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Acronyms

ACOE	U.S. Army Corps of Engineers
ADD	average daily demand
APFO	Adequate Public Facility Ordinance
BMPs	Best Management Practices
CAMPO	Capital Area Metropolitan Planning Organization
cfs	cubic feet per second
CWMTF	North Carolina Clean Water Management Trust Fund
DEHNR	North Carolina Department of Environment, Health and Natural Resources
DENR	North Carolina Department of Environment and Natural Resources
DOT	Department of Transportation
du/ac	dwelling unit per acre
DWQ	North Carolina Division of Water Quality
DWR	North Carolina Division of Water Resources
EA	environmental assessment
EID	environmental information document
EIS	environmental impact statement
EMC	North Carolina Environmental Management Commission
EPA	Environmental Protection Agency
ETJ	Extraterritorial Jurisdiction
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FONSI	Finding of No Significant Impact
GMP	Growth Management Plan
GDP	General Development Plan
GIS	Geographic Information System
gpd	gallons per day
IBT	interbasin transfer
LOD	limits of disturbance
MDD	maximum daily demand
mgd	million gallons per day
NC CRD	North Carolina Cultural Resources Department
NC EPA	North Carolina Environmental Policy Act
NCAC	North Carolina Administrative Code
NCCGIA	North Carolina Center for Geographic Information and Analysis
NEPA	National Environmental Policy Act

NFIP	National Flood Insurance Program
NHP	Natural Heritage Program
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NSW	Nutrient Sensitive Waters
NWI	National Wetland Inventory
OSHRP	Open Space and Historic Resources Plan
OWASA	Orange Water and Sewer Authority
PPAs	Perimunicipal Planning Areas
PUD	Planned Unit Development
R&D	research and development
RC	Recreation and Conservation
RCA	Resource Conservation Area
RDU Airport	Raleigh/Durham Airport Authority
RTP South	Research Triangle Park South
SCLMP	Swift Creek Land Management Plan
TJCOG	Triangle J Council of Governments
TLC	Triangle Land Conservancy
TND	Traditional Neighborhood Development
UDO	Unified Development Ordinance
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UT	unnamed tributary
WPAO	Watershed Protected Area Overlay
WRC	North Carolina Wildlife Resources Commission
WRP	North Carolina Wetlands Restoration Program
WSWS	Water Supply Watershed
WTP	water treatment plant
WWTP	wastewater treatment plant

Executive Summary

The Towns of Cary, Apex, and Morrisville, and Wake County are requesting an interbasin transfer (IBT) certificate from the North Carolina Environmental Management Commission (EMC) for a total of 27.0 mgd, from the Haw River basin to the Neuse River basin. This represents an increase of 11 mgd from the existing 16.0-mgd IBT certificate of the Towns of Cary and Apex. The EMC determined that there were no significant impacts associated with the IBT of 16.0 mgd in 1989. Results of the Cape Fear River Basin hydrologic model, which was developed under the guidance of the Division of Water Resources (DWR), have confirmed the lack of impact for the 11-mgd increase in IBT.

This Final Draft Environmental Impact Statement (EIS) identifies and discusses the direct, indirect, and cumulative impacts of the proposed IBT on both the source and receiving basins, and proposed Utility Services Area. Potential impacts on wetlands, urban lands, prime agricultural lands, forestry resources, public and recreational lands, archaeological and historical resources, fish and wildlife resources, sensitive aquatic and terrestrial species and habitats, water quality and water resources, air quality, groundwater, noise, and toxic substances were evaluated. Also evaluated in detail were the direct, indirect and cumulative impacts of the following project alternatives: 1) no action; 2) water acquisition from the Neuse basin; 3) increased wastewater discharges to the Cape Fear basin; 4) merger of water and sewer utilities with Durham; and 5) no construction of a regional treatment and water reclamation facility in the Cape Fear River.

This EIS concludes that the direct impacts of the proposed IBT on both the source and receiving basins would be insignificant. The project will not significantly change lake elevations, minimum dam releases, surface water hydrology, or water quality in the source or receiving basins, or in downstream areas. Existing discharges or permits in the receiving basin will not be expanded or amended as a result of the proposed IBT. No direct impacts to environmental resources are expected.

The potential for the proposed IBT to facilitate growth and development in the source and receiving basins, however, when combined with other planned water, sewer and transportation infrastructure for the region, may be significant. Impacts from such growth are predicted to potentially cause significant impacts to a variety of environmental resources. These impacts, however, should be reduced substantially by the implementation of existing and proposed federal, state and local regulations. To address the potentially significant indirect impacts that may remain, enhancements are identified that could strengthen local environmental protection efforts.

The EIS also provides a list of mitigation measures designed to reduce the potentially significant direct environmental impacts of water and wastewater infrastructure projects in the project area through conditions on future environmental assessment (EA) and EIS documents that are required under North Carolina Environmental Policy Act (NC EPA). Table 1 lists future water and sewer projects for which impacts will be evaluated prior to approval and permitting.

TABLE 1
Areas of Potential Impacts to be Addressed by Permitting & NC EPA Processes for Projects in the Source and Receiving Basins

	Source Basin					Receiving Basin				
Environmental Resource	Proposed Cary/Apex IBT	Western Wake WWTP	Cary / Apex WTP Expansion	Sewer Line Extensions	Water Line Extensions	Proposed Cary/Apex IBT	Existing Cary North WWTP	Existing Cary South WWTP	Sewer Line Extensions	Water Line Extensions
Wetlands	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Urban / Developed Land	LI	PI	♦	PI	PI	LI	•	•	PI	PI
Public Land / Recreation Uses	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Prime Agricultural Land	LI	PI	♦	PI	PI	LI	•	•	PI	PI
Forestry Land	LI	PI	♦	PI	PI	LI	•	•	PI	PI
Archaeological / Historical Areas	LI	PI	♦	PI	PI	LI	•	•	PI	PI
Wildlife Habitat	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Fisheries and Aquatic Resources	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Sensitive and Threatened Species & Habitat	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Water Resources	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Water Quality	PI	PI	♦	PI	PI	LI	•	•	PI	PI
Air Quality	LI	PI	♦	PI	PI	LI	•	•	PI	PI
Groundwater	LI	LI	♦	LI	LI	LI	•	•	LI	LI
Noise	LI	PI	♦	PI	PI	LI	•	•	PI	PI
Toxic & Hazardous Substances	LI	PI	♦	PI	LI	LI	•	•	PI	LI
Secondary Growth (with impacts to environmental resources)	PI	PI	♦	PI	PI	PI	•	•	PI	PI

LEGEND:
PI = Areas of Potential Impact (major relevance in NC EPA documents and permitting applications)
LI = Areas of Limited Impact (minor relevance in NC EPA documents and permitting applications)
♦ = Potential impacts from expansion of the Cary / Apex Water Treatment Plant have already been addressed in a previous EA document and permits have been approved.
• = Potential impacts from Cary North and South WWTPs have already been addressed in previous EA documents and permits that have been approved. No additional expansion is expected as a result of the IBT.

NOTE: This table is meant to show the relevance of each of the environmental issues for each particular project. **"PI" indicates areas where there is a potential for impacts to occur as a direct consequence of the identified projects.** This table is not meant to conclude the significance of the impacts of each project on these environmental resources. The individual SEPA documents prepared for each of these projects will address whether or not these impacts will be significant.

Cary, Apex, Morrisville, and Wake County have gone to great lengths to reduce the amount of the proposed IBT. The requested IBT is limited to an increase of 11 mgd as the communities individually and regionally pursue options to reduce demands, implement water reuse, and return wastewater to the Cape Fear River basin. Without these efforts, their combined needs could necessitate an IBT of about 50 mgd.

Except for one alternative, which is considered infeasible, the other alternatives evaluated in this EIS will not alter the projected growth in the area, meaning that all of the alternatives will result in substantially the same indirect impacts as the proposed action. A few of the alternatives actually create additional direct and indirect impacts that may be significant. None of the identified alternatives significantly reduces potential indirect and cumulative impacts of the proposed action and meets short-term and long-term water supply needs of the applicants at the same time.

SECTION 1

Background and Project Description

1.1 Background

B. Everett Jordan Lake (Jordan Lake) is a U.S. Army Corps of Engineers (ACOE) multi-purpose lake located in Chatham County, North Carolina. The construction of the dam started in 1967 and Jordan Lake completed filling in 1982, covering an area of 14,300 acres. Jordan Lake Dam is located on the Haw River just downstream of the confluence of the Haw River and the New Hope Creek.

Jordan Lake is designed to provide for water supply, recreation, flood control, fish and wildlife management, and flow augmentation to maintain downstream Cape Fear River water quality during natural low flow periods. The water supply component of the Jordan Lake storage volume is estimated to provide a safe yield of 100 mgd. Currently Chatham County, Cary/Apex, Holly Springs, and Orange Water and Sewer Authority (OWASA) have allocations for water supply from Jordan Lake.

During 1996, the Towns of Cary, Apex, and Morrisville, as well as Wake County/Research Triangle Park South (RTP South), requested authorization from DWR and the EMC to withdraw water from Jordan Lake to meet potable water demands for their rapidly growing communities. The Cary/Apex water treatment plant (WTP) currently treats raw water withdrawn from Jordan Lake and supplies water on a regular basis to Cary, Apex, Raleigh/Durham Airport Authority (RDU Airport), RTP South, and the Town of Morrisville from the allocation of 16 mgd which was granted to Cary/Apex in 1987. Although the DWR recommended additional individual allocations in 1997 for Cary/Apex, Morrisville, and RTP South as shown in Table 2, the Cary/Apex WTP will continue to treat and supply the allocations to the RDU Airport, Morrisville, and RTP South. However, the 1997 allocation is contingent upon the issuance of an IBT certificate by the EMC.

TABLE 2
Water Supply Allocation Recommendations for IBT Applicants

Allocation Applicant	Current Allocation (mgd)	DWR Total Allocation Recommendation (mgd) [1]
Apex and Cary	16.0	21.0
Morrisville	0	2.5
Wake County/RTP South	0	1.5

[1] Based on 2015 average day demands.

Currently there are three wastewater treatment plants (WWTPs) that serve Cary, Apex, Morrisville, RTP South, and RDU Airport. The North Cary WWTP (permitted at 12 mgd) serves northern, western, and central Cary, Morrisville, RDU Airport, and RTP. The South Cary WWTP (permitted at 16 mgd) serves eastern, central, and southern Cary. Apex also has a WWTP (permitted at 3.6 mgd) that serves the residents within the Apex town limits.

The basin boundary between the Cape Fear River basin and the Neuse River basin runs through the Towns of Cary and Apex (see Figure 1), and all three of the WWTPs discharge in the Neuse basin. Raw water is withdrawn from the DWR designated Haw River basin (in the Cape Fear River basin); treated water is supplied in both the Haw River basin and the Neuse basin; and wastewater is discharged in the Neuse basin. A transfer of water occurs from the Haw River basin to the Neuse River basin for the purpose of this IBT.

1.2 Project Description

The transfer of water from one river basin to another is defined by DWR as an IBT and requires a certificate from the EMC in accordance with North Carolina General Statute 143-215.22I. Cary/Apex currently has an IBT certificate for 16 mgd (maximum day basis) and has begun the application process to increase their IBT to 27.0 mgd, an increase of 11.0 mgd. This EIS provides supporting documentation for the IBT certificate application for the study area designated as the following "Source" and "Receiving" basins, as shown in Figure 1:

- Haw River Basin (source basin): Jordan Lake and the watershed areas of 03-06-05 and 03-06-06, and the Haw River arm of Jordan Lake (and its floodplain). The Haw and Cape Fear rivers from the Jordan Lake dam to the town of Lillington are also included.
- Neuse River Basin (receiving basin): The general area contained within the outer boundary of the existing/projected Utility Service Area contributing to the proposed IBT (North Cary, South Cary, and Apex WWTPs), as well as Crabtree Creek and Middle Creek extending from the WWTP service area boundary to their individual confluence with the Neuse River.

The boundary of the study area around the river and creeks is offset 0.7 miles from the shoreline to incorporate floodplain areas as shown on digital Federal Emergency Management Agency (FEMA) flood zone maps.

The Cary North WWTP, the Cary South WWTP and the Apex WWTP will not be expanded as a result of the proposed IBT. No WWTP capacity will be requested in the Neuse River basin in conjunction with this IBT request, since current permitted discharge amounts are adequate. One or more WWTPs and/or water reclamation facilities, assumed to discharge to the mainstem of the Cape Fear River, are being considered or planned and will likely serve Cary, Apex, and the Wake County portion of RTP, as well as other portions of western Wake County. This will limit the amount of water discharged to the Neuse River basin, thereby minimizing the IBT amount. At present, several alternative discharge locations below the Jordan Lake dam are being investigated for those proposed facilities. The request addressed by this document is for the maximum IBT that will occur during the planning period through 2030 (24.1 mgd, as shown in Table 3), plus an additional contingency factors that brings the total requested IBT amount to 27 mgd. Section 2.4 provides a further discussion of how the IBT figures were calculated. The proposed action assumes the future return of water to the source basin through a highly treated effluent from a regional treatment and water reclamation facility in the mainstem of the Cape Fear River.

Figure 1

TABLE 3
Projected IBT[1]

Year	IBT Maximum Day (mgd)
2000	19.7
2010	17.9
2020	18.4
2030	24.1

[1] Projected IBT calculations are only estimates if an IBT increase of 11 mgd is granted

Population, water demand, and wastewater flow projections are presented in Section 2, as well as the IBT calculation. The existing conditions and primary consequences of the proposed IBT are presented in Section 3, followed by a discussion of the secondary consequences in Section 4.

SECTION 2

Purpose and Need

2.1 Population Growth

The towns of Cary and Apex and the surrounding areas have grown rapidly. Over the last two decades, Cary's population has almost tripled while Apex's has almost doubled. The future rate of growth for Apex is expected to be higher than Cary's historical growth trends. Morrisville had an average population increase of 19 percent annually between 1980 and 1990; however, the development slowed in the early 1990s because of the shortage of water and limited sewer capacity. Growth has been rapid since the agreement with the Town of Cary in 1995 for additional water and wastewater treatment capacity. Since that time, Cary has adopted a building permit allocation system that is based on the availability of treated water.

Population projections are presented in Table 4. A special U.S. Census documented Cary's population as of April 1998 as 85,400. Population projections are not calculated for Wake County since the water supply allocation is for RTP South, which is exclusively office and industrial. Development rates for the available acreage were estimated based on historical records.

TABLE 4
Population Projections

Year	Apex	Cary	Morrisville
1997	11,500	82,700	2,100
2000	22,000	94,400	6,500
2010	48,800	120,900	14,700
2020	74,600	154,700	20,800
2030	100,400	198,000	27,000

2.2 Water Demand Projections

The average daily water demand (ADD) projections presented in Table 5 have been updated since the 1995-1996 Jordan Lake allocation applications. Average day demands for the towns are based on historic average treated water demands of 102, 110, and 213 gallons per capita per day for Cary, Apex and Morrisville, respectively. Raw water needs are increased by 8 percent over treated water demands to account for WTP losses. The maximum day demands (MDD) were calculated based on historical MDD/ADD peaking factors of 1.65 for Cary, Apex, and Morrisville, and 1.5 for RTP South. The towns plan to utilize conservation measures; Cary and Morrisville have a goal of reducing per capita water demands by 20 percent by 2015 from the 1998 level, and Apex plans to reach 20 percent reductions by 2027. These demand reductions are included in the projections below. Projections for Cary also incorporate the implementation of water reuse to reduce the MDD by 2.2 mgd in 2002, increasing to 3.8 mgd in 2015.

TABLE 5
Raw Water Demand Projections

	Cary		Apex		Morrisville		RTP South	
Year	ADD[1]	MDD[2]	ADD	MDD	ADD	MDD	ADD	MDD
1997	10.3	16.5	1.2	2.0	0.5	0.7	0.2	0.3
2000	10.7	17.6	2.6	4.3	0.5	0.8	0.5	0.7
2010	9.9	16.3	5.2	8.6	2.9	4.8	2.0	2.9
2020	11.8	19.5	7.15	12.4	3.8	6.3	2.5	3.7
2030	15.7	25.8	9.6	15.8	5.0	8.3	2.5	3.7

[1]ADD = Average Day Demand (mgd)

[2]MDD = Maximum Day Demand (mgd)

The Cary/Apex WTP has a rated capacity of 16 mgd; Cary owns 77 percent of this amount, 12.32 mgd, while Apex owns the remaining 3.68 mgd. Cary currently cannot produce enough treated water to supply the entire Town's needs; therefore, Cary contracts with both Raleigh and Durham on a "take and pay" basis for additional treated water. The contract with the City of Raleigh is to purchase 4.5 mgd of treated water a minimum of 280 days each year through September 30, 2003, and the contract with the City of Durham is to purchase 3.5 mgd of treated water every day through April 30, 2002. Morrisville also has a contract with Durham for the purchase of 1.5 mgd through 2003. Expansion of the Cary/Apex WTP to 40 mgd is being planned, and the outside contracts will not be necessary following completion of the proposed expansion.

Cary has a Water Conservation Ordinance, and the Town Manager is authorized to determine when certain conditions exist that require water restrictions or rationing measures. When the Town Manager determines that a water emergency exists, conservation efforts will be enforced and may include voluntary conservation measures, mandatory conservation measures, and water shortage emergency measures. Cary has also hired a permanent Water Conservation Specialist and adopted a Water Conservation Demand Management Program, which provides incentives and guidance to homeowners and developers.

Morrisville has also adopted an ordinance establishing water shortage conservation measures. The Town Manager is authorized to adopt and enforce water conservation measures when it has been determined that an emergency exists in Morrisville. The emergency measures will be adopted as a Town Policy and will apply to all water users of the Town.

The Apex ordinance establishes continuing water conservation measures that apply at all times whether or not a water shortage exists. In addition, the Town Manager may initiate and enforce five stages of conservation ranging from voluntary, different levels of mandatory, and finally, rationing. As of July 20, 1999, Apex no longer offers irrigation meters to customers, and the rate for existing irrigation customers was increased to $4.65/1000 gallons.

The towns' conservation programs are planned to reduce peak demands and the associated IBT and are reflected in Table 5.

As part of the IBT certification process, the IBT Certificate will include a drought management plan (approved by the EMC) describing management of the transfer to protect the source river basin during drought conditions.

2.3 Wastewater Treatment Plant Capacities

Cary operates two municipal WWTPs that discharge to the Neuse River basin and contribute to the proposed IBT. The North Cary WWTP discharges into Crabtree Creek and the South Cary WWTP discharges to Middle Creek. Apex also has a WWTP that discharges into the Neuse River basin via Middle Creek. The permitted flows and design flows for the facilities are listed in Table 6.

TABLE 6
Wastewater Treatment Plant Capacities

WWTP	Permitted Capacity (mgd) [1]	Existing Facility Design Capacity (mgd) [1]	Expected 2030 Capacity (mgd) [1]
North Cary	12.0	10.0	12.0
South Cary	16.0	12.8	16.0
Apex	3.6	3.6	0.0 [2]
Cape Fear WWTPs (combined)	--	--	40

[1] Based on maximum month flows.

