raise roadway	0.04
Randolph	SR 1936	0.22	Tributary of Deep River	0.8 mile north of junction with SR 1987	abandon site	0.00
Total		6.81				2.50

Table 22
Average Reservoir Fill Time Using a 30 cfs Release Rate

Month Number	Average Inflow (acre-feet)	Minimum Release (acre-feet)	Average Net Evaporation (acre-feet)	End of Month Volume (acre-feet)	End of Month Elevation (feet msl)
1	9,703	1,808	0	7,895	650
2	9,703	1,808	58	15,732	660
3	9,703	1,808	89	23,538	666
4	9,703	1,808	118	31,315	671
5	9,703	1,808	146	39,064	675
6	9,703	1,808	172	46,787	679
7	9,703	1,808	201	54,481	681
8	9,703	1,808	217	62,159	682+

Source: Black & Veatch, 1991a.

Table 23
Predicted Impact of 30 cfs Release Rate on Downstream Flows During Filling

Location on the Deep River⁽¹⁾	Average Flow (cfs) Without Project	Amount Stored (cfs) During Filling	Percent Reduction in Average Flow
Randleman dam (0)	163	133	82
Randleman (2)	176	133	76
Worthville (4)	224	133	59
Ramseur (15)	350	133	38
High Falls (41)	800	133	17
Gulf (69)	1,100	133	12
Moncure (88)	1,436	133	9

⁽¹⁾ Numbers in parentheses equal to miles (rounded) downstream from dam site.

Source: NCDEHNR, 1991

**Table 24
Predicted Impact of Randleman Dam on Average Flows**

Location on the Deep River⁽¹⁾	Drainage Area (Square Miles)	Average Flow (cfs) Without Project	Percent Reduction in Average Flow
Randleman dam (0)	171	163	29
Randleman (2)	177	176	27
Worthville (4)	236	224	21
Ramseur (15)	349	350	13
High Falls (41)	791	800	6
Gulf (69)	1,060	1,100	4
Moncure (88)	1,436	1,436	3

(1) Numbers in parentheses equal to miles (rounded) downstream from dam site.

Source: NCDEHNR, 1991.

**Table 24a
Estimated Fecal Coliform Concentrations for the Proposed Lake**

Lake Segment	Estimated Range of 80th Percentile Concentration of Fecal Coliform Bacteria During Low Flow Conditions (organisms/100 mL)
Deep River 1	104-223
Deep River 2	10-23
Deep River 3A	5-11
Deep River 3B	18-39
Muddy Creek 1	32-144
Muddy Creek 2	59-130
Near Dam	35-76

Table 24b
Predicted Average Chlorophyll a Concentrations and
Frequency of Standard Violations

Reservoir Segment**	Predicted Chlorophyll a, ug/L	Frequency of Standard Violation, %*
Deep River 1	39	37
Deep River 2	31	24
Deep River 3A	18	5
Deep River 3B	13	1
Muddy Creek 1	22	9
Muddy Creek 2	13	1
Near Dam	11	<1
Reservoir Average	18	—

* Frequencies of standard violations are the predicted percentages of the growing season (May-September) during which chlorophyll a levels are expected to exceed the N.C. water quality standard of 40 ug/L.

** See Figure 7a for lake modeling segmentation locations.

Table 25
Comparison of Water Quality in Piedmont Lakes

Lake	Secchl Depth (m)	Total Phosphorus (TP) (mg/L)	Chlorophyll a (µg/L)	Area (acres)
Badin Lake	1.1 (1.4)	0.03 (0.025)	23.5 (17)	5,350
Belews Lake	3.95 (3.2)	0.015 (0.01)	1 (1)	4,030
Jordan Lake	0.5 (0.4)	0.08 (0.09)	26 (40)	14,300
Falls Lake	0.6 (0.5)	0.08 (0.07)	56 (32)	12,490
Harris Lake	1.8 (2.0)	0.03 (0.03)	24 (9)	4,150
Lake Hickory	1.55 (1.15)	0.035 (0.03)	22.5 (5)	4,100
Lake Rhodhiss	1.0 (1.1)	0.1 (0.06)	22 (3)	3,515
Lake Tom-A-Lex	0.8 (0.9)	0.045 (0.045)	26 (32)	650
Randleman Lake*	1.2	0.07	19.4 (18**)	3,123

* Assuming High Point Eastside WWTP effluent TP concentration is 0.5 mg/L.