[2] Apex plans to shift wastewater discharge to the planned Cape Fear River basin WWTP when the existing facility reaches the end of its useful life.

Both Cary and Apex are in the process of planning for a new plant (either together, or as part of a regional facility) to discharge to the Cape Fear River basin, which would result in a decrease of the total IBT amount to the Neuse River basin. Wake County and other local governments have been discussing the concept of a regional WWTP to accommodate Cary, Apex, and other communities in western Wake County as well as adjacent areas in Harnett and Chatham counties. As previously mentioned, this EIS assumes the return of water to the source basin through a highly treated effluent from a regional treatment and water reclamation facility by 2010. It is also assumed that this facility will discharge into the mainstem of the Cape Fear River. However, there are no specific plans and the location of such a plant (or plants) is only speculative at this time. It is recognized that in the future there may be more than one new facility discharging into the Cape Fear River basin that will service the communities of the region (within or adjacent to the study area).

Discharge to the mainstem of the Cape Fear River will not result in an IBT from the Haw River basin to the Cape Fear River basin. Results using the Cape Fear River Basin Hydrologic Model (Appendix B) showed that direct hydrologic impacts from a discharge to the Cape Fear River upstream of Lillington are equivalent to the impacts from a discharge into Jordan Lake.

Cary is in the process of implementing a 1.6-mgd (MDD) reclaimed water system based on the North Cary WWTP. This system would provide highly treated water to customers for nonpotable uses such as irrigation and cooling water make-up. Several major customers have been identified and have agreed to participate in the program. Additional users will be included in the system when the distribution lines are installed. The first phase of the system has been designed and permitted. The system is projected to be operating at the 1.6-mgd level in 2002, and to increase to 3.2 mgd by 2015.

Additionally, Cary designed a water reuse project at the South Cary WWTP. Several parks, schools, and ball fields have been identified as potential reuse customers. The expected rate of reuse from the South Cary WWTP is about 0.6 mgd MDD in 2001. Therefore, the implementation of water reuse at both plants is expected to reduce the MDD by 2.2 mgd in 2002 and 3.8 mgd in 2015. This system is currently under regulatory review. Reuse opportunities have also been identified for the Apex WWTP. Apex is pursuing industrial reuse opportunities with Cooper Tools and Ready-Mix for approximately 0.1 MGD.

2.4 IBT Calculation

Based on the water demand projections presented in Table 5 and the estimated wastewater discharge to the Cape Fear River basin, the IBT calculation is presented in Table 7. The following assumptions apply:

- Customer consumptive use includes in-basin water uses such as irrigation and septic systems and is assumed to be 22 percent of raw water withdrawal based on discussions with the DWR staff. In addition to customer consumptive use, total consumptive uses include WTP losses of eight percent in the Haw River Basin.
- A WWTP that will discharge to the Cape Fear River will be on-line prior to the year 2010 and will treat the discharges proposed in the table.

TABLE 7
Interbasin Transfer Water Balance Table (Maximum Day Basis)

Year	Water Withdrawal from the Haw River Basin	Consumption		Estimated Wastewater Discharge[1]		Total Return to the Haw River Basin[2 3]	Interbasin Transfer[4]
		Haw River Basin	Neuse River Basin	Haw River Basin	Neuse River Basin		
2000	23.4	3.7	3.3	0.0	16.4	3.7	19.7
2010	32.6	5.4	7.0	9.2	11.0	14.7	17.9
2020	41.8	6.9	8.7	16.5	9.7	23.5	18.4
2030	53.6	8.6	10.3	20.9	13.8	29.5	24.1

[1]Estimated wastewater discharges represent the amount of water withdrawal that is discharged as wastewater. They do not include the impacts of inflow and infiltration or seasonal consumptive use variations on actual wastewater discharge amounts.

[2]Total Return to Haw River Basin = Haw River Basin Consumption + Haw River Basin Wastewater Discharge.

[3]Analysis using the Cape Fear Hydrologic Model (Appendix B) showed that discharge of wastewater to the Cape Fear River basin upstream of Lillington was equivalent to discharge into Jordan Lake (Haw River basin). It is assumed that the discharge will be to the mainstem of the Cape Fear River.

[4]Interbasin Transfer = Water withdrawal from Haw River Basin – Total Returned to Haw River Basin

While the IBT need based on the calculations presented in Table 7 is about 25 mgd in 2030, the requested IBT of 27 mgd allows for about a 10 percent contingency to account for uncertainty in the projections. A limited sensitivity analysis shows the potential for the proposed IBT to reach a peak of 27 mgd during the planning period based upon considering the following factors:

- Historically the region's growth has exceeded projections, and all the towns are predicting growth at slower rates than have occurred recently.
- The towns are working toward aggressive conservation goals, but potential savings are hard to quantify and program success can vary greatly among different communities.
- It may take longer than expected to obtain permits for Cary's planned reuse system.
- It may take longer then expected to obtain permits and construct the planned WWTP discharging to the Cape Fear River basin.

According to a draft DWR document concerning IBTs in the Cape Fear basin completed for updating the Cape Fear Basinwide Water Quality Management Plan, there are several transfers between the Cape Fear and the Neuse basins. Currently, only a few numerical estimates have been made; however, the estimated IBT will be required in future water supply plan submittals to DWR. Durham and Raleigh were listed as transferring 18 and 0.8 mgd, respectively, from the Neuse to the Cape Fear basin, while Benson was listed as transferring 1.0 mgd from the Cape Fear to the Neuse basin. With the Cary/Apex permitted transfer of 16.0 mgd, the net "known" transfer is 1.8 mgd from the Neuse basin to the Cape Fear basin. The number of IBTs occur as noted in Table 8.

TABLE 8
Number of Transfers According to DWR Basin/Subbasin Classification

Source	Receiving	IBT	Emergency IBT	Total
Haw basin	Neuse basin	1	2	3
Neuse basin	Haw basin	2	3	5
Cape Fear basin	Neuse basin	3	2	5
Neuse basin	Cape Fear basin	2	5	7

Note: The basin numbers include the transfers indicated for the subbasins. DWR's names of basin for IBT purposes differs from North Carolina Department of Water Quality's (DWQ's) standard identification procedures.

SECTION 3

Existing Environment and Primary or Direct Consequences

The existing environment for the proposed IBT study area is divided into two sections:

- Section 3.1—Source Basin, which describes the portion of the study area from which raw water is withdrawn
- Section 3.2—Receiving Basin, which describes the portion of the study area where wastewater is discharged

Each basin is further divided and described by the following potentially affected areas: wetlands, land use, fish and wildlife resources, water resources/water quality, air quality, groundwater resources, noise level, and toxic substances/hazardous waste.

The existing environment is described for each area studied, followed by a discussion of the primary consequences, if any, on the area. The secondary/cumulative impacts of the proposed IBT as a whole are discussed in Section 4. The data were gathered through literature reviews, Internet searches, GIS queries, phone conversations, letters, and meetings with various resource agencies.

3.1 Source Basin

The "source basin", for purpose of the IBT rules, is DWR's designated Haw River basin (part of the Cape Fear River basin). The source basin study area includes Jordan Lake and the watershed areas of 03-06-05 and 03-06-06, and the Haw River arm of Jordan Lake (and its floodplain). The area contained within the current jurisdictional boundaries of the Town's of Apex, Cary and Morrisville and RTP South is referred as the Urban Service Area in this document. The Haw and Cape Fear rivers from the Jordan Lake Dam to the town of Lillington are also included in the study area (Figure 1). Potential flow impacts downstream of Lillington at Fayetteville are evaluated to address specific comments from stakeholders during the EA and EIS scoping processes.

The boundary of the study area around water bodies is offset 0.7 miles from the shoreline to incorporate flood plain areas as shown on FEMA flood zone maps.

The Cape Fear River basin encompasses a land area that is approximately 200 miles long and 60 miles wide stretching from northwest of Greensboro to southeast of Wilmington. One-third of the basin is located in the Piedmont and the remaining area lies in the Coastal Plain. The Cape Fear River, the largest river system in North Carolina, forms at the confluence of the Deep and Haw rivers in south central North Carolina in the Piedmont physiographic region and flows southeasterly for approximately 195 miles where it discharges into the Atlantic Ocean near Southport. The Cape Fear is the largest river basin lying completely within the state of North Carolina, with a total drainage area of more than 9,000 square miles. The basin includes portions of 27 counties and 114 municipalities, and encompasses about 600 miles of freshwater streams and rivers, 36 lakes, and approximately

60 square miles of estuarine waters (DWQ 1996; North Carolina Wildlife Resources Commission [NC WRC] 1998).

The portion of the Piedmont within the source basin is characterized by rolling hills and incised valleys. Land elevations in this area range from about 1,000 feet to approximately 300 to 400 feet. The floodplains are generally relatively narrow, but there are relatively broad in-stream areas. In contrast to the Piedmont, floodplains of major rivers in the Coastal Plain are broad and well developed. Along the border of the Piedmont and Coastal Plain, the land is also characterized by rolling hills (DWQ, 1996).

3.1.1 Wetlands

According to the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." In general, wetlands share three key characteristics: wetland hydrology, wetland soils, and wetland plants. Wetlands and vegetated riparian areas are valuable because they preserve biological diversity, protect wildlife, provide natural open spaces, protect water quality, stabilize stream banks, control erosion, and prevent flooding damage.

3.1.1.1 Existing Environment

The northern portion of the source basin project area is characteristic of the Piedmont physiographic province of the state, which is characterized by rolling topography with broad ridges, sharply indented stream valleys, and low gradient streams composed of a series of sluggish pools separated by riffles and occasional small rapids. Stream floodplains in the region are relatively narrow and mostly forested (DWQ, 1998). The southern portion of the source basin, downstream of Jordan Lake Dam, however, enters into the Coastal Plain Province, which is characterized by flat terrain and slow-moving, blackwater streams lined by extensive swamps, bottomland hardwood forests, or marshes. (DWQ, 1998).

Floodplains are the low, relatively flat-lying areas adjacent to streams that are subject to flooding during periods of intense rainfall. Associated with floodplains are often riverine wetlands, which function as storage areas for floodwaters, slowing runoff and thereby lessening flood levels downstream. These wetlands also serve as areas of deposition for sediment and other material carried by floodwaters. Area streams tend to have relatively narrow floodplains, although broader floodplains are associated with several significant local streams in the source basin, including White Oak Creek. Riverine wetlands are associated with each of these floodplains and are common throughout the area.

The type and area of wetlands within the study area were determined using U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps in Geographical Information System (GIS) format. The coverage of each wetland type within the study area was estimated directly from the GIS database (USFWS, 1999A). The source basin study area is comprised mostly of open water, the majority of which is represented by Jordan Lake and the Haw and Cape Fear rivers. Excluding open water, total wetland coverage within the entire source basin study area is approximately 37,454 acres. Of this total wetland acreage, 84.1 percent is located in the unincorporated area around Jordan Lake; 12.3 percent is within the Haw and Cape Fear River corridor; and 3.6 percent is within the Urban Services Area for

Apex, Cary, Morrisville, and RTP South (USFWS, 1999A). Table A-1 in Appendix A provides a complete breakdown of wetland acreages from the NWI GIS data search.

The source basin study area is extensively covered by palustrine forested wetlands. Broad-leaved deciduous bottomland forested wetlands constitute approximately 38 percent of the total wetland coverage within the source basin study area. Other palustrine wetland types within the study area of the source basin include palustrine scrub shrub, palustrine emergent, and palustrine unconsolidated bottom wetlands, representing approximately 2 percent, 0.7 percent, and 4.5 percent, respectively, of the total wetland coverage within the source basin study area. Extensive Headwater Forest wetlands are associated with the floodplains of the headwater tributaries of Jordan Lake (Morgan Creek, New Hope Creek, and Northeast Creek) and, to a lesser extent, with the floodplain of the Haw and Cape Fear rivers downstream of Jordan Lake Dam, which are dominated with Palustrine and Riverine Bottomland Hardwood Forests (North Carolina Wetlands Restoration Program [NCWRP], 1998A).

Lacustrine (lake) unconsolidated bottom wetlands are also found surrounding Lake Jordan, making up approximately 48 percent of the total wetland acreage in the source basin. The riverine unconsolidated bottom classification constitutes approximately 2 percent of the wetland coverage within the study area of the source basin, located primarily along the Haw and Cape Fear corridors (USFWS, 1999A).

Dominant tree species of the forested wetlands in the source basin include red maple (*Acer rubrum*), and ash (*Fraxinus* spp.)(Schafale, 1990).

The types of natural wetland community types known to occur in the counties that compose the source basin project area are listed and described in Table A-3 in Appendix A. The majority of the wetlands within the source basin project area are of bottomland hardwood and headwater forests of the Piedmont/Low Alluvial Forest, Piedmont/Mountain Levee and Swamp Forest, Piedmont/Mountain Bottomland Forest, Floodplain Pools, Piedmont/Mountain Semi-Permanent Impoundment, Rocky Bar and Shore, or Upland Depression Swamp Forest natural community types (NCWRP, 1998A; Natural Heritage Program [NHP],1999).

The Cape Fear River basin contains many rare animal and plant species which are dependent on wetlands or open water for their existence. For more information on these species, please see the Fish and Wildlife Section of this EIS.

3.1.1.2 Primary Impacts

The proposed transfer does not require the construction of additional water intake structures in Jordan Lake. Therefore, direct impacts are not expected. However, expansion of associated facilities such as pumps, raw water transmission lines, water treatment plants, and the finished distribution system may be necessary. These associated projects will be permitted separately under appropriate state and federal programs and their wetland and environmental impacts evaluated under separate North Carolina Environmental Protection Agency (NCEPA) or National Environmental Policy Act (NEPA) processes, when and if they become necessary.

DWR has developed a hydrologic model for the Cape Fear River Basin for water supply planning, using Moffat & Nichol and the Danish Hydraulic Institute as contractors. The model considers all major water withdrawals (water supply and irrigation) and discharges

within the Cape Fear River basin, including those into and out of Jordan Lake. The model has been used to evaluate the impact of the requested IBT on Jordan Lake surface water elevation, minimum releases from the dam, water quality pool levels, the target flows at Lillington, flows at Fayetteville, and water quality pool levels (see Appendix B). The proposed IBT will not have any significant direct impacts on wetlands in the source basin. Model results indicate that the proposed IBT increase will not result in significant changes in surface lake elevations, minimum lake releases, or downstream flows compared to the other alternatives and the base scenarios. The proposed IBT will not have any direct impacts on wetlands in the source basin due to construction since there is no construction associated with the proposed IBT.

3.1.2 Land Use

3.1.2.1 Existing Conditions

This section summarizes the existing land cover and land uses in the source basin. The primary source for land cover information is satellite imagery data developed by Earth Satellite Corporation for the North Carolina Center for Geographic Information and Analysis (NCCGIA). Created to assist governmental agencies and others in making resource management decisions, these data provide a seamless coverage of the Source and Receiving basins. The satellite imagery reflects land cover conditions at imagery dates and field data collection activities occurring between May of 1993 and June of 1996.

Urban / Developed Lands

The major land cover categories are described as Urban Lands, Agricultural Lands, Forest Lands, Shrub Lands, and Water. The NCCGIA land coverage classifies urban land uses as either high intensity developed or low intensity developed. High intensity developed land has more than 80 percent synthetic or impervious land cover, while low intensity developed land represents between 50 and 80 percent synthetic cover.

The overall acreage and the proportions of these land cover categories are illustrated in Table A-1 in Appendix A. It should be noted that the State and Triangle J Council of Government generally concur that the NCCGIA land use data underestimates low density urban land. Efforts to update land use from the source satellite imagery are in the process of being funded by the Triangle J Council of Governments through funds provided by the Cape Fear River Assembly.

Jordan Lake and Urban Services Area. As shown on Table A-1 in Appendix A, land uses surrounding Jordan Lake in the source basin project area (see Figure 2) include 178,565 acres of forest; 1,603 acres of agriculture; 21,521 acres of open land; and 13,873 acres of urban land uses. The Urban Services portion of the source basin contains the western edges of Cary, Morrisville, Apex, and RTP South. This area also includes portions of planned urban areas within Cary's jurisdiction abutting the ACOE land around Jordan Lake, which includes Cary's existing town boundary, and the Extraterritorial Jurisdiction (ETJ) and Special Study Areas for Cary immediately adjacent to Jordan Lake. In this planned urban services area within the source basin, there are 21,391 acres of forest land; 586 acres of agricultural land; 4,445 acres of open land; and 880 acres of urban land (see Table A-1 in Appendix A).

As shown on Table A-4 in Appendix A, Subbasins 03-06-05 and 03-06-06 (which contain Jordan Lake and the Urban Services Area on the source basin side for the project), rapidly increased annual population growth between 1980 and 1990 (2.5 percent), with a steadily

increasing amount of population density. Total population and density for these subbasins in 1990 was 159,975 people, with 277 persons per square mile for Subbasin 05, and 509 persons per square mile for Subbasin 06 (DWQ, 1996).

Most of the developed lands surrounding Jordan Lake are concentrated along headwater tributaries draining into the lake from the north and northeast. Several large residential Planned Unit Development projects (i.e., Panther Creek and Amberly) are planned in Cary's ETJ, immediately to the east of ACOE land surrounding Lake Jordan's northeast boundary.

The largest concentration of high and low intensity developed lands occurs along New Hope Creek in the City of Durham. Morgan Creek drains developed lands from the cities of Chapel Hill and Carborro. The headwaters of Northeast Creek drain most of Research Triangle Park, and small portions of the cities of Morrisville and Durham.

Generally, soils in the receiving basin around Cary function well as absorption fields for septic systems and present few problems for construction, such as high shrink-swell potential. However, soils in the source basin, particularly at the western edge of Wake County and in Chatham County, tend to function poorly as absorption fields and have a high shrink-swell potential. Very large lot sizes for residential and other development are therefore planned in the part of the Chatham County Study Area beyond Cary's future urban services area, since the area is not planned to be served by municipal sewers (Cary, 1996).

Haw and Cape Fear River Corridor. As shown on Table A-1 in Appendix A, land uses surrounding the Haw and Cape Fear rivers in the source basin project area include 17,105 acres of forest; 964 acres of agriculture; 2,697 acres of open land; and 257 acres of urban land uses. Total acreage of land in the river corridor portion of the source basin is 22,461 acres, including 1,437 acres of water bodies.

As shown on Table A-4 in Appendix A, Subbasin 03-06-07 (which contains the stretch of the Haw and Cape Fear Rivers shown on Figure 1 and its basin drainage area), has very low population density, but has, in the past ten years had a very rapid increase in annual rate of population growth (4.4 percent). Total population and density for this subbasin in 1990 was 39,713 people, with 98 persons per square mile (DWQ, 1996).

South of Jordan Lake, small pockets of developed land are found along State Highway 55 and US Highway 401 in the cities of Apex, Holly Springs, and Fuquay-Varina. Portions of Apex and Holly Springs drain to White Oak Creek, a tributary to Harris Reservoir, and the Cape Fear River. Fuquay-Varina drains to the Cape Fear River via Neal Creek.

Public Lands (Parks/Recreation Areas and Greenways)

This section discusses lands designated for a particular public or conservation use. These include State and local parks, recreation areas, and greenways. Park and recreation areas were identified based on data created cooperatively by the NC Department of Environment and Natural Resources (DENR), NC Division of Parks and Recreation, and the NCCGIA, depicting the boundaries of recreation projects constructed using Land and Water Conservation Funds. These public lands, generally held in perpetuity, cannot be redeveloped without a permit. These lands include: recreation sites; district, county, municipal, and community parks; playgrounds; greenways; nature trails; ballparks; beach access; state boating access areas; and some state forests. The source basin contains a variety of public lands, which are described on Table A-5 provided in Appendix A.

Figure 2

Jordan Lake State Recreation Area and Raven Rock State Park are both located in the source basin. Jordan Lake is a very popular regional recreational area, containing 14,300 acres of camping, fishing, boating, sailing, hiking, swimming, and picnicking areas (DeLorme, 1993). Fishing tournaments are held throughout the year, with the most plentiful recreational fish caught being crappie, catfish, and pan fish, although largemouth bass, striped bass, white bass, carp, and sunfish are also present (DeLorme, 1993). All twelve recreational areas around the lake provide boat ramps, fishing areas, and parking. Most others provide camping, swimming, and trails. Many visitors at the site enjoy birdwatching. In addition to these recreational uses, Jordan Lake contains an educational state forest on the western shore, off of Big Woods Road, that provides outdoor environmental education, including a talking tree trail, and picnic facilities (NC Parks and Recreation, 1997).

According to Mike Seigh with NC Parks and Recreation, Jordan Lake had an estimated 1.2 million visitors in 1997, with 70 percent of the visitation occurring between May and September. Of the visitors, 90,000 were campers and 75 percent of those were NC residents. Potential impacts from low flows could be inaccessible boat ramps and docks, and increased exposure of underwater hazards (e.g., tree stumps). Most impacts to recreation would occur with an 8- to 10-foot drop in water elevation (Seigh, 1998).

Raven Rock State Park consists of 3,136 acres located on the Cape Fear River in Harnett County. Popular activities at the park include fishing at the Fish Traps and at the mouth of Campbell Creek and canoeing the Class I-III rapids of the 56-mile Cape Fear River Canoe Trail. Raven Rock is renowned for its spectacular rock cliffs. Hiking along the Rock Loop Trail is also a popular recreational activity in the park. Nature study opportunities are provided (DeLorme, 1993).

In addition to public lands utilized for recreation, the source basin has a variety of lands dedicated to conservation and natural resource protection. These lands include the 41,872-acre New Hope Wildlife Game Lands around the northern edge of Jordan Lake and the 2,421-acre Lee Game Lands and Shearon Harris Game Lands near Harris Reservoir off the Cape Fear River north of Lillington. These gamelands are administered by the WRC and contain hunting opportunities for deer, raccoon, fox, rabbit, squirrel, turkey, quail, and waterfowl (DeLorme, 1993).

The portion of the Haw River in the project area northeast of Pittsboro is also a popular fishing area, with species caught including largemouth bass, white bass, catfish, and sunfish (DeLorme, 1993).

A network of greenways is planned for or already exists in most of the municipalities throughout the basin. Cary, Apex, Morrisville and Wake County have been working together as well as with the Triangle Land Conservancy, the Triangle Greenways Council, and the NC Division of Parks and Recreation (Trails) to ensure connectivity of their greenways and other trails on a regional basis. There are plans to link the Towns' greenways with the American Tobbacco Trail as well as Umstead Park trails, Lake Crabtree, and Lake Johnson. The Southwest Wake County land use plan that has been adopted includes a regional greenway system of approximately 46 miles to continue Town greenways.

Cary is proposing an extensive series of greenways and conservation corridors throughout the portion of its jurisdiction in the Jordan Lake watershed. In addition, Cary is planning some neighborhood, regional, and community parks adjacent to ACOE property on the eastern edge of Jordan Lake (Cary, 1996).

Prime Agricultural and Forestry Land

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture (USDA). It is of major importance for meeting the nation's short and long range needs for food and fiber. These soils are best suited for producing high yields of food, feed, forage, fiber, and oilseed crops with minimal input of energy and economic resources and the least damage to other environmental resources. Approximately 55 percent of the soils in Orange County, 21 percent in Durham County, 23 percent in Chatham County, and 35 percent in Wake County are considered prime farmland (personal communication with jurisdictional Soil and Water Conservation Districts).

Most agricultural land uses in the source basin occur to the west of N.C. 55, with centers in the Green Level and Carpenter communities, and to the west of Jordan Lake, south of Chapel Hill (Cary, 1996). As shown on Table A-1 included in Appendix A, agricultural land made up less than one percent of the land within the Jordan Lake project area, five percent of the Haw and Cape Fear corridor area, and two percent of the Urban Services Area within the source basin. Major crops grown include tobacco, soybeans, wheat, barley, oats, corn, and pastures and forages.

Soils in the floodplain around Jordan Lake consist mostly of Chewacla soils that are poorly drained (USDA, 1971; USDA, 1977). Soils that have a high water table and are frequently flooded have severe limitations when used for agriculture even if those soils qualify as prime agricultural land. These limitations would almost entirely exclude all of the soils in the floodplain of the waterbodies in the source basin study area from being considered of significant importance as prime agricultural land.

Although some NC counties have enacted voluntary farmland preservation programs, they have not been adequate to slow the conversion of agricultural lands to suburban land uses. It has been estimated that Wake County alone has lost 50 percent of its agricultural land since 1970. Under present policies, it is likely that suburbanization will continue within the source basin, around the land controlled by the ACOE (encircling Jordan Lake) and south of Jordan Lake Dam into Lee and Harnett counties. Agricultural land throughout the source basin is rapidly converting to large-lot residential subdivisions despite a lack of public water and sewer services.

Although much of the original forest community in the source basin study area has progressively been cleared out for wood products, crop production, and residential and industrial development, significant forested areas remain in eastern Chatham County surrounding Jordan Lake and in the New Hope Game Lands. Natural reseeding of abandoned tracts of land in urban areas usually results in a mixture of pine and second growth hardwoods. Forest land occupies approximately 217,061 acres or about 83 percent of the total land area in the source basin study area. The natural forest vegetative cover for the source basin consists primarily of mixed coniferous and broadleaf forests. Table A-6 in Appendix A lists the known types of terrestrial or upland forest Natural Communities that occur in the source basin counties. Wetland forests known to exist in the source basin are listed in the Wetlands Section. Additionally, the distribution of forest land in the study area is presented in Figure 2.

Forests provide a number of "quality of life" benefits for local communities. For example, the conversion of large tracts of forest to paved surfaces and grass lawns can have profound impacts on urban micro-climates, causing summer temperatures to be higher and winter

temperatures to be lower. For a number of reasons, this micro-climatic effect is also linked to declining air quality. Forests also provide habitat for wildlife and selected sites may serve the community as parks, greenways, and recreational areas. Forested buffers protect water quality in local streams by slowing stormwater runoff and removing nutrients, sediment, and other pollutants, and can also be used as a buffer or screen between incompatible land uses. Finally, trees provide an important urban amenity by enhancing the beauty and overall attractiveness of a community, thereby contributing to overall land value (Cary, 1996).

Archaeological and Historic Areas

NCEPA requires the conservation and protection of North Carolina's natural resources and preservation of "the important historic and cultural elements of our common inheritance." The Upper Piedmont has enjoyed a rich history since being settled by Europeans in the 1700s.

Historic structures from those periods are significant since they preserve North Carolina history. Historic districts consist of whole blocks of downtown areas including many structures that are culturally and historically significant. Most of the historic sites and districts in the source basin are clustered around the cities of Durham, Chapel Hill, and Carrboro on tributaries draining to Jordan Lake from the north. There are also four 19th century National Register of Historic Places (NRHP) sites scattered along the shores of Jordan Lake. Table A-7 in Appendix A lists the historic sites and districts located in the counties that make up the source basin, as listed in the NRHP as determined by the Department of Cultural Resources, Division of Archives and History. Wake County is not considered part of the source basin for purposes of this analysis. The total number of historic sites and historic districts in the counties that make up the source basin are 135 and 22, respectively.

Archaeological sites are important since they contain the only material remains of extinct Native American cultures dating back 12,000 years throughout North Carolina. The Cape Fear and Neuse River basins contain many archeological sites that have been surveyed and several sites where significant archeological resources have been found from many native groups that lived in the region up until 200 years ago. As shown on Table A-8 in Appendix A, the total number of prehistoric sites found in the counties that compose the source basin (excluding Wake County) is 2,050.

According to the NC Cultural Resources Department (NC CRD), there were more than 7,000 recorded archaeological sites located within the Cape Fear River Basin, 1,200 of which were located in Wake County. Due to the size of the project's source and receiving basins, and the fact that no construction will occur with the project, NC CRD did not require the preparation of an archeological survey for the project (refer to Gledhill-Early, 1998, letter in Appendix C).

3.1.2.2. Primary Consequences

The proposed IBT will not have any direct impacts on urban/developed land, public lands, recreational land, prime agricultural land, forest land, or archeological or historic resources in the source basin, since no construction is planned for the proposed IBT. Many of the infrastructure improvements that transfer finished drinking water to the Neuse River subbasin are already in place.

The Cape Fear River Basin hydrologic model shows that the proposed IBT increase will not have a significant effect on land use resources since there will be no significant changes in lake elevation nor significant modification to releases from the Jordan Lake dam compared to the other alternatives and base scenarios. Flooding of low areas is not expected under the proposed action.

3.1.3 Fish and Wildlife Resource

3.1.3.1 Existing Environment

Wildlife Habitat and Resources

The vegetation in the central Cape Fear River basin around Jordan Lake is characterized mainly by mixed upland hardwoods, mixed hardwoods and conifers, and southern yellow pine. Interspersed among these types of vegetation are bottomland forest and hardwood swamps. The northern part of the river basin consists mainly of mixed upland hardwoods and southern yellow pine with small areas of bottomland forest, hardwood swamps, and deciduous shrubland. The southern edge of the river basin and the southeastern portion of the river basin have a high density of cultivated land. The southwestern portion of the basin is mainly mixed hardwoods and conifers mixed with southern yellow pine. Throughout the entire river basin are large pockets of mixed hardwoods and conifers (NHP, 1999).

Jordan Lake is not only a major regional water supply, but the gamelands and recreational lands that surround it play a key role in maintaining populations of wildlife throughout the region. Natural wetland and forest community types that exist in the counties that make up the source basin are listed in separate tables in Appendix A. Figure 3 summarizes rare and significant species and habitats.

Fishery Habitat and Aquatic Resources

The major tributaries which feed into the Cape Fear are generally dark and acidic swamp-drainage streams. The waters of the Cape Fear are usually very turbid. The majority of the Cape Fear is a typical coastal plain river meandering along a flat, broad flood plain and forming a series of pools. Aquatic resources within the basin are varied and include important sport fish, commercial fish, and threatened and endangered species (DWQ, 1996).

Over 95 fish species have been found in the Cape Fear River basin including a variety with recreational and commercial importance. Striped bass are stocked regularly in Jordan Lake by the WRC (NC WRC, 1998). Recreationally and commercially important anadromous species, including striped bass, American and hickory shad, and herring, migrate into freshwater portions of the Cape Fear River and tributaries to spawn during the spring (NC WRC, 1998).

Sport fishing in the study area occurs in farm ponds, municipal water supply reservoirs, and riverine sections of the Cape Fear and its tributaries. Species sought include many different sunfish, bass (striped and largemouth), and catfish. Jordan Lake supports at least 28 different species of fish including several different species of bass, sunfish, and shad, as described on Table A-9 in Appendix A. Anadromous species occurring in the Cape Fear Estuary, lower Cape Fear River, and Northeast Cape Fear River include blue-back herring, alewife, hickory shad, and Atlantic sturgeon. In addition, American shad and striped bass are actively pursued by anglers.

The majority of commercial fishing occurs a substantial distance downstream of the study area within the Cape Fear estuary and immediately upstream of Lock and Dam No. 1. Species sought include marine-estuarine, anadromous, and freshwater.

Rare and Protected Species or Habitats

The Cape Fear River basin is home to 30 endangered, threatened, or special concern species, including fish, amphibians, mammals, crustaceans, and mollusks. Figure 3 shows the location of rare and significant species and habitats in the project area, and Table 9 lists significant rare and protected species in the source basin, as provided by the NHP. A discussion of selected significant species, habitat, and location is found below.

In addition to these species, several significant natural areas and sites have been identified by LeGrand (1999) and Roe (1986) around Jordan Lake, including:

- New Hope Creek Floodplain (Stagecoach Road to NC 54)
- New Hope Creek Floodplain (north and south of Old Chapel Hill Road)
- Haw River Habitat (confluence of Haw River and Lake Jordan)
- Jordan Lake Eagle Foraging Habitat (entire length of Jordan Lake north of US64)
- Morgan Creek Swamp (Jordan Lake to Farrington Mill Road)

Aquatic Vertebrates

Cape Fear shiner (*Notropis mekistocholas*)

The Cape Fear shiner is both a federal and state listed endangered species. The shiner is a small minnow that is mostly found in pools, slow riffles, and runs with gravel, cobble, or boulder bottoms. It requires good currents, circumneutral pH, and abundant water willow (*Justicia americana*) (Jon Alderman, Wildlife Resources Commission, communication 1998). The Cape Fear shiner is small, rarely exceeding 2 inches in length. The fish's body is flushed with a pale silvery yellow, and a black band runs along its sides (Snelson, 1971). The fins are yellowish and somewhat pointed. The upper lip is black, and the lower lip bears a thin black bar along its margin. The Cape Fear shiner, unlike most other members of the large genus Notropis, feeds extensively on plant material, and its digestive tract is modified for this diet by having an elongated, convoluted intestine. Plant material forms the primary part of the shiner's diet. No information is presently available on the species' breeding behavior, fecundity, or longevity (USFWS, 1999B).

The Cape Fear shiner formerly occurred in Haw River tributaries impounded by the reservoir, and probably occurred in segments of the Haw and lower New Hope Rivers now flooded and no longer suitable. It does not occur in the Neuse River basin.

The USFWS has identified it to exist in four small populations in the Cape Fear drainage in Randolph, Moore, Lee, Harnett, and Chatham counties, North Carolina—approximately 4.1 miles of the Rocky River from North Carolina State Highway 902 Bridge downstream to Chatham County Road 1010 Bridge; approximately 0.5 river mile of Bear Creek, from Chatham County Road 2156 Bridge downstream to the Rocky River, then downstream in the Rocky River (approximately 4.2 river miles) to the Deep River, then downstream in the Deep River (approximately 2.6 river miles) to a point 0.3 river mile below the Moncure, North Carolina, U.S. Geological Survey (USGS) Gaging Station (USFWS, 1999B). Two additional populations were identified in 1995 to be in the Haw River in Chatham County, one above the dam at Bynum, and the other below the dam at Bynum, to the headwaters of

the Haw River arm of Jordan Lake. Both of these populations were considered small, isolated, and vulnerable to extirpation (Alderman, 1995).

TABLE 9
Threatened and Endangered Species Potentially Occurring in the Source Basin

Scientific Name	Common Name	State Status	Federal Status
	Aquatic Resources		
Vertebrates			
Notropis mekistocholas	Cape Fear shiner	E	E
Hemidactylium scutatum	four-toed salamander	SC	-
Acipenser brevirostrum	Shortnose sturgeon	E	E
Invertebrates			
Alasmidonta varicosa	brook floater	T	FSC
Fusconaia masoni	Atlantic pigtoe	T	FSC
Lampsilis cariosa	Yellow lampmussel	T	FSC
Strophitus undulatus	Squawfoot	T	-
Elliptio roanokensis	Roanoke slabshell	T	-
Alasmidonta undulata	Triangle floater	T	-
Gomphus septima	Septima's clubtail dragonfly	SR *	FSC
Toxolasma pullus[1]	Savannah lilliput	T	FSC
	Terrestrial Resources		
Vertebrates			
Haliaeetus leucocephalus	bald eagle	E	T
Picoides borealis	red-cockaded woodpecker	E	E
Vascular Plants			
Ptilimnium nodosum	Harperella	E	E
Phacelia covillei	buttercup phacelia	C	-
Juglans cinerea	Butternut		FSC
Rhus michauxii	Michaux's sumac		E
Echinacea laevigata	Smooth coneflower		E
Monotropsis odorata	Sweet pinesap		FSC
Isotria meedeoloides	small whorled pogonia	E	E
D*elphinium exaltatum*	Tall larkspur		FSC

E = Endangered
T = Threatened
SC = Special Concern
FSC = Federal Special Concern
SR * = Significantly Rare (only a NHP designation)
C = Candidate
Source: NHP, 1997 & 1999; 1 USFWS; personal communication with Tom Augspurger

Figure 3

At least until 1987, the shiner was present in the Cape Fear River and tributaries between Buckhorn Dam and Lillington. Although it was believed that it may be extirpated from this area a population of Cape Fear shiner was inventoried at the Haw River Aquatic Habitat Natural Area. This area is south of Highway 64 on the Haw River, immediately before the river becomes part of Jordan Lake. No extant (living) populations have been found or are known to exist in the source basin project area in the immediate location of Jordan Lake or in the Cape Fear River below the Haw/Cape Fear confluence (Alderman, 1995 and USFWS, 1999C).

Four-toed salamander (*Hemidactylium scutatum*)

The four-toed salamander lives in moist mossy woods near seeps and in fish-free vernal pools with thick moss for nesting. It prefers peat bogs or mossy areas bordering streams as breeding sites. Its unique breeding habit, where eggs are laid in moss and larvae wiggle down to the water, makes them especially sensitive to any changes in hydrology (Braswell, personal communication). Adult salamanders have also been found in woodland habitats during summer. The four-toed salamander is found in several counties in North Carolina including eastern Chatham, western Wake, southern Durham, and Orange counties (Braswell and Murdock 1979). According to Alvin Braswell, with the NC Museum of Natural History, four-toed salamanders have been found at Jordan Lake, primarily using the western side of the lake for breeding. LeGrand (1999) found a healthy population of the species in Morgan Creek Floodplain Forest Natural Area, located on the northwest side of the lake, where Morgan Creek drains into Lake Jordan. *Hemidactylium scutatum* is a species of special concern for the state of North Carolina.

Shortnose sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is an anadromous species that prefers to live in deep pools with soft substrates and vegetated bottoms and moves to deeper water in winter. It spawns in freshwater wetlands or rapid streams with gravel or cobble bottoms. Historically, populations of this species were located throughout the Cape Fear drainage basin. It is both a federally and state listed endangered species.