** Based on 1998 modeling by NCDWQ.

Source: Final Environmental Impact Statement for Randleman Lake, NCDEHNR, 1991. Values derived from "1988 North Carolina Lakes Monitoring Report," NCDEM Report No. 89-04, 1988.

Values in parentheses are from "North Carolina Lake Assessment Report," NCDEM Report No. 92-02.

**Table 25a
Canoeing Conditions for the Deep River**

Segment	Current Conditions	Predicted Reduction in Average Flow	Remarks
SR 2128 at Worthville to SR 2221 at Cedar Falls	Runnable in moderately wet weather	21% (Worthville)	
SR 2221 at Cedar Falls to SR 2615 at Ramseur	Runnable in moderately wet weather	13% (Ramseur)	
NC 42 at Coleridge to SR 1456 at Howards Mill	Not runnable after a long dry spell		
NC 22 at High Falls to SR 1006 at Glendon	Fairly flat; requires less water than above segments	6% (High Falls)	
SR 1006 at Glendon to NC 42 at Caribton	Runnable year-round		
NC 42 at Caribton to US 15-501	Runnable year-round	4% (Gulf)	Includes segments where Rock Rest Adventures offers guided trips.
US 15-501 to US 1	Runnable except after prolonged dry spell		
US 1 to NC 42 near Corinth	Runnable year-round	3% (Moncure)	

**Table 26
Estimated Acreage of Mitigation Design Units**

Mitigation Site	Mitigation Design Unit					
	Length of Stream Valley (feet)	Average Width of Floodplain (feet)	Total Area (acres)	In-Stream Habitat and Upland Stream-Side Levees (acres)	Existing Wetlands (acres)	Mitigation (acres)
	In-Stream Structures					
Archdale	3,200	150	10	4	1 ¹	5
Hickory Creek	3,500	310	25	7	3	15
Mile Branch	1,100	200	5	1	1 ¹	3
Muddy Creek	2,200	260	13	5	1	7
Kereey Valley	4,100	150	14 ²	4	1 ¹	4
Richland Creek	3,300	660	50	8	7	34
Subtotal						68
Green Tree Impoundments						
Bob Branch	1,800	190	8	—	1 ¹	7
Edgar (<i>Upper Muddy Creek</i>)	6,800	150	23	—	2 ¹	21
Reddicks Creek	3,900	210	19	—	0	19
Sophia	2,200	150	7	—	1 ¹	6
Subtotal						53
TOTAL	31,900	—	174	29	18	121

- Notes:**
- ¹ The acreage of existing wetlands has been estimated by assuming an average of 10% of low-order, Piedmont floodplains support jurisdictional wetlands.
 - ² The approximately 14-acre acquisition boundary includes areas near secondary roads that may not provide restorable wetlands. The potential for hydraulic impacts to adjacent properties and structures must be determined at all potential mitigation corridors.
 - ³ Floodplain widths and acreages have been estimated based on available topographic mapping and limited field reconnaissance.
 - ⁴ Greentree impoundments are not considered jurisdictional wetlands by the U.S. Army Corps of Engineers (USACE) and thus do not provide wetland restoration for USACE purposes. They are considered wetlands by the N.C. Division of Water Quality (NCDWQ) and thus are applicable for the 1:1 ratio of restoration or creation of riparian wetlands required for the Section 401 water quality certification.



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