Both Atlantic and shortnose sturgeon were once plentiful in the Cape Fear River but the population levels for both species are currently at low levels, with the few remaining individuals located primarily in the lower Cape Fear and Brunswick rivers. The last shortnose sturgeon to be captured in the Cape Fear River was collected in 1993 (NCWRC, 1998). Moser, who captured that last individual, observed in 1995 that low level dams such as Lock and Dam No. 1 on the lower Cape Fear River blocked upstream migration of shortnose sturgeon (Moser, 1995B). Recent conversations with Mike Wicker (USFWS) indicated that in the past few years the ACOE has improved their operations at the three lock and dams on the Cape Fear to allow more fish passage. He indicated that anadromous (and catadromous) fish and eels of all varieties are able to get above L&D Nos. 1 and 2 easily now, with some getting above No. 3. However, if they were to get above No. 3, they would be stopped at Buckhorn Dam, located above the Chatham/Harnett county line on the Cape Fear River (Mike Wicker, USFWS, personal communication).

American eel (*Anguilla rostrata*)

The American eel is a catadromous species which occupies temperate and tropical portions of the Atlantic Ocean. The American eel is the only North American species of eel. It is catadromous, spending most of its life in fresh or brackish water and returning to the sea to breed and die. Eels have extremely elongated bodies referred to as anguilliform, and they travel by synchronous undulations of the body. They often hide when hunting by sliding backwards into crevices and under soft sediment. Although not specifically sited in the project area, a literature search indicates that this species is very prevalent in Virginia's freshwater streams, from the coastal plain to the Piedmont, and is listed on species lists for some of North Carolina's streams (NC Museum lists it for the Neuse basin). Obstructions caused by dams have been documented to extirpate the species from river segments in VA.

Terrestrial Vertebrates

Bald eagle (*Haliaeetus leucocephalus*)

The bald eagle is a large raptor. The characteristic adult plumage consists of a white head and tail with a dark brown body. Juvenile eagles are completely dark brown and do not fully develop the majestic white head and tail until the fifth or sixth year. Fish are the primary food source but bald eagles will also take a variety of birds, mammals, and turtles (both live and as carrion) when fish are not readily available. Adults average about three feet from head to tail, weigh approximately 10 to 12 pounds, and have a wingspread that can reach seven feet. Generally, female bald eagles are somewhat larger than the males. Breeding pairs of bald eagles unite for life or until the death of their mate. The breeding season varies throughout the U.S., but typically begins in the winter for the southern populations and progressively shifts toward spring the further north the populations occur. The typical nest is constructed of large sticks and lined with soft materials such as pine needles and grasses. The nests are very large, measuring up to six feet across and weighing hundreds of pounds. Many nests are believed to be used by the same pair of eagles year after year. Female eagles lay an average of two eggs; however, the clutch size may vary from one to three eggs. The eggs are incubated in about 35 days. The young fledge 9 to 14 weeks after hatching and at approximately 4 months the young eaglets are on their own (USFWS, 1999B).

Nesting bald eagles are generally associated with mature, secluded forests (particularly conifers) where there are flowing streams, areas of open water, and abundant fish. Bald eagles began nesting at Jordan Lake shortly after it was completed in 1981. Prior to this, no nestings had been reported in North Carolina since 1971. Four active bald eagle nests were recently found on lands surrounding Jordan Lake, three of which were on ACOE lands at the northern end of Jordan Lake (LeGrand, 1999). The bald eagle is federally listed as a threatened species and state listed as an endangered species; however, the bald eagle will be delisted at the federal level as a threatened species in the near future. It is unknown at this time if the eagle will be afforded any protected status once this delisting occurs.

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker is 18 to 20 centimeters long with a wing span of 35 to 38 centimeters. There are black and white horizontal stripes on its back, and its cheeks and underparts are white. Its flanks are black streaked. The cap and stripe on the side of the neck and the throat are black. The male has a small red spot on each side of the black cap. After

the first post-fledgling molt, fledgling males have a red crown patch. This woodpecker's diet is composed mainly of insects, including ants, beetles, wood-boring insects, caterpillars, and corn ear worms, if available. About 16 to 18 percent of the diet includes seasonal wild fruit (USFWS, 1999B).

Egg laying occurs during April, May, and June with the female utilizing her mate's roosting cavity for a nest. Most often, the parent birds and some of their male offspring from previous years form a family unit called a group. A group may include one breeding pair and as many as seven other birds. Commonly, these groups are comprised of three to five birds. Rearing the young birds becomes a shared responsibility of the group. However, a single pair can breed successfully without the benefit of the helpers.

This bird's range is closely tied to the distribution of southern pines. Historically, the red-cockaded woodpecker occurred from East Texas and Oklahoma, to Florida, and north to New Jersey. The present distribution is similar, except the species has been extirpated from Missouri, Maryland, and New Jersey. Longleaf pines (*Pinus palustris*) are most commonly used, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods, or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 30 years old or older with foraging preference for pine trees 10 inches or larger in diameter. In good, well-stocked pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres.

Roosting cavities are excavated in living pines, and usually in those which are infected with a fungus producing what is known as red-heart disease. The cavity tree ages range from 63 to 300 plus years for longleaf, and 62 to 200 plus years for loblolly and other pines. The aggregate of cavity trees is called a cluster and may include 1 to 20 or more cavity trees on 3 to 60 acres. The average cluster is about 10 acres. Completed cavities in active use have numerous, small resin wells which exude sap. The birds keep the sap flowing apparently as a cavity defense mechanism against rat snakes and possibly other predators. The territory for a group averages about 200 acres, but observers have reported territories running from a low of around 60 acres, to an upper extreme of more than 600 acres. The expanse of territories is related to both habitat suitability and population density (USFWS, 1999B).

Natural Heritage Program files indicate that a population of red cockaded woodpeckers existed in the study area near Shearon Harris. This population has not been in existence since 1980 (NHP, unpublished records).

Invertebrates

Cape Fear mussels (7 species)

Seven state protected species, the brook floater (*Alasmidonta varicosa*), Atlantic pigtoe (*Fusconaia masoni*), yellow lampmussel (*Lampsilis cariosa*), squawfoot (*Strophitus undulatus*), Roanoke slabshell (*Elliptio roanokensis*), Savanna lilliput (*Toxolasma pullus*), and triangle floater (*Alasmidonta undulata*) occur in free-flowing streams in the Cape Fear River basin. Areas with significant populations include the Deep River, Rocky River, Cape Fear River above Fayetteville, the Black River, Town Creek, and Rices Creek. A population of the Savannah lilliput (federally listed as a Species of Concern) is listed by the USFWS as existing in the Morgan Creek/University Lake watershed near Chapel Hill (USFWS, 1999B; USFWS, personal communication with Tom Augspurger of USFWS). Populations of both the yellow lampmussel and brook floater were found by Alderman in the Haw River Aquatic Habitat

Natural Area, south of US 64, where the Haw River meets Jordan Lake (NCWRC, unpublished records). All seven of the mussels mentioned here are listed as threatened by the state of North Carolina.

Septima's clubtail (*Gomphus septima*)

Gomphus septima is a species of dragonfly in the Cape Fear drainage and occurs in sympatry with the Cape Fear shiner. It may occur perched on rocks, in riffle habitats composed of shallow depths, swift moving waters, and high oxygen levels. Like the Cape Fear shiner, it requires abundant water willow (*Justicia americana*). It did occur in other streams with similar habitats to the Cape Fear River in the 1960s, but is no longer found in those streams (Ken Tennessen, Tennessee Valley Authority, personal communication 1998). The Natural Heritage Program (unpublished records_inventoried this dragonfly within the Haw River Aquatic Habitat Natural Area, south of US 64, where the Haw River meets Jordan Lake. *Gomphus septima* is a federal species of concern.

Vascular Plants

Harperella (*Ptilimnium nodosum*)

Harperella is an annual plant that occurs in rocky or gravelly shoals and margins of clear, swift-flowing stream sections, along the edges of intermittent pineland ponds in the coastal plain, in damp meadows, or in soggy ground around springs. It can tolerate a certain amount of flooding, but will be smothered if too much silt is deposited. Harperella is found in Chatham County along a stretch of the Deep River and in Granville County on a Tar River tributary (WWF Guide to Endangered Species of North America Vol. I. 1992). It is both a federally and state listed endangered species.

Buttercup phacelia (*Phacelia covillei)*

Phacelia covillei, also known as buttercup phacelia, or *Phacelia ranunculacea*, is usually found in alluvial woods or floodplains. It is found in several counties in North Carolina including Chatham County. *P. covillei* is found in the upper headwaters of the Cape Fear River in the Potomac. It has a narrow distribution, but is abundant in this area (Jame L. Amoroso, Natural Heritage Program, personal communication 1998). LeGrand (1999) found this species on two Natural Area sites around Jordan Lake—Poe's Ridge and Haw River Slopes. This is a candidate species for the state of North Carolina.

Small whorled pogonia (*Isotria medeoloides*)

Isotria medeoloides is a terrestrial, woodland orchid. It is found most commonly in second-growth deciduous or deciduous-coniferous forest with an open canopy and shrub layer, a sparse herb layer, and light to moderate shade. Small whorled pogonia typically prefers deep leaf litter over an acidic loam with a low nutrient content (WWF Guide to Endangered Species of North America Vol. I. 1992). It is both state and federally listed as an endangered species.

3.1.3.2 Primary Consequences

In total, there appears to be a significant number of rare natural communities, Significant Natural Areas, and sensitive species potentially existing in the source basin project area. In addition, there is a substantial number of recreational fishery species that exist in the lakes and rivers that compose the source basin. No anadromous fish species, however, are

predicted in the source basin project area, due to several dams located downstream blocking upstream migration, especially Buckhorn Dam.

Both aquatic and terrestrial resources that inhabit lake or stream-side habitat, including aquatic and wetland plants, freshwater mussels, and fisheries in the source basin, could be directly affected by water quality and quantity changes from transfers of water out of the basin, if lake elevations or the volume or rate of flow into or out of the reservoir changes dramatically. Such changes could lead to either flooding or draining of sensitive species or habitat areas, or shifts in water quality, depending on how the hydrology in the system changes.

The Cape Fear River Basin hydrologic model has been used to evaluate the impact of the requested interbasin transfer on Jordan Lake surface water elevation, minimum releases from the dam, water quality pool levels, the target flows at Lillington, and flows at Fayetteville (see Appendix B). The proposed IBT will not have any significant direct impacts on fish, fish spawning or nursery areas, aquatic, wildlife or sensitive resources or their habitats within the source basin, above or below Jordan Lake dam in the source basin since model results do not predict significant changes in surface lake elevations or minimum lake releases compared to the other alternatives or base scenarios.

The proposed transfer does not require the construction of additional water intake structures in Jordan Lake and therefore will not cause any direct impacts to fish or wildlife resources.

3.1.4 Water Resources and Water Quality

3.1.4.1 B. Everett Jordan Lake and its Tributaries

Jordan Lake is used in part to maintain a minimum flow of approximately 550 to 600 cubic feet per second (cfs) at Lillington. The target flow is 600 cfs but a flow 550 cfs is considered acceptable due to flow variability (ACOE, personal communication with Alan Piner). The required minimum flow release from the Jordan Lake dam is 40 cfs. However, this minimum release only takes place during short duration events, such as maintenance. The reservoir is operated to meet a minimum low flow release of 130 to 200 cfs (ACOE, personal communication with Eric Farr). The dam is located on the Haw River just downstream of the confluence of the Haw River and the New Hope Creek.

Jordan Lake has a shoreline of approximately 150 miles. The major tributaries to Jordan Lake are the Haw River, Northeast Creek, New Hope Creek, and Morgan Creek (Figure 1). The reservoir is about five miles long on the Haw River arm, and 17 miles long on the New Hope Creek arm. The Jordan Lake Project encompasses an area of 46,768 acres of which 13,900 acres are permanently flooded to form a reservoir at 216 feet above mean sea level. At this elevation, Jordan Lake has a total capacity of 215,100 acre-feet, a maximum depth of 66 feet, and a mean depth of about 17 feet. The Haw River arm has a mean hydraulic retention time of five days, and the New Hope Creek arm has a mean hydraulic retention time of 418 days (DWQ, 1996; DENR, 1999).

Figure 4 delineates the Water Supply Watershed (WSWS) Areas in the study area. In North Carolina, all waterbodies used for public water supply are given a “WS” classification. Jordan Lake has been classified “WS-IV-NSW” waters. Minimum statewide water supply protection standards (certain watershed development and wastewater discharge restrictions) apply to the Water Supply Watershed Areas. Municipal and industrial point

sources are allowed in WS-IV waters. Chatham County, Holly Springs, Cary/Apex, OWASA, and Orange County have been authorized to withdraw water from Jordan Lake.

The lake has been eutrophic since it was filled in 1982. In 1983, the Jordan Lake drainage basin was classified as nutrient sensitive (NSW) and the DWQ implemented a basinwide nutrient management strategy aimed to control phosphorus inputs from point sources.

Elevated nutrient and chlorophyll a levels have frequently been found in the reservoir along with periodic blooms of blue-green algae. The nutrient enrichment of Jordan Lake has been reported by DWQ, the University of North Carolina at Chapel Hill, Triangle J Council of Governments, and the USGS, DENR, 1999; USGS, 1990; USGS, 1996). Researchers at UNC and USGS have reported that Jordan Lake supports a large phytoplankton standing crop that reduces ammonium, nitrate, and phosphate to very low concentrations when gross primary productivity is highest during the warm months (USGS, 1997; Kuenzler, et al., 1986). These low nutrient concentration periods coincide with lake's low surface water elevations (drawdown levels) that characterize the summer months. It has also been reported that the nitrogen and phosphorus concentrations during these periods are not consistently low enough to limit algal growth (Kuenzler, et al., 1986). According to USGS, the greatest concentrations of phosphorus generally occurred during late summer and fall months. Peaks in chlorophyll a concentration coincided with phosphorus peaks (USGS, 1996). A trend analysis conducted by USGS indicates that during the period 1991-1995 Jordan Lake experienced an increasing trend in chlorophyll a; however, a trend was not detected for total nitrogen, total phosphorus, total suspended solids, total iron, and total manganese (USGS, 1997).

DWQ reported, in a two-year study, that violations of the NC water quality standard of not greater than 110 percent saturation for dissolved gases occurred in Jordan Lake, with the highest values found in August (DENR, 1999).

DWQ and Triangle Area Water Supply Monitoring Project monitoring stations for the surface waters in the study area are shown in Figure 4. Monitoring locations in Northeast Creek and in New Hope Creek have revealed elevated median summer concentrations of nitrate/nitrite-nitrogen and conductivity. Elevated fecal coliform values have been observed in Northeast Creek, New Hope Creek, and Morgan Creek.

Bioclassifications of the Jordan Lake tributaries range from Excellent to Poor, with ecological health ratings ranging from Good to Poor/Fair. The lake is considered threatened for overall use due to elevated nutrients. New Hope Creek, and Morgan Creek are partially supporting their uses. Third Fork Creek (another lake tributary) and a section of Morgan Creek are not supporting its uses (DWQ, 1996). Figure 5 illustrates the Use Support Ratings for the study area.

Metal samples collected in Jordan Lake by DWQ in 1996-1997 indicated concentrations higher than the state water quality action levels for copper and zinc (DENR, 1999). Concentrations in excess of the action levels of copper, iron, and zinc have also been reported in ambient monitoring stations in New Hope Creek (near Blands), and Morgan Creek (near Farrington) (DEHNR, 1995). These parameters are included as Action Levels versus standards in the State rules because total recoverable measurements for these parameters are not necessarily indicative of toxicity related problems associated with bioavailable fractions of the metals.

Figure 4

DWQ has collected and analyzed 128 fish tissue samples in Subbasins 03-06-05 and 03-06-06 of the Jordan Lake watershed. The vast proportion of samples has been lower than FDA and U.S. EPA criteria for metals, except for five samples that had mercury concentrations above the FDA and U.S. EPA criteria. These three samples were collected at the mouth of New Hope Creek, Morgan Creek, and Folkner Creek (DEHNR, 1995).

According to DWQ, upstream water quality of the lake's major tributaries is being impacted by urban runoff (DWQ, 1996). A number of streams have been targeted for nonpoint source controls in the source basin. In particular, the body of Jordan Lake (including the arms of its major tributaries and the Haw River arm) has been given the highest priority rating for nonpoint source management of waters under Section 319 of the federal Clean Water Act and the Unified Watershed Assessment program. This rating will prioritize implementation of non-point source management strategies in the basin. University Lake, in the Morgan Creek watershed, has also been given high priority for nonpoint source controls because it provides habitat for the invertebrate Savannah lilliput (*Toxolasma pullus*). This species has been listed as threatened by the State of North Carolina and as a federal species of concern by the USFWS.

The USDA and DENR have also recently launched a Conservation Reserve Enhancement Program (CREP), with the participation of the Natural Resources Conservation Service (NRCS), the Farm Service Agency, the NC Wetlands Restoration Program, and the N.C. Clean Water Management Trust Fund to create 5,000 acres of buffers and conservation areas in the Jordan Lake watershed. This program uses financial incentives to encourage farmers to voluntarily remove sensitive land from agricultural use.

3.1.4.2 Cape Fear River

The confluence of the Haw River and the Deep River, downstream from the B. Everett Jordan Lake dam, form the Cape Fear River in Subbasin 03-06-07 (Figure 1). Subbasin 03-06-07 consists mainly of the Cape Fear River and several small tributaries. As shown on Figure 4, approximately one-third of the segment of the Cape Fear in the source basin study area (from the dam to Lillington) is classified "WS-IV" waters. Figure 4 delineates the Water Supply Watershed Areas in the study area. The Cape Fear River at Lillington has the following hydrologic characteristics: drainage area = 3,464 sq. mi^2; average flow = 3,580 cfs; and 7Q10 = 535 cfs. These flow statistics have been estimated by USGS after the Jordan Lake dam was constructed.

DWQ maintains two ambient monitoring stations in the segment of the Cape Fear River in our study area: Cape Fear River at NC 42 (near Corinth), and Cape Fear at US 401 (near Lillington) (Figure 1). Fecal coliform and iron levels exceeded criteria for 38 percent and 59 percent, respectively, for all samples collected near Corinth. These exceedances decreased to 25 percent for fecal coliform and to 47 percent for iron at US 401. Copper concentrations also exceeded the NC action level. Bioclassifications for the Cape Fear River at Lillington have been good from 1983 to 1993. Fish tissue samples collected within the portion of the study area have been below the FDA and U.S. EPA criteria for metals, dioxin, and organic contaminants, except for a sample collected near Moncure that was equal to the U.S. EPA screening value (DEHNR, 1995). An analysis conducted by CH2M HILL water quality data collected by the Middle Cape Fear River Association (MCFRMA) during the last half of 1998 indicated that the water quality of the river is good. The data further indicated that nutrient levels are elevated and that DO levels are compromised in the lower reaches of the river

(CH2M HILL , 1999). This segment of the Cape Fear is not considered NSW waters and it is fully supporting its uses. Figure 5 illustrates the Use Support Ratings for the study area.

3.1.4.3 303 (d) Listed Streams

Section 303(d) of the Clean Water Act requires that states develop a list of waters not meeting water quality standards or which have impaired uses. The State must prioritize these waterbodies and prepare a management strategy or total maximum daily load (TMDL). The Jordan Lake's major tributaries New Hope Creek, Northeast Creek, and Morgan Creek, are included in the North Carolina's 303 (d) list. In addition, other small stream and tributaries in the source basin study area are listed; these are: Third Fork Creek, Bolin Creek, Meeting of the Waters Creek, and White Oak Creek. Most of these streams have been reported to be impaired mainly due to urban run-off and land development, except for White Oak Creek that is believed to also be impaired by on-site septic systems. DWQ has assigned a medium priority to most of these streams.

3.1.4.4 Primary Impacts

As previously mentioned, DWR has developed a hydrologic model for the Cape Fear River Basin for water supply planning, using Moffatt & Nichol and the Danish Hydraulic Institute as contractors. The model was designed to assist DWR with evaluating Jordan Lake allocation and interbasin transfer issues. The model considers all major water withdrawals (water supply and irrigation) and discharges within the Cape Fear River basin, including those into and out of Jordan Lake. The model has been used to conduct analyses of the impact of the requested interbasin transfer on Jordan Lake surface water elevations, minimum releases from the dam, water quality pool levels, the target flows at Lillington, and flows at Fayetteville.

The ACOE has asserted that the withdrawal would have no impact on the current operation of the dam or the lake. The potential impacts of the proposed increase in interbasin transfer will be on the cumulative reservoir outflows. The model has been used to evaluate whether there will be significant changes in the flow frequency distribution (See Appendix B). The model results indicate that there are not significant changes in flow downstream from the dam compared to the other alternatives and base scenarios; therefore 1) the transfer will not affect downstream water users and their future needs; and 2) the transfer will not affect downstream wastewater discharges (from an assimilation standpoint).

During a drought situation Cary would be following the water conservation measures established in the Water Conservation Ordinances, which include either voluntary or mandatory conservation measures for the service area depending on the severity of the drought. Apex utilizes continuing water conservation measures, as well as additional voluntary, mandatory and rationing measures as established in the Water Conservation Provisions of the Code of Ordinances. Morrisville has also established an ordinance for Water Shortage Conservation Measures. Therefore, the expected impacts on lake surface elevations and cumulative reservoir outflows during a drought would be even less than those predicted by the model.

Figure 5

No water quality models have been developed by the State for Jordan Lake or for the upper segment of the Cape Fear River (above Buckhorn Dam). The Triangle J Council of Governments is currently leading efforts for the development of a water quality model for Jordan Lake. This model is expected to be completed in 2002. The Town of Cary has developed a QUAL2E model for the Cape Fear River from the Jordan Lake Dam to the Buckhorn Dam. DWQ has not approved the model because of concerns related to river velocity estimates, oxidation rates for ammonia and organic nitrogen, phytoplankton effects, and sediment oxygen demands. Therefore, direct impacts on the water quality of the source basin cannot be assessed with a modeling tool at this time. However, changes in the existing assimilative capacity of the surface waters in the source basin are not expected since the DWR hydrologic model indicates there would not be any major changes in the hydrology of the system related to the increase in IBT for the applicants.

3.1.5 Air Quality

According to the U.S. EPA AIRS database, the overall ambient air quality in the source basin has mostly been in the "Good" range. An Air Quality Index (AQI) is used to report ambient air conditions for the prominent pollutant, and the AQI ranges from good, moderate, unhealthful, very unhealthful, to hazardous. From 1994 through 1998, the index levels have not exceeded the moderate range, with most reports indicating a higher percentage of the days in the "Good" range. In 1997, Chatham County reported more days in the "Moderate" range than in the "Good" range.

Wake and Durham were non-attainment areas for the National Ambient Air Quality Standard (NAAQS) for carbon monoxide and ozone and were redesignated as attainment areas in September 1995 and June 1994, respectively. The U.S. EPA established a new, more stringent NAAQS for ozone in 1997. The new 0.08-ppm eight-hour standard took effect in 1997; however, on May 14 1999, a federal appeals court blocked the U.S. EPA from imposing the new standard. Currently there are ambient monitoring sites in Wake, Chatham, and Durham counties that are in violation the new standard; however, none of the sites are in violation of the old 0.12-ppm eight-hour average standard. If the new standard remains in effect, it is likely that Wake County and the surrounding counties will be classified as a non-attainment area for ozone. Once the attainment level is determined, the non-attainment contingency plan will be reviewed and implemented over an anticipated two to five year time frame.

Ozone is not directly emitted, but is formed when sunlight reacts with volatile organic compounds (VOCs) and nitrogen oxides (NO_x). According to the NC Air Awareness program, NO_x is the limiting factor on the formation of ozone in North Carolina because of the abundance of naturally occurring VOCs from trees, which cannot be controlled. In NC urban areas, more than 60 percent of NO_x emissions are from automobiles.

3.1.5.1 Primary Impacts

There is no construction associated with the proposed IBT, and the increased withdrawal of water will not affect air quality. Therefore, there are no primary air quality impacts in the source basin.

3.1.6 Groundwater Resources

The study area in the source basin is located in the physiographic region described as the Piedmont region, which is between the Blue Ridge and the Coastal Plain region. According to the North Carolina Cooperative Extension Service, the crystalline bedrock aquifer in the Piedmont region has relatively little storage capacity, and the well yields tend to be low (around 5-35 gal/min). The USGS indicates that the major groundwater related issues in North Carolina are (1) declining water levels (especially in the Coastal Plain region); (2) contamination from hazardous wastes and landfill leachate; and (3) effects of land use on water quality (especially the effects of urbanization).

All of the Triassic geologic area, which includes Apex, west of Cary, and Morrisville, has problems with no yield or low yield wells. Water cannot move through the upper portions of sediments; therefore, it is difficult for groundwater to be created. It is also difficult to find water-yielding veins in the sediments.

3.1.6.1 Primary Impacts

There is no construction associated with the proposed IBT, and the increased withdrawal of water will not affect groundwater resources. According to *Basic Elements of Ground-Water Hydrology with References to Conditions in North Carolina* (Heath, 1980), groundwater recharge occurs by precipitation in all inter-stream areas (areas except along streams and their adjoining flood plains). Streams and flood plains are, under most conditions, discharge areas for groundwater; therefore, there are no primary impacts to groundwater resources due to the project.

3.1.7 Noise Level

Quiet is conducive to psychological and physiological well-being for humans. Just as excessive noise has been documented to negatively affect human health and welfare, elevated noise levels from human activities can disrupt the normal behavior patterns of wildlife, interfering with migration, breeding, hunting, and predator avoidance.

The source basin currently exhibits the day-to-day normal noise conditions representative of mostly forested and open land cover. Seasonal use of Jordan Lake for recreational purposes contributes to increased mobile source, as well as water craft, noise during the warmer months.

3.1.7.1 Primary Impacts

There is no construction associated with the proposed IBT and, therefore, no increase in noise levels from the proposed IBT. The increased withdrawal of water will not affect noise levels in the source basin; therefore, there are no primary noise impacts in the source basin.

3.1.8 Toxic Substances/Hazardous Wastes

Prior to the 1970s, few controls were in place to control the discharge of hazardous materials into the environment. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 was adopted to regulate hazardous waste disposal and the cleanup of abandoned sites on a national level. In addition, North Carolina passed the Inactive Hazardous Sites Response Act in 1987 to establish a program which identifies, assesses, and remedies hazardous waste disposal sites not addressed by other programs. Currently, approximately 1,000 sites have been identified nationwide.

According to the 1996 annual "Inactive Hazardous Waste Sites Report" to the North Carolina General Assembly, there are currently no inactive hazardous waste sites in Cary identified on the federal "Sites Priority List." However, the "Old State Lab" site, owned by North Carolina State University, is identified on the "Sites with Evaluations Pending" list. This site, approximately 278 acres in size, is bounded on three sides by Chatham Street, 1-40, and Cary Towne Boulevard, respectively. (Cary, 1996)

Although there are no operating hazardous waste landfills within the study area, there are several treatment, storage or disposal facilities (TSDs) within the study area. Chatham, Orange and Johnston Counties area listed with one TSD each per the RCRA Notifiers List of TSDs from the NC Division of Waste Management. Wake County is listed as having five TSDs within Cary and Apex. Household hazardous waste collection sites are available in Chatham, Orange and Wake Counties, as well as the City of Durham.

Potential sources for toxic substances present in the source basin are agricultural-related substances such as fertilizers, weed control chemicals, and pesticides. Other common toxic substances are employed in the construction of homes and commercial buildings such as glues, solvents, and paints. Typical household hazardous wastes would include oils, cleaners, solvents, paints, herbicides and fertilizers.

3.1.8.1 Primary Impacts

There is no construction associated with the proposed IBT. There are no potentially significant impacts to the environment from the releases of toxic substances or hazardous wastes associated with the proposed IBT.

3.2 Receiving Basin

The "receiving basin" is considered to be the portion of the study area that is within the Neuse River subbasin. The receiving basin study area includes a general area (Urban Service Area) delineated by the outer boundary of the existing/projected Utility Service Area contributing to the proposed IBT (North Cary, South Cary, and Apex WWTPs). This outer boundary followed in most cases the current jurisdictional boundaries, except around the RDU International Airport property. The study area also includes Crabtree Creek and Middle Creek (and their floodplains) extending from the WWTP service area boundary to their individual confluence with the Neuse River (Figure 1).

The boundary of the study area around water bodies is offset 0.7 mile from the shoreline to incorporate flood plain areas as shown on FEMA flood zone maps.

The Neuse River watershed is the third largest river basin in North Carolina. It is located within the Piedmont and Coastal Plain physiographic regions and includes portions of 19 counties. It encompasses about 6,100 square miles, with approximately 3,300 miles of freshwater streams, more than 500 square miles of salt water, and several impoundments. The river is formed by the confluence of the Eno and Flat rivers northeast of Durham. The uppermost portion of the Neuse River is impounded by Falls- of-the-Neuse Dam, an ACOE project. One dam is also located near Raleigh (Milburnie Dam) with several additional small impoundments on upstream tributaries. Quaker Neck Dam, located near Goldsboro, was removed in 1998 to restore access to upstream spawning areas used by anadromous fishes. From the Falls-of-the-Neuse Dam the river flows southeasterly into an estuary at New Bern and then into Pamlico Sound (NC WRC, 1998B).

The Neuse and its tributaries drain all or a portion of 18 counties in North Carolina. The Piedmont Region of North Carolina encompasses the upper third portion of the Neuse River. The tributaries included in the Piedmont Region are generally swift and turbid and usually flow through well-defined valleys and narrow flood plains. The Coastal Plain waters are dark and slow moving. The average stream gradient within this region is 1.1 percent.

3.2.1 Wetlands

3.2.1.1 Existing Environment

The northern portion of the receiving basin project area is characteristic of the Piedmont physiographic province of the state, which is characterized by rolling topography with broad ridges, sharply indented stream valleys, and low gradient streams composed of a series of sluggish pools separated by riffles and occasional small rapids. Stream floodplains in the region are relatively narrow and mostly forested (DWQ, 1998). The southern portion of the receiving basin, downstream of the North Cary WWTP and the Apex WWTP, however, enters into the Coastal Plain Province, which is characterized by flat terrain and slow-moving, blackwater streams lined by extensive swamps, bottomland hardwood forests or marshes. (DWQ, 1998).

The type and area of wetlands within the study area were determined using USFWS NWI maps in GIS format. The coverage of each wetland type within the study area was estimated directly from the GIS database. (USFWS, 1999A) Total wetland coverage within the receiving basin study area is approximately 9,365 acres. Eleven percent (1,029 total acres) is within the Crabtree Creek corridor; 67 percent (6,305 total acres) is within the Middle Creek Corridor; and 22 percent (2,032 total acres) is within the Urban Service Area for Apex, Cary, Morrisville, and RTP South (USFWS, 1999A). Table A-1 in Appendix A provides a complete breakdown of wetland acreages from the NWI GIS data search.

Most of the wetland coverage within the Urban Service Area is represented by palustrine forested wetlands associated with floodplains of Swift Creek (only within the service areas of Apex and Cary), and Crabtree and Middle Creeks to their confluence with the Neuse River. Palustrine hardwood bottomland forests make up 62 percent of the Urban Services portion on the receiving basin. Broad-leaved deciduous forested wetlands constitute approximately 40 percent and 70 percent, respectively, of the total wetland coverage for the Crabtree Creek and Middle Creek portions of the receiving basin area. In total, PFO wetlands compose 65 percent of the entire receiving basin.

Other palustrine wetland types within the study area of the receiving basin include palustrine scrub shrub, palustrine unconsolidated bottom, and palustrine emergent wetlands, representing approximately 14 percent, 8 percent, and 1 percent, respectively, of the total wetland coverage within the source basin study area. The riverine unconsolidated bottom classification constitutes approximately 1 percent of the wetland coverage within the receiving basin (located primarily along the Haw and Cape Fear corridors), while the lacustrine wetlands compose approximately 3 percent of the receiving basin (USFWS, 1999A). The plant species composition of the receiving basin is similar to that of the source basin with forested wetlands being dominated by red maple (*Acer rubrum*), and ash (*Fraxinus* spp.).

The types of natural wetland community types known to occur in the counties that compose the receiving basin project area are listed and described in Table A-10, found in Appendix A. The majority of the wetlands within the receiving basin project area are of bottomland hardwood and headwater forests of the Piedmont/ Low Alluvial Forest, Piedmont/ Mountain Levee Forest or Piedmont/ Mountain Bottomland Forest natural community types (NCWRP, 1998A; NHP,1999). Without performing detailed wetlands mapping and field delineations, there is no way to tell whether or not each of these wetland natural communities exist in the defined receiving basin study area since the NWI maps do not distinguish between wetland natural community types.

The Cape Fear River Basin contains many rare animal and plant species which are dependent on wetlands or open water for their existence. For more information on these species, please see the Fish and Wildlife Section of this EIS.

3.2.1.2 Primary Consequences

The proposed IBT will not have any significant direct impacts on wetlands in the receiving basin since the additional amount of wastewater planned to be discharged from the North Cary, South Cary and Apex Wastewater Treatment Plants as a result of the proposed IBT will not require existing plants to be expanded, nor will it require additional plants to be constructed, as explained in the Water Resources section of this document. Although the total amount of treated effluent discharged from these facilities will increase as a result of the proposed IBT, these discharges will not exceed their current permit limits. The effects of increased flows in the receiving basin were considered at the time the original National Pollutant Discharge Elimination System (NPDES) permits were issued. There will therefore be no significant water quality impacts to the receiving basin as a direct result of the proposed IBT. The proposed IBT will also not have any direct impacts on wetlands in the receiving basin due to construction since no construction for the proposed IBT is planned. No significant flooding of wetlands is predicted from the proposed IBT.

3.2.2 Land Use

3.2.2.1 Existing Environment

Urban / Developed Lands

Existing developed lands represent approximately 13 percent of the total acreage in the Urban Services Area portion of the receiving basin. This area currently contains 28,939 acres of forest; 566 acres of agriculture, 9,416 acres of open land; and 6,094 acres of urban uses. Total land area in this portion of the receiving basin totals 45,012 acres (not including water bodies) (see Table A-1 in Appendix A).

Existing developed lands represent approximately 2 percent of the total land acreage in the Middle Creek corridor project area. This area currently contains 18,686 acres of forest; 8,281 acres of agriculture; 3,030 acres of open land; and 549 acres of urban uses. Total land area in this portion of the receiving basin totals 30,546 acres (not counting water bodies). Developed areas in the Middle Creek corridor are mostly clustered in the upper reaches of the basin near the towns of Apex, Holly Springs, and Fuquay-Varina.

Existing developed lands represent approximately 21 percent of the total acreage in the Crabtree Creek corridor project area. This area currently contains 10,198 acres of forest; 360 acres of agriculture; 1,285 acres of open land; and 3,220 acres of urban uses. Total land area

in this portion of the receiving basin totals 15,063 acres (not including water bodies). The Crabtree Creek corridor is heavily developed from Cary, through downtown Raleigh, to the confluence with the Neuse River south of Hwy 64 in southeast Raleigh.

Public Lands (Parks/Recreation Areas and Greenways)

The urban services portion of the receiving basin contains some open spaces and greenway areas surrounding Crabtree Lake and Crabtree Creek above the lake in Morrisville and Cary, and Swift Creek within Apex and Cary. Long-range plans for Cary show several neighborhood, regional, and community parks around the Town, most not located on any particular stream or creek, but more oriented around residential developments. Cary is, however, proposing an extensive series of greenways and conservation corridors throughout the receiving basin area, along stream corridors.

The Crabtree Creek corridor contains a variety of public lands, which are described in Table A-11 located in Appendix A. Approximately three miles of Crabtree Creek run through William B. Umstead State Park just downstream of the North Cary WWTP. Totaling 5,442 acres, Umstead State Park is the largest recreation area in the basin. In addition to mountain bike and horse trails, the park offers ten hiking trails with over 19 miles of fairly easy hiking. Other activities include picnicking, camping, swimming, and fishing.

In addition to public lands utilized for recreation, the city of Raleigh has an extensive network of greenways in the Crabtree Creek receiving basin. Totaling 27.5 miles and over a 1,000 acres, the Capital Area Greenways system provides for activities such as walking, jogging, hiking, fishing, and picnicking.

The Middle Creek corridor has no recreational lands, public lands, greenways, or parks or open spaces. The portion of Middle Creek within Cary's planning jurisdiction, however, is planned as a conservation corridor, with tributaries off of Middle Creek proposed for conservation corridors also (Cary, 1996).

The portion of Swift Creek within Cary's current jurisdiction (within the project's Urban Services portion of the receiving basin north of Lake Wheeler) contains the Hemlock Bluffs State Natural Area (DeLorme, 1993). A large portion of the Swift Creek floodplain to the east of Regency Parkway has been set aside as conservation and recreational land, including Hemlock Bluffs State Park, Lochmere Park, and Lochmere Golf Course. North of Regency Parkway, Swift Creek flows through heavily urbanized lands, including the office and commercial employment center adjacent to U.S. Highway 1, near the U.S. 64 interchange. Cary, 1996) The Town of Cary is also planning a large linear park, greenway, and conservation corridor along Swift Creek and its tributaries through the Town. Most of the perennial and intermittent blue line streams within Cary are planned for greenways or conservation corridors (Cary, 1996).

Prime Agricultural and Forestry Land

Approximately 35 percent of the soils in Wake County and 52 percent of the soils in Johnston County are considered prime farmland (USDA, 1994; and personal communication with jurisdictional Soil and Water Conservation Districts). Cultivated lands represent approximately 2 percent of total land uses in the Crabtree Creek corridor, 27 percent of the total land area in the Middle Creek corridor, and 1 percent of the land within Urban Service Area. Cultivated lands in the Crabtree Creek basin are primarily clustered along the northern side of the creek near its confluence with the Neuse River. Large tracts of

cultivated lands are distributed throughout the Middle Creek basin with the exception of the upper headwaters of the creek, which drain the Towns of Apex and Holly Springs. Major crops grown include tobacco, soybeans, wheat, barley, oats, corn, and pastures and forages.

Agricultural land throughout the receiving basin is rapidly converting to residential subdivisions and even some limited commercial uses despite a lack of public water and sewer services. This is most evident in the Swift Creek and Middle Creek watersheds, and along the lower stretches of Middle and Crabtree Creek in Wake and Johnston counties.

Although much of the original forest community in the study area has been progressively cleared out for wood products, crop production, and residential and industrial development, significant forested areas remain. Natural reseeding of abandoned tracts of land usually results in a mixture of pine and second growth hardwoods. The acres of forest land within the Urban Service Area portion of the receiving basin totals 28,939 acres, while the Crabtree Creek corridor contains 10,198 acres of forest and the Middle Creek corridor contains 18,686 acres. The natural forest vegetative cover for the source basin consists primarily of mixed coniferous and broadleaf forests. Table A-12, presented in Appendix A, lists the known types of terrestrial or upland forest Natural Communities that occur in the source basin counties. Wetland forests known to exist in the source basin are listed in the Wetlands Section. Additionally, the distribution of forest land in the study area is presented in Figure 2**.**

Archaeological and Historic Areas

The Upper Piedmont has enjoyed a rich history since being settled by Europeans in the early 1700s. Historic structures from those periods are significant since they preserve North Carolina history. Historic districts consist of whole blocks of downtown areas including many structures that are culturally and historically significant. Table A-13 in Appendix A lists the historic sites and districts located in the counties that make up the receiving basin, as listed in the NRHP as determined by the Department of Cultural Resources, Division of Archives and History.

The total number of historic sites and historic districts in the counties that make up the receiving basin are 149 and 12, respectively. The majority of the historic sites in the receiving basins are located in the cities of Raleigh, Apex, and Fuquay-Varina in Wake County. Wake County has more than 100 listings in the NRHP. In Raleigh, 75 listings include ten historic districts, Umstead State Park, and three properties that also are National Historic Landmarks. Apex, Cary, Fuquay-Varina, Garner, Knightdale, Wake Forest, and Zebulon, as well as rural areas of the county, have a total of 29 listings.

Archaeological sites are important since they contain the only material remains of extinct Native American cultures dating back 12,000 years throughout North Carolina. The Cape Fear and Neuse River Basins contain many archeological sites that have been surveyed and several sites where significant archeological resources have been found from many native groups that lived in the region up until 200 years ago. As shown on Table A-8 in Appendix A, the total number of prehistoric sites found in the counties that compose the receiving basin (Wake and Johnston) is 1,500. Due to the size of the project's source and receiving basins, and the fact that no construction will occur with the project, the NC CRD did not require the preparation of an archeological survey for the project (refer to Gledhill-Early, 1998, letter in Appendix C).

3.2.2.2 Primary Consequences

The proposed IBT will not have any direct impacts on urban/developed land, public lands, recreational land, prime agricultural land, forest land, or archeological or historic resources in the receiving basin, since no construction is planned for the proposed IBT.

Increased wastewater discharges into Middle and Crabtree Creeks as a result of the proposed IBT will be within existing permit limits and will not significantly affect land uses or land resources along the receiving stream corridors. No properties or land resources will be subject to additional threats of flooding as a result of the proposed IBT.

3.2.3 Fish and Wildlife Resources

3.2.3.1 Existing Environment

Wildlife Habitat and Resources

Since the Neuse River spans two physiographic provinces—the coast and the lower Piedmont—the river basin contains a wide array of natural communities, both upland and wetland (NHP, 1999). A total of 29 endangered, threatened, special concern or significantly rare species, including fish, amphibians, mammals, crustaceans, and mollusks, is listed by federal and state agencies for the basin (NHP, 1999).

The vegetation in the Neuse River Basin consists of southern yellow pine, mixed hardwoods and conifers, mixed upland hardwoods, evergreen shrubland, and bottomland forest and hardwood swamps. There are areas of high intensity and low intensity developed land throughout the river basin and also a few areas of cultivated land. Each of these types of vegetation occurs throughout the river basin with an emphasis on developed land in the southeastern portion of the basin.

Wake County is home to a variety of terrestrial species including both birds and mammals, as shown on Table A-14 in Appendix A. Figure 3 summarizes rare and significant species and habitats.

Fishery Habitat and Aquatic Resources

Over 90 fish species have been found in the Neuse River basin including a variety with recreational and commercial importance. Popular sportfish species found in the freshwater portion of the river and reservoirs include largemouth bass, sunfish, crappie, catfish, and pickerel. The Neuse River basin is also home to a variety of other, non-game species of fish, including several species of shiners and suckers (see Table A-15 in Appendix A). Lake Michie, a 219-half acre impoundment on the Flat River, is considered a trophy largemouth bass fishery.

The freshwater rivers and streams of the Neuse Basin are spawning areas for anadromous fishes such as shad and herring, which are saltwater species that migrate upriver to spawn. Recreationally and commercially important anadromous species in the Neuse Basin include striped bass, American and hickory shad, and herring. They migrate into freshwater portions of the Neuse River and tributaries to spawn during the spring. The Neuse River below New Bern to Pamlico Sound supports valuable recreational and commercial fisheries for striped bass, speckled trout, croaker, flounder, and spot (NC WRC, 1998B). Other important commercial and recreational fishing stocks in either the fresh or estuarine waters of the Neuse include catfish, flounder, blue crab, and oyster.

Atlantic sturgeon (*Acipenser oxyrhyncus*) and the Shortnose sturgeon (*Acipenser breirostrum*) were once plentiful in the Neuse River. Atlantic sturgeon have declined significantly and shortnose sturgeon are thought to be extirpated from the basin. The Roanoke bass, listed as a significantly rare species in North Carolina, is found almost exclusively within the Eno River basin. This situation may be changing, however, since the Quaker Neck Dam was removed from the Neuse River near Goldsboro in January 1998. This opened up 75 miles of the Neuse mainstem and 925 miles of basin tributaries to anadromous fish such as striped bass, blueback herring, alewife, American shad, hickory shad, and Atlantic sturgeon. These saltwater fish have been unable to use this freshwater spawning habitat since 1952, when the dam was constructed for a CP&L Steam Plant (American Sportfishing Association, 1997). According to Mike Wicker with the USFWS (personal communication), the Neuse River above the old Quaker Neck dam site has seen a substantial influx of anadromous fish species since it was removed. In the project area, Crabtree Creek is now open to anadromous species, with these species being seen all the way to old Lassiter Mill Dam in Raleigh. And with the gate at the dam opened and recent partial removal of the dam itself, it is most likely that anadromous species are up to Umstead Park and even to the dam at Crabtree Lake. Anadromous species have also been sighted all the way to the South Cary WWTP on Middle Creek and to Lake Benson dam on Swift Creek.

Rare and Protected Species or Habitats

Like the Cape Fear River Basin, the Neuse River Basin is home to a variety of protected aquatic and terrestrial species. Figure 3 shows the location of rare and significant species and habitats in the project area, and Table 10 lists significant rare and protected species in the receiving basin, as provided by NHP. A discussion of selected significant species, habitat, and location is found below.

Vertebrates

Bald eagle (*Haliaeetus leucocephalus*)

The bald eagle *(Haliaeetus leucocephalus)* nests at the tops of tall trees near the edges of estuarine habitats, but it also nests in the Piedmont at large reservoirs such as Falls Lake and Lake Wheeler. It forages for fishes on both fresh and brackish waters of lakes, large rivers, and sounds. It has been identified to occur along Lake Wheeler and Swift Creek, outside of the project area (NHP, 1999). It will soon be delisted at the federal level as a threatened species.

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker lives in large tracts of pine or mixed pine/hardwood forest with some pines at least 60 years old. It is both a state and federally listed endangered species.

Tiger salamander (*Ambystoma tigrinum*)

The tiger salamander requires forested temporary pools on high floodplains or headwaters that provide a refuge from predatory fishes, particularly the mosquitofish (*Gambusia holbrooki*). It tends to inhabit marshes, forests, or grassland, depending on the location. It has been identified in Middle Creek in the project area (NHP, 1999) and is listed as a threatened species by the state of North Carolina.

American eel (*Anguilla rostrata*)

The American eel is a poorly documented catadromous species that lives its life in freshwater and requires saltwater for breeding. The American eel is listed in the NC Natural History Museum's species database as having been sighted in the Neuse River basin. In addition, the NC Division of Marine Fisheries lists the eel as being observed between 1972 and 1997 in the Neuse Basin (NC DMF, 1997).

Additional significant species include the aquatic amphibian named the Neuse River waterdog *(Necturus lewisi*), which is a state species of concern that is endemic to the Neuse and Tar systems in the upper Coastal Plain and lower Piedmont. Another aquatic vertebrate species endemic to North Carolina is the Carolina madtom (*Noturus furiosus*). Like the Neuse River waterdog, this small fish lives only in the Neuse and Tar basins and is listed as a species of concern by the state. (NHP, 1999)

TABLE 10
Threatened and Endangered Species for the Receiving Basin

Scientific Name	Common Name	State Status	Federal Status
	Aquatic Resources		
Vertebrates			
Ambystoma tigrinum	tiger salamander	T	-
Invertebrates			
Alasmidonta heterodon	dwarf wedgemussel	E	E
Alasmidonta undulata	Triangle floater	T	-
Elliptio lanceolata	Yellow lance	T	FSC
Elliptio roanokensis	Roanoke slabshell	T	-
Fusconaia masoni	Atlantic pigtoe	T	FSC
Lasmigona subviridis	green floater	E	FSC
Strophitus undulatus	Squawfoot	T	-
Vascular Plants			
Isoetes piedmontana	Piedmont quillwort	T	-
Portulaca smallii	Small's portulaca	T	-
	Terrestrial Resources		
Vertebrates			
Haliaeetus leucocephalus	bald eagle	E	T
Picoides borealis	red-cockaded woodpecker	E	E
Vascular Plants			
Rhus michauxii	Michaux's sumac	E-SC	E
Ruellia humilis	low wild-petunia	T	-
Trillium pusillum var pusillum	Carolina least trillium	E	FSC

E = Endangered
T = Threatened
SC = Special Concern
FSC = Federal Special Concern
SR = Significantly Rare
C = Candidate
Source: NHP, 1997 & 1999

Invertebrates

Dwarf-wedge mussel (*Alasmidonta heterodon*)

The dwarf-wedge mussel is relatively small, rarely exceeding 1.5 inches in length. The shell's outer surface (periostracum) is usually brown or yellowish brown in color, with faint green rays that are most noticeable in young specimens. This mussel is considered to be a long-term brooder, with gravid females reportedly observed in fall months. Like other freshwater mussels, this species' eggs are fertilized in the female as sperm are taken in through their siphons as they respire. The eggs develop with the female's gills into a larvae (glochidia). The females later release the glochidia which then attach to the gills or fins of specific host fish species. Based on anecdotal evidence, such as dates when gravid females are present or absent, it appears that release of glochidia occurs primarily in April in North Carolina. Recent research has confirmed at least three potential fish host species for the dwarf-wedge mussel to be the tessellated darter, Johnny darter, and mottled sculpin (USFWS, 1999B).

The dwarf-wedge mussel occurs in at least 25 stream reaches along the Atlantic Coast from New Brunswick, Canada, to North Carolina. Documented populations in North Carolina are located in the following drainages and streams: Neuse River Drainage-Little River (Wake and Johnston County); Swift Creek (Wake and Johnston County); Middle and Buffalo Creek (Johnston County); Turkey Creek (Nash and Wilson County); Stony Creek (Nash); and Moccasin Creek (Nash, Wilson, and Johnston Counties); Tar River Drainage-Tar River and Shelton Creek (Granville County); Ruin, Little Ruin, and Tabbs Creek (Vance County); Cedar, Crooked, Fox, Shocco, and Little Shocco Creeks (Franklin County); and Shocco Creek (Warren County) (USFWS, 1999B).

The dwarf-wedge mussel lives in medium to large streams and usually occurs on a sand/gravel bottom, but sometimes burrows into clay at the edges of channels. It occurs in the Neuse River basin, but does not occur in the Cape Fear River basin. It is both a federally and state listed endangered species.

Neuse River mussels (6 species)

Six state protected species, the triangle floater (*Alasmidonta undulata*), yellow lance (*Elliptio lanceolata*), Roanoke slabshell (*Elliptio roanokensis*), Atlantic pigtoe (*Fusconaia masoni*), green floater (*Lasmigona subviridis*), and the squawfoot (*Strophitus undulatus*), occur in free-flowing streams in the Neuse River basin. All six species, with the exception of the green floater, are considered threatened species by the state of North Carolina. The green floater is listed as an endangered species by the state of North Carolina. Many of the larger rivers in the state, such as the main stem of the Neuse, no longer support populations of rare mussels because of high amounts of sedimentation and pollution. Most populations of the rare mollusk species occur in the Piedmont and upper Coastal Plain, in rapidly developing areas such as the Research Triangle (NHP, 1999).

Septima's clubtail (*Gomphus septima*)

Gomphus septima is a species of dragonfly that occurs in both the Neuse and Cape Fear drainage. (NHP, 1999) When in the Cape Fear Basin it appears in sympatry with the Cape Fear shiner. Like the Cape Fear shiner, it requires abundant water willow (*Justicia americana*). It may occur perched on rocks, in riffle habitats composed of shallow depths, swift moving waters, and high oxygen levels. *Gomphus septima* is a federal species of concern.

Among the other rare fishes in the Neuse Basin, the Roanoke bass (*Ambloplites cavifrons*) and Carolina darter (*Etheostoma collis*) have restricted ranges, being limited mainly to the Piedmont and upper Coastal Plain of southern Virginia and North Carolina (NHP, 1999).

Vascular Plants

Piedmont quillwort (*Isoetes piedmontana*)

Piedmont quillwort occurs in wet depressions on granite flatrock outcrops. It has been reported from northeastern Wake County, but not Chatham County. It is considered a threatened species by the state of North Carolina.

Small's portulaca (*Portulaca smallii*)

Small's portulaca occurs in wet depressions on granite flatrock outcrops. Populations are known from northeastern Wake County. It is considered a threatened species by the state of North Carolina.

Michaux's sumac (*Rhus michauxii*)

Michaux's sumac is a rhizomatous, densely hairy shrub, with erect stems from 1 to 3 feet in height. Most plants are unisexual; however, more recent observations have revealed plants with both male and female flowers on one plant. The flowers are small, borne in a terminal, erect, dense cluster, and colored greenish yellow to white. Flowering usually occurs from June to July; while the fruit, a red drupe, is produced through the months of August to October. Michaux's sumac is historically thought to be endemic to the coastal plain and Piedmont of the Carolinas, Georgia, and Florida. The USFWS listed the species as endangered on September 28, 1989, due to its rarity and vulnerability to threats. Only 36 extant populations are known, with 31 in North Carolina, three in Virginia, and two populations in Georgia. Currently, the plant is documented in the following North Carolina counties: Richmond, Hoke, Moore, Scotland, Franklin, Davie, Robeson, and Wake (USFWS, 1999B).

Michaux's sumac grows in sandy or rocky open woods in association with basic soils. Apparently, this plant survives best in areas where some form of disturbance has provided an open area. When found in the Piedmont region, it is usually associated with clayey soils derived from mafic rock such as the Carolina slates. At least twelve of the plant's populations in North Carolina are on highway rights-of way, roadsides, or on the edges of artificially maintained clearings. Two other populations are in areas with periodic fires, and two populations exist on sites undergoing natural succession. One population is situated in a natural opening on the rim of a Carolina bay (USFWS, 1999B).

Low wild-petunia (*Ruellia humilis*)

Low wild-petunia occurs in mesic to dry open woods on diabase dikes and sills. It is known to occur in northeastern Wake County (Cary-Apex Environmental Assessment, 1997). It is considered a threatened species by the state of North Carolina.

Carolina least trillium (*Trillium pusillum var pusillum*)

Carolina least trillium is a colonial species which grows in alluvial woods in the lower Piedmont and Coastal Plain. No populations are known from Chatham County. The only known colony in Wake County is on N.C. State University property in the Swift Creek basin southeast of Cary (Cary-Apex Environmental Assessment, 1997). It is considered an endangered species by the state of North Carolina.

Significant Natural Heritage Areas

The North Carolina Natural Heritage Program (NHP) compiles the North Carolina Department of Environment, Health, and Natural Resources' (DEHNR's) list of Significant Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A- 164 of Article 9A). The list is based on the program's inventory of natural diversity in the State (DEHNR, 1997). Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's significance rating. The sites included on this list are the best representatives of the natural diversity of North Carolina, and therefore have priority for protection. Inclusion on the list does not imply that any protection or public access exists. The following SNHAs have been identified along with seven small SNHA's within the receiving basin project area.

Swift Creek. This stream in southern Wake and Johnston counties contains eleven rare animals: one rare fish and ten rare mussels, including the federally endangered dwarf-wedge mussel. Although there are several protected areas along the stream above Lake Wheeler, all of the rare animals live in the creek below Lake Benson, where there are no lands protected along the creek banks.

Middle Creek. This tributary in southern Wake and Johnston counties contains eleven rare animals: two fishes, one amphibian, and eight mussels, including the Federally Endangered dwarf-wedge mussel. Most of the creek flows through private, unprotected lands.

William B. Umstead State Park. This State Park protects nearly 5,400 acres of forest land in the upper part of the Neuse River Basin. Crabtree Creek flows for several miles through the park, which features bottomland hardwoods as well as several rhododendron bluffs along the creekbank.

Swift Creek Bluffs. This area is a dedicated State Nature Preserve that contains the most extensive known tract of mature beech in North Carolina.

Hemlock Bluffs. This site is a steep 80-foot high bluff along Swift Creek. It contains a population of Canadian hemlock that is over 200 miles east of its typical habitat in the mountains. Other species that are less common in the Piedmont include: chestnut oak, yellow lady's slipper, showy orchis, and some mosses.

Dutchman's Branch Bluffs. This site is approximately 70 acres of mixed hardwood forest with fairly rich shrub and herbaceous layers.

Schenck Forest North Area. This pine-hardwood forest is owned by NC State University and is used as a teaching, research and demonstration forest. Hiking trails traverse the area. A 15.7 acre natural area is within the boundary of the forest.

3.2.3.2 Primary Consequences

In total, there appears to be a significant number of rare natural communities, Significant Natural Areas, anadromous, and threatened or endangered species existing in the receiving basin project area. In addition, there is a substantial number of recreational fishery species that exist in the receiving basin.

Both aquatic and terrestrial resources that inhabit lakes or stream-side habitats, including aquatic and wetland plants, freshwater mussels, and fisheries in the receiving basin, could be directly affected by water quality and quantity changes from transfers of water into the basin. If stream levels or the volume or rate of flow rise or fall dramatically, either flooding or draining of sensitive species or habitat areas could occur. In addition, altering stream and river flow dramatically during periods of anadromous fish migration could lead to significant negative impacts on these fish (Moser, 1995A). Such hydrologic changes could also create shifts in water quality, depending on how the hydrology in the system changes.

However, the proposed IBT will not have any significant direct impacts on fisheries, wildlife, or sensitive species or their habitats in the receiving basin since the additional amount of wastewater planned to be discharged from the Cary and Apex Wastewater Treatment Plants as a result of the proposed IBT will not require existing plants to be expanded. Although the total amount of treated effluent discharged from these plants will increase as a result of the proposed IBT, these discharges will not exceed their current permit limits. In addition, these facilities are required to reduce total nitrogen by 30%, as per the Neuse River NSW Management Strategy Rules. There will therefore be no significant water quality impacts to the receiving basin as a direct result of the proposed IBT. The effects of increased flows in the receiving basin were analyzed at the time the original NPDES permits were issued. Specifically, DWR conducted studies to determine instream flow needs for fish habitat in Crabtree Creek and Middle Creek. The studies concluded that the current permitted wasteflows for the Cary WWTPs would not exert a significant impact on fish habitat (DWR, 1985; DWR, 1987). The proposed IBT will also not have any direct impacts on fish or wildlife or natural areas in the receiving basin due to construction since no construction for the proposed IBT is planned.

3.2.4 Water Resources and Water Quality

3.2.4.1 Existing Environment

The surface waters of the receiving basin are part of Subbasins 03-04-02 and 03-04-03 in the Neuse River Basin (Figure 1). The entire Neuse River Basin was declared NSW in 1988 and the DWQ implemented a basinwide nutrient management strategy aimed to control nitrogen and phosphorus inputs from point and non-point sources.

Crabtree Creek

The upper reach of the Crabtree Creek (upstream of Lake Crabtree dam) and its tributaries drain the urban areas of Morrisville and Cary. These urban areas are served by the Cary North WWTP. This WWTP would receive a portion of the proposed transfer of water, and therefore their service areas are included in the study area due to issues related to secondary impacts. The study area also contains the lower section of Crabtree Creek and its floodplain, downstream from the Cary North WWTP. The stream flows for several miles through the William B. Umstead State Park, and through the City of Raleigh before its confluence with the Neuse River. Lake Crabtree and the segment of Crabtree Creek through the park are classified "B-NSW" waters. The remainder of the stream is classified "C-NSW." The "B-NSW" classification is protected for swimming whereas the "C-NSW" classification is protected for fishing, aquatic life propagation and survival, and wildlife. Point sources are allowed in "B-NSW" and "C-NSW" waters.

Crabtree Creek, at the point of discharge of the Cary North WWTP, immediately downstream from the Lake Crabtree Dam, has the following hydrologic characteristics: drainage area = 52 mi^2 and 7Q10 = 0.3 cfs (DWQ WLA files). The minimum release from the Lake Crabtree dam is 2.59 cfs (NRCS, personal communication with Robert Williams).

USGS maintains a gauge station at Ebenezer Church Road, downstream from the park, and a gage station at US 1, in the lower segment of the creek before its confluence with the Neuse River. The drainage area at Ebenezer Church Road is 76 mi^2; the estimated average flow is 68 cfs; and the estimated 7Q10 is 0.3 cfs. The drainage area at US 1 is 121 mi^2, the estimated average flow is 145 cfs, and the estimated 7Q10 is 2.0 cfs. These flow statistics have been estimated by USGS after the Lake Crabtree dam was constructed (USGS, 1998).

DWQ ambient monitoring stations for the surface waters in the study area are shown in Figure 4. The ambient monitoring data collected in Crabtree Creek have revealed exceedances of the state criteria for dissolved oxygen, fecal coliform, and turbidity, and exceedances of the action levels for copper, iron, and zinc. A poor benthos rating was assigned to the upper section of Crabtree Creek while good-fair ratings were assigned in the lower section of the stream. Fish samples have given a better rating in the lower segments of Crabtree Creek than the benthos samples (DEHNR, 1996). The upper segments of Crabtree Creek (upstream from Lake Crabtree) and a segment immediately downstream from the Lake Crabtree dam are not supporting its uses. The segment of the stream through the City of Raleigh is partially supporting its uses (DWQ, 1998) (Figure 5).

Swift Creek Headwaters

A small portion of the headwaters of Swift Creek (upstream of Lake Wheeler) is contained in the study area. This portion of the Swift Creek watershed is within or in proximity to the service area of the Apex, Cary North, and Cary South WWTPs that would receive a portion of the water being transferred, and therefore their service areas are included in the study area due to issues related to secondary impacts. There are no USGS gauge stations or DWQ ambient monitoring stations in the headwaters of Swift Creek. However, USGS estimates a 7Q10 of zero in the upper portions of Swift Creek (USGS, personal communication with Curtis Weaver). DWQ has reported poor to fair water quality (based on benthos samples) in the headwaters of Swift Creek with a gradual downstream recovery. The stream has been observed to carry a heavy sediment load (DEHNR, 1996). The upper portions of Swift Creek are not supporting its uses, and segments immediately upstream of Lake Wheeler and Lake Benson are partially supporting its uses (DWQ, 1998) (Figure 5). Sedimentation may be caused by new development, urban areas, or streambank erosion due to increased streamflows brought about by increases in impervious surface areas.

Figure 4 delineates the Water Supply Watershed Areas in the study area. In North Carolina, all waterbodies used for public water supply are given a "WS" classification. The Swift Creek watershed, above Lake Benson, has been classified "WS-III-NSW." Minimum statewide water supply protection standards (certain watershed development and wastewater discharge restrictions) apply to the Water Supply Watershed Areas. Point sources discharges are allowed in "WS-III-NSW" waters.

Middle Creek

A small portion of the headwaters of Middle Creek is also contained in the urban service portion of the receiving basin study area. This portion of the Middle Creek watershed is within or in proximity to the service area of the Apex WWTP that would receive a portion of the water being transferred, and therefore its service area is included in the study area due

to issues related to secondary impacts. In addition, a UT to Middle Creek and Middle Creek proper receive the effluent of the Apex WWTP and the Cary South WWTP, respectively. Therefore, the mainstem and the floodplain of the UT to Middle Creek from the Apex WWTP discharge, along the mainstem and the floodplain of Middle Creek to its confluence with the Neuse River, are included in the project study area.

The UT to Middle Creek receiving the effluent from the Apex WWTP has a 7Q10 = 0 cfs (DWQ WLA files). Downstream of Sunset Lake (Figure 4), the streamflows are controlled by this dam which has no required minimum flow release. Flows below the dam vary from zero during drought conditions to 800 cfs following storms (DWQ, 1992). The segment of Middle Creek receiving the effluent from the Cary South WWTP (below Sunset Lake) has a 7Q10 = 0.3 cfs (DWQ WLA files). USGS maintains a continuous flow recording gauge on Middle Creek at NC 50, 2.6 miles downstream of the Cary South WWTP. The drainage area at NC 50 is 83.5 mi^2; the estimated average flow is 92 cfs; and the estimated 7Q10 is 0.5 cfs (DWQ, 1992). Most of Middle Creek is classified "C-NSW" except for Sunset Lake which is classified "B-NSW." The "B-NSW" classification is protected for swimming whereas the "C-NSW" classification is protected for fishing, aquatic life propagation and survival, and wildlife. Point sources are allowed in "B-NSW" and "C-NSW" waters.

Middle Creek has been rated good-fair (based on benthos). The water chemistry data collected at the DWQ ambient station near Clayton indicated exceedances of the State criteria for fecal coliform and the action levels for copper and iron. Fisheries data have given ratings of excellent to good excellent to Middle Creek (DEHNR, 1996). Middle Creek has been rated as "support threatened" (Figure 5) (DWQ, 1998).

303 (d) Listed Streams

According to the NC 303 (d) list, Crabtree Creek and Swift Creek are listed as impaired in our study area of the receiving basin. Crabtree Creek impairment is attributed to new development and urban runoff. DWQ has assigned a medium priority to Crabtree Creek. Swift Creek impairment is attributed to agriculture and urban runoff. DWQ has given a high priority to Swift Creek and will develop a management strategy for the Swift Creek watershed within the next five years.

3.2.4.2 Primary Impacts

The transfer of water will not result in an increase of existing permitted wastewater flows being discharged into the receiving basin. No increase in wastewater treatment plant capacity will be requested in the Neuse River Basin as the result of this transfer since current permitted discharge amounts are adequate.

Primary impacts due to the wasteflows of the wastewater facilities receiving the transfer of water have been addressed through previous NPDES permitting and NC EPA processes for those facilities discharging into the receiving basin. Both the NPDES and NC EPA rules require that all environmental impacts must be adequately addressed and mitigated before any permit to discharge is issued.

Water quality modeling analyses have been previously conducted in Crabtree Creek and Middle Creek to determine the water quality impacts of existing and proposed discharges in those streams (Diehl & Phillips, 1993; DWQ, 1992). Wasteload allocations and current oxygen-consuming management strategies for facilities discharging into these streams have been based on those modeling analyses. In addition, the DWR conducted studies on flooding, streambank erosion, and fish habitat in both Crabtree Creek and Middle Creek

(DWR, 1985; DWR, 1987). These studies concluded that there was not a significant impact on water quality, flooding, streambank erosion, and fish habitat due to currently permitted wasteflows.

3.2.5 Air Quality

3.2.5.1 Existing Environment

According to the U.S. EPA AIRS database, the overall ambient air quality in the source basin has mostly been in the "Good" range. An AQI is used to report ambient air conditions, and the AQI ranges from good, moderate, unhealthful, very unhealthful, to hazardous. From 1994 through 1998, the index levels have not exceeded the moderate range, with most reports indicating a higher percentage of the days in the "Good" range. In 1997 and 1998, Johnston County reported more days in the "Moderate" range than in the "Good" range.

Wake and Durham were non-attainment areas for the NAAQS for carbon monoxide and ozone and were redesignated as attainment areas in September 1995 and June 1994, respectively. A new, more stringent NAAQS for ozone was established by the U.S. EPA in 1997. The new 0.08-ppm eight-hour standard took effect in 1997; however, on May 14 1999, a federal appeals court blocked the U.S. EPA from imposing the new standard. Currently there are ambient monitoring sites in Wake, Johnston, and Durham counties that are in violation the new standard; however, none of the sites are in violation of the old 0.12-ppm eight-hour average standard. If the new standard remains in effect, it is likely that Wake County and the surrounding counties will be classified as a non-attainment area for ozone. Once the attainment level is determined, the non-attainment contingency plan will be reviewed and implemented over an anticipated two to five year time frame.

Ozone is not directly emitted, but is formed when sunlight reacts with VOCs and NO_x. According to the NC Air Awareness program, NO_x is the limiting factor on the formation of ozone in North Carolina because of the abundance of naturally occurring VOCs from trees, which cannot be controlled. In NC urban areas, more than 60 percent of NO_x emissions are from automobiles.

3.2.5.2 Primary Impacts

There is no construction associated with the proposed IBT, and the additional discharge to the Neuse basin due to the proposed IBT will not affect air quality. Therefore, there are no primary air quality impacts.

3.2.6 Groundwater Resources

3.2.6.1 Existing Environment

The study area in the source basin is located in the physiographic region described as the Piedmont region, which is between the Blue Ridge and the Coastal Plain region. According to the North Carolina Cooperative Extension Service, the crystalline bedrock aquifer in the Piedmont region has relatively little storage capacity, and the well yields tend to be low (around 5 to 35 gal/min). The USGS indicates that the major groundwater related issues in North Carolina are (1) declining water levels (especially in the Coastal Plain region); (2) contamination from hazardous wastes and landfill leachate; and (3) effects of land use on water quality (especially the effects of urbanization).

The receiving basin study area lies within the Raleigh belt, as defined by the DENR Groundwater Section. This region is described as having only moderately productive wells.

3.2.6.2 Primary Impacts

There is no construction associated with the proposed IBT, and the additional discharges of water will not affect groundwater resources. According to *Basic Elements of Ground-Water Hydrology with References to Conditions in North Carolina* (Heath, 1980), groundwater recharge occurs by precipitation in all inter-stream areas (areas except along streams and their adjoining flood plains). Streams and flood plains are, under most conditions, discharge areas for groundwater; therefore, there are no primary impacts to groundwater resources due to the project.

3.2.7 Noise Level

3.2.7.1 Existing Environment

Quiet is conducive to psychological and physiological well-being for humans. Just as excessive noise has been documented to negatively affect human health and welfare, elevated noise levels from human activities can disrupt the normal behavior patterns of wildlife, interfering with migration, breeding, hunting, and predator avoidance.

The study area currently exhibits the day-to-day normal noise conditions of a mixture of agricultural land, undeveloped rural land, and urbanizing areas. Current practices on agricultural land rarely produce significant noise. Undeveloped rural land is naturally devoid of significant human noises. Urbanization of the area is currently contributing to increases in mobile and stationary sources of noise associated with urban living. The various mobile sources increasing in the study area include car and truck traffic on highways and major roads and railroad traffic. Stationary sources include the construction of roads in new subdivisions, homes, and commercial development and operation of large business and industrial facilities.

3.2.7.2 Primary Impacts

There is no construction associated with the proposed IBT, and the additional discharge to the Neuse subbasin due to the proposed IBT will not affect noise levels. Therefore, there are no primary impacts expected due to noise.

3.2.8 Toxic Substances/Hazardous Wastes

3.2.8.1 Existing Environment

There are no operating hazardous waste landfills within the study area; however, there are several treatment, storage or disposal facilities (TSDs) within the study area. Chatham, Orange and Johnston Counties area listed with one TSD each per the RCRA Notifiers List of TSDs from the NC Division of Waste Management. Wake County is listed as having five TSDs within Cary and Apex. Household hazardous waste collection sites are available in Chatham, Orange and Wake Counties, as well as the City of Durham.

Potential sources for toxic substances present in the source basin are agricultural-related substances such as fertilizers, weed control chemicals, and pesticides. Other common toxic substances are employed in the construction of homes and commercial buildings such as glues, solvents, and paints. Typical household hazardous wastes would include oils, cleaners, solvents, paints, herbicides and fertilizers.

3.2.8.2 Primary Impacts

There is no construction associated with the proposed IBT. The additional discharge to the Neuse subbasin due to the proposed IBT could cause the release of toxic substances and hazardous wastes from operating the Apex and North and South Cary WWTPs; however, these impacts have been addressed individually with the EA or EIS documentation required for the existing NPDES permits. Potential toxic impacts from the WWTPs are expected to be insignificant. There are not direct impacts on toxic substances and hazardous wastes due to the proposed IBT.

SECTION 4

Secondary and Cumulative Environmental Consequences

4.1 Introduction

This section provides a broad evaluation of the potential secondary[1] and cumulative[2] impacts that may result from development facilitated by the proposed action. As discussed below, secondary and cumulative environmental impacts are expected to occur in the area planned to be served by water and sewer utilities within both the source and receiving basins, known as the Utility Service Area (see Figure 6). This area occupies a portion of the current local jurisdiction (including extraterritorial jurisdiction) of Apex, Cary, Morrisville and RTP/Wake County. The discussion in this section is not site specific to either basin, and considers the potential general impacts of growth, on a large scale, associated with full buildout (worst case scenario) of the Utility Service Area within the Towns of Apex, Morrisville and Cary, and RTP South, including the development of water and sewer conveyance and treatment systems, other public infrastructure projects, and private development. Full buildout of the Utility Service Area is considered as a conservative assumption representing a "worst case" scenario.

Growth in the Triangle area is being fueled by a strong economic environment around RTP and a number of infrastructure projects such as the Outer Wake Expressway. Industries and research and development (R&D) organizations continue to be attracted to this area due to state government incentives, RTP, existing and proposed road infrastructure, top-notch colleges and universities, and state-of-the-art medical treatment and research facilities. During the past years the applicants have been engaged in a concerted effort to accommodate the rapid growth in their communities. The proposed 11-mgd increase in IBT of water from the Cape Fear River basin to the Neuse River basin is one of many concurrent projects and actions being taken by the Towns of Cary, Apex, and Morrisville, along with Wake County, to accommodate the rapid growth in the area. These municipal projects are a response to the growth in western Wake and eastern Chatham counties, and are not the cause of such growth. Nevertheless, the secondary and cumulative impacts are being considered in this section because the IBT approval is one of several public projects that facilitate growth.

The proposed IBT, when considered in connection with these other projects, will facilitate growth although it is not the base cause of such growth. The growth will result in effects to the environment. Together, these projects will indirectly and cumulatively influence where and how growth occurs in the source and receiving basin urban service areas.

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1 "Indirect Effects" (also called secondary impacts) are "caused by and result from the proposed activity although they are later in time or further removed in distance, but they are still reasonably foreseeable." (15A NCAC 1C .0101(d)(4))

2 "Cumulative Effects" are defined as "resulting from the incremental impact of the proposed activity when added to other past, present, and reasonably foreseeable future activities regardless of what entities undertake such other activities." (15A NCAC 1C .0101(d)(2))

Figure 6

Environmental impacts of the predicted growth are considered in the remainder of this section, which provides a general description of the potential for this urban growth to subsequently impact specific environmental resources, given current trends and literature records. This overview discusses the indirect impacts of the proposed IBT and other expected public infrastructure improvements (Section 4.2.1), and the indirect effects of full buildout (worst-case scenario) of the Utility Service Areas (Section 4.2.2). In addition, the cumulative impact analysis provided in Section 4.3 covers the impacts of full urbanization of the Utility Service Areas in both the source and receiving basins.

It should be noted that the following overview is broad and may reflect a "worst-case" scenario that does not take into consideration current regulations or proposed programs that would mitigate the impacts. A summary of existing federal, state and local regulations is provided in Section 6 to identify areas where opportunities exist to better address the identified potential secondary and cumulative impacts discussed below.

4.2 Secondary Impacts

It is expected that the proposed IBT increase would specifically facilitate growth in the Utility Service Areas of both the source and receiving basins for the following reasons:

- Growth rates in Apex, Morrisville, Cary and RTP have historically correlated with the shortage or availability of water and sewer services. For example, growth rates for Morrisville slowed during the early 1990s due to lack of water and sewer services and Cary's watering restrictions, and a growth moratorium due to water shortages has been extensively covered by the local news media in the last year.
- The recent lack of water supply and wastewater treatment capabilities has caused growth to be curtailed in both the source and receiving basin Utility Service Areas, both in terms of in-fill development (where infrastructure like water and sewer lines are available) and in terms of new developments (that will require additional infrastructure to be built, such as new roads, new sewers and/or water lines). Cary's building permit allocation system, that is based on the availability of treated water, is one sign that the communities recognize a relationship between growth and the adequate provision of water and sewer services.

4.2.1 Water and Sewer Infrastructure

Growth that will be facilitated by the IBT will necessitate the approval, construction, and operation of a variety of additional water and sewer projects in the source and receiving basins, as discussed above, including:

a. The expansion to the existing Cary/Apex WTP;

b. The construction and operation of a proposed treatment and water reclamation facility in western Wake County; and

c. The installation and operation of new or extended water and sewer conveyance systems, including gravity lines, pump stations, and force mains.

Although the proposed IBT itself will not require additional water or sewer lines to be constructed, the availability of additional water will facilitate development and consequential demands for additional water and wastewater treatment, distribution, and

collection systems in the basins. These additional water and wastewater projects will lead to the expansion of urban land uses into rural areas, changing the pattern, rate, density, and type of development in both the source and receiving portions of the Utility Service Area.

Although the proposed IBT will result in new water and sewer lines and additional water treatment and wastewater treatment facilities, existing WWTPs in the receiving basin (Cary North and South WWTPs and Apex WWTP) will not require expansion in order to process the increased wastewater flows generated as a result of the proposed IBT. Potential environmental impacts from these additional permitted discharge flows have already been evaluated prior to DWQ issuing the original NPDES permits for the facilities. Additional reviews of these discharges for environmental impacts, are therefore not necessary.

Constructing and operating water distribution and wastewater treatment and conveyance systems in the source and receiving basin (considered secondary impacts of the proposed IBT) may have direct environmental impacts. These direct impacts will be assessed during the planning and environmental review phase of specific projects.

EAs and EISs for any future water and sewer infrastructure projects are recommended to include discussions of the specific elements identified in Section 6 to ensure that potential direct effects from future water and sewer infrastructure projects are fully evaluated. These conditions recognize the sensitive environmental resources present in the study area and will remind state agencies, project applicant, and consultants of the areas where special attention may be needed in addressing the potential primary impacts of the subsequent projects.

4.2.2 Buildout of the Source and Receiving Basins

Land use changes facilitated by the proposed IBT, combined with the cumulative effects of road construction and development of other urban infrastructure and public services, could create potentially significant direct, indirect, and cumulative impacts on environmental and human resources in the planned Utility Service Areas within the source and receiving basins, as discussed in detail below and in Section 4.3. As previously mentioned, a worst-case scenario is represented by buildout of the Utility Service Area. Growth is not likely to be facilitated in areas of the project study area that are outside of the Utility Service Area (Figure 6).

4.2.2.1 Wetlands

As discussed in Sections 3.1.1 and 3.2.1, wetlands found in the Utility Service Area consist primarily of bottomland hardwood, ephemeral wetland, freshwater marsh, headwater forest, and wet flat wetlands in western Wake and eastern Chatham Counties (NCWRP, 1998A & B). Wetland habitat community types include Piedmont/Low Alluvial Forest and Piedmont/Mountain Bottomland Forest. As shown on the Land Cover Utility Service Area Table (Table A-2 in Appendix A), there are 2,778 acres of wetlands in the jurisdiction of Cary, 1,289 acres in Apex, 322 acres in Morrisville and 341 acres in the RTP South area of Wake County (Figure 7).

Dense urban development in eastern Chatham and western Wake Counties, as possible through buildout of the Utility Service Area, could have significant impacts on these identified wetlands. Impacts could be direct, in terms of filling or draining of wetlands for construction of roads, private or public building sites, or utilities. Urban development could also have significant indirect impacts to wetlands, in terms of increased levels of silt and

Figure 7

sediment from grading activities and the increasing amount of non-point source pollutants entering into the wetlands over the long term from upland development activities and urban land uses. Typical urban stormwater pollutants include sediment, nutrients, (nitrogen, phosphorus), bacteria (fecal coliform as indicators), and potential toxicants (metals, oil and grease, hydrocarbons, pesticides).

It is also widely accepted that, in general, increases in stormwater runoff from elevated impervious surfaces resulting from development could cause erosion and collapse of stream banks, leading to loss of riparian canopy trees, degraded stream habitat, and loss of wetlands. Construction within floodplains, particularly when riverine wetlands are damaged or destroyed, can also lessen the storage capacity of floodplains, contribute to higher flood levels downstream, increase turbidity, and increase erosion problems due to higher stream flow velocities.

The NCWRP indicated in its Cape Fear Basinwide Wetland And Riparian Restoration Plan, that in subbasin 030606 of the Cape Fear River basin (the area on the east side of Jordan Lake including portions of Wake and Chatham Counties, extending to the boundary with the Neuse Basin), there were 5 acres and 8.5 acres of wetlands drained or filled due to development activities in 1996 and 1997, respectively. These impacts occurred with 13 and 14 separate development projects per year, respectively, and were reported through DWQ's Section 401 permitting process. (NCWRP, 1998A)

In the NCWRP report for the Neuse River basin, subbasins 030402 and 030403 (which include drainage from Swift, Crabtree and Middle Creek) reported a total of 86 acres and 21 acres of wetlands drained or filled due to development activities in 1996 and 1997, respectively. These impacts occurred as a part of 46 and 39 separate development projects per year, respectively, and were reported through DWQ's Section 401 permitting process. (WRP, 1998B)

The acreage of wetlands impacted by growth may increase as the level and intensity of land use changes and the number of development projects increases in the area.

4.2.2.2 Land Use

As discussed in Sections 3.1.1.1 and 3.2.2.1, and shown on Table A-2 in Appendix A, the most prevalent land cover type in the Utility Service Area as of 1996 was forest. Lands in the Utility Services Area may also contain archaeological or historic sites with significant native and cultural resources. At that time there was a total of 4,679 acres of high and low intensity urban development, 25,891 acres of forest, 268 acres of agricultural cropland and pasture, and 7,302 acres of vacant shrubland in this area. At that time, the Town of Cary consisted of 12% urban lands, Apex was 13% urban, and Morrisville was 12% urban. No urban areas were shown within the Utility Service Area portion of RTP South; however, 26 acres of urban lands were shown within the non-utility service area portion of RTP South.

Future Land Use maps for Cary, Apex, Morrisville and RTP are presented in Appendix D. A Land Use Plan for Cary can also be found in Appendix D. For the most part, Cary has planned its land use patterns so that the most low-density development would be adjacent to the WRC game lands around Jordan Lake, with densities increasing to the east. However, areas around Panther and Northeast Creeks show greater allowable densities including commercial development.

The most significant indirect impact of any growth in the Utility Service Area will be land use changes within the currently open/vacant urban services areas within western Wake County. This growth and urbanization, including land use changes and other effects of land development, could cause significant secondary impacts to other land uses, including rare forest resources, prime agricultural land, and archeological resources.

Impacts of land use changes could include the direct loss of the resource from conversion to urban uses. For example, the loss of forest land and open shrub land to urban land uses not only means a loss of timber resources, but also the loss of wildlife habitat, which can have significant impacts to various sensitive species in the area.

Land use changes can also cause other potential impacts, including the indirect degradation of recreational lands by the development of incompatible land uses along their periphery. Also, parks, greenways, and natural areas may be degraded through overuse of the resource by the local population, usually resulting from limited recreational opportunities and a lack of open space set aside, both common occurrences for fast growing areas.

As land uses change and populations increase around the project area, public lands such as State parks may experience periods of overuse, especially during summer months. Potential impacts from allowing incompatible land uses adjacent to recreational and natural areas and overusing parks and open spaces include:

- Localized degradation of air quality from increased levels of traffic congestion within parking lots, access roads, and major road crossings.
- Loss of sensitive wildlife species, recreational game species (such as deer, opossum, rabbit, raccoon and fox) and non-game species (including snakes, turtles, frogs, bats and birds) due to: 1) hunting of species by local residents, 2) collisions with vehicles from increased traffic volumes on roads adjacent to and within parks and greenways, 3) predatory behavior of dogs and cats introduced into the park by the owners or who are feral, and 4) intentional extermination of "pest" species from residential properties adjacent to these natural areas.
- Loss of recreational value due to the intrusion of residential land uses immediately adjacent to public hunting grounds, which precludes the use of firearms in the gamelands.

4.2.2.3 Fish and Wildlife Resources

As detailed in Sections 3.1.3 and 3.2.3, a wide variety of wildlife resources, fisheries resources, sensitive species, and Significant Natural Heritage Areas were considered to determine if they currently exist in the study area. As discussed in detail in Sections 3.1.3.1 and 3.2.3.1, particular species of concern known to be present in the study area that may be impacted by growth and development include: red-cockaded woodpecker, buttercut phacelia, tiger salamander, four-toed salamander, Carolina least trillium, Piedmont quillwort and various mussels and anadromous species. These species may be directly and indirectly impacted by full buildout. However, not all of these species have been clearly identified to exist in the Utility Service Area. Other species such as the Cape Fear shiner and the dwarf-wedge mussel are known to exist outside the Urban Service Area and Utility Service Area. The presence of sensitive species in the Utility Service Area is possible, but it has not been confirmed.

Some of the aquatic species, if they are found downstream of the Utility Service Area, may be impacted by overall changes to water quality from point and non-point sources of pollution generated from growth. Impacts may be due to increased sedimentation and erosion, loss of streambanks, loss of riparian buffer and increased amount of non-point source pollutants entering into the surface waters as urban land uses replace rural land uses in the project area.

Sensitive environmental areas within the study area that could be affected by growth effects in the Utility Service Areas include: Jordan Lake, Jordan Lake WRC Game Lands, Umstead State Park, Middle Creek, Swift Creek, and Crabtree Lake. These areas are outside but adjacent or in close proximity to the Utility Service Area.

Further urbanization and buildout of the region may have significant impacts on fish and wildlife resources, sensitive species and habitat areas, through the continued:

- loss, fragmentation or degradation of sensitive and non-sensitive aquatic and terrestrial species and their habitats through conversion of land and wetland areas and filling or piping of streams and creeks for residential, business, or public facility uses;
- degradation of water quality and negative impacts on aquatic resources, fisheries, and wetlands through increasing erosion and sedimentation from construction activities, increased stormwater runoff containing high levels of non-point source pollutants, and introduction of additional point source wastewater discharges;
- degradation of air resources through increased automobile usage and traffic congestion related to urban sprawl; and
- loss of species diversity and value of open space through the combined impacts listed above.

4.2.2.4 Water Quality / Water Resources

Dense urban development from full buildout (worst-case scenario) of the Utility Service Area may affect water quality. Short-term declines in water quality from installation of public improvements and changes in land uses due to sedimentation and erosion from construction activities, and long-term declines in water quality from land use activities and increasing amounts of non-point sources of pollution may have significant impacts on water quality, and subsequent impacts on aquatic habitat, wetlands, and sensitive aquatic and amphibian species.

Changes in land use have a major effect on both the quantity and quality of stormwater runoff. Urbanization and land use development, if not properly planned and managed, can dramatically alter the natural hydrology of an area. Impervious surfaces increase the volume and rate of stormwater runoff. These changes lead to more frequent and severe flooding and also leads to degradation of water quality from the various stormwater pollutants that wash off impervious areas during rain events (e.g. sediments, nutrients, oils, toxics, bacteria, etc.). As imperviousness increases, impacted surface waters become more impacted from pollution and flooding. The cumulative effects of stormwater runoff are evident in the frequent correlation between the location of a stream and its water quality, where urban streams overall have poorer water quality than rural streams.

One major positive secondary impact of the proposed IBT and the construction of regional public water and wastewater collection and treatment systems in the Utility Service Area will be the eventual elimination of privately owned package treatment plants, eventual elimination of septic systems, adequate maintenance of sewer lines to prevent overflows, and public enforcement actions on failing septic systems that will together protect surface waters from discharges of wastewater in the project area.

4.2.2.5 Air Quality

Ozone and carbon monoxide are the primary pollutants of concern in the study area, and the levels of ozone in the study area will likely be affected by the projected increasing growth. Since NOx is the limiting factor in ozone formation, and an estimated 60 percent of NOx is emitted by automobiles, the additional vehicle miles traveled due to increased population will likely result in higher concentrations of ozone formed during the hot, summer months.

4.2.2.6 Groundwater

The largest problems with groundwater in urbanizing portions of the Piedmont are low yield wells and contamination from land uses. The proposed IBT and increased Jordan Lake allocation, coupled with subsequent extensions of water and sewer lines throughout the Utility Service Area, will eventually lead to abandonment of most groundwater wells being used in the area, as existing homes take advantage of plentiful water from the new system. Once full buildout of the Utility Service Area begins to occur, however, groundwater infiltration and recharge will probably be reduced, due to increased impervious areas in the region, which would further limit the yield of existing groundwater wells.

Land use activities and growth in the receiving basin could also potentially impact groundwater quality by introducing contaminants into or onto the soil where it can seep into the groundwater aquifer. Such contamination can affect drinking water wells for communities and individual homes. Potential sources of groundwater contamination include storage or use of hazardous substances, poorly designed or maintained septic systems, accidental spills, and leaking underground storage tanks.

The proposed regional wastewater collection services will capture a significant number of residences presently using septic tanks. This will result in a beneficial impact to groundwater in the study area by reducing the public health risk of groundwater contamination in the service area from leaking or failing septic tanks.

4.2.2.7 Noise

The predicted full urbanization and buildout of the Utility Service Area will produce greater amounts of noise from greater density of land uses, more people living in the region, more businesses and industries operating in the area, and a significant increase in number of vehicles using local roads and highways. As development occurs with the provision of water and sewer services, existing residential developments, once isolated in the countryside, will be joined by additional subdivision developments next to them. The cumulative effect of lawn mowers, leaf blowers, barking dogs, etc. will rise accordingly. Businesses and industries will move into the area also, potentially bringing elevated noise levels to existing residential areas. The continued growth and development of the Utility Service Area will significantly impact the community noise levels through the introduction of additional domestic and commercial traffic and intensification of industry.

4.2.2.8 Toxic Substances / Hazardous Wastes

As urbanization continues in the Utility Service Area, the potential for release of toxic substances from residential and commercial sources increases. The improper disposal of these substances could have adverse impacts on the environment by entering the groundwater or the sewer system and reaching the WWTPs.

As the amount of traffic and urban uses in the receiving basin increase, stormwater runoff may contain increasing levels of pollutants, some of them toxic. Typical urban stormwater pollutants include sediment and silt, nitrogen and phosphorus, oils and greases, rubber deposits, toxic chemicals, pesticides and herbicides. Unless contained and treated before entering into surface waters, this urban stormwater could significantly impact the water quality and sensitive species living within the Utility Service Area.

The long-term impact of new toxic discharges to the surface and groundwaters from urban stormwater and accidental and/or intentional spill of household and industrial chemicals will likely lead to declines in water quality and the potential loss of wildlife.

4.3 Cumulative Impacts

Cumulative impacts are impacts that result from the proposed project when added to other past, present and reasonably foreseeable future activities. Other activities that will impact the project area include:

- The Towns of Cary and Apex are jointly pursuing an expansion to the Cary/Apex WTP, which will expand water supplies to serve Cary, Apex, Morrisville, RTP South, and RDU Airport. Expanding the WTP that withdraws water from Jordan Lake will provide more water to the entire area, allowing the growth and development that has been recently curtailed by water shortages. This will affect all water available for growth in the Utility Service Area, not just what is transferred across basin boundaries. The EA/Finding of No Significant Impact (FONSI) was approved for this project in 1997 (Goldstein, 1997).
- In an effort to provide more sewage capacity to the area and to minimize IBTs, a new treatment and water reclamation facility is proposed for western Wake County (potentially up to 40-mgd capacity). It is assumed the facility will discharge to the main stem of the Cape Fear River. This facility would reduce the cost of pumping wastewater into the Neuse basin from the Cape Fear basin, and would reduce the IBT, since water would be returned to the source Cape Fear basin. An EA is currently being prepared for the facility by Arcadis Geraghty & Miller Engineers.
- Additionally, the proposed Outer Wake Expressway (Outer Loop) planned to traverse the Utility Service Area from north to south near the Cape Fear/Neuse basin boundary will significantly affect growth and development in the area, especially at planned interchanges and along major thoroughfares leading to the interchanges.

Cumulative impacts, related to growth, are expected to be essentially the same as those identified as secondary impacts in the previous section. Today, the Town of Cary covers 40 square miles with a population of over 92,000. The Town's current Land Use Plan estimates the Town will reach a population of 230,000 and cover 95 square miles at full buildout (Cary, 1996). These figures do not include the population and coverage predicted for Morrisville and Apex over the next 30 years. Such growth limits are depicted on Figure 6 as

the planning jurisdiction for the project. A general discussion of the cumulative impacts of full buildout (worst case scenario) and urbanization of the Utility Service Area is addressed in this section. As previously discussed, buildout is being considered because it represents a conservative assumption of a "worst case" scenario.

Full urbanization of the Utility Service Area may cumulatively cause degradation and loss of certain wetlands, forest resources, prime agricultural land, sensitive wildlife habitat and archeological resources. Conversion of these land uses and the resultant urban development activities that normally accompany these changes may cumulatively impact water quality and aquatic habitat adjacent to and downstream of these urbanizing areas. Streams, lakes and other surface waters in the Utility Service Area may be impacted by the cumulative effect of urban non-point source pollutants and hydrologic modification. Increased levels of silt and sediment and the increasing amount of non-point source pollutants entering surface waters in the project area from development activities and urban land uses pose a threat to the natural system in the long term. The inclusion of a new wastewater discharge in the Cape Fear River below Jordan Lake dam may also cumulatively affect water quality, aquatic species and habitat and recreational uses.

Long-term declines in water quality from on-going non-point pollution and stormwater from urban land uses can have significant impacts on aquatic habitat, wetlands and sensitive aquatic and amphibian species in urbanizing areas. Such impacts may lead to the decline of sensitive aquatic species. In general, unless stormwater is properly managed, and wetlands and stream buffers are protected, erosion and urban stormwater could cause significant cumulative impacts to the water quality and/or the sensitive species living within the project area and in downstream environments.

As land uses change and open spaces are developed and cut off from other open areas, fish and wildlife habitat will be lost and fragmented, and species diversity potentially diminished. Loss of terrestrial natural communities to urban development is a particular concern for the sensitive species living on marginal habitats or on small preserves that may be degraded from the intrusion of adjacent urban land uses. Sensitive terrestrial and aquatic species and their habitats may be lost to development or may be degraded over time by the negative impacts of urban uses in close proximity, especially as a result of degradation of water and air resources. Both the water quality and sensitive species habitat in the Utility Service Area and downstream areas may be significantly impacted through the increase in stormwater, increased sedimentation and erosion, loss of streambanks, and increased amount of non-point source pollutants entering into the surface waters from urban land uses.

Public and recreational lands and waters could receive additional use from an increased population, creating stress on wildlife that are trying to occupy the few natural areas remaining. Urbanization will also increase the base level of noise in the receiving basin, potentially impacting wildlife behavior.

Urbanization of the area may result in a loss of acres of prime agricultural and forest land. Stormwater runoff may increase, causing streambank erosion and increased amount and severity of flooding damage to public and private properties. Archeological and historical sites may be lost to development activities. The additional vehicle miles traveled due to increased population growth will likely result in higher concentrations of ozone formed during the hot summer months. Urbanization in the Triangle area has in the past

contributed to a decrease in air quality, and this trend is likely to continue as a result of growth.

A potential impact to groundwater availability is the reduced infiltration capacity due to increase of impervious areas as growth continues; thus affecting the recharge capacity of the groundwater storage. Land use activities and growth could also potentially impact groundwater quality by introducing toxic contaminants in recharge areas. The long-term, cumulative impact of new toxic discharges to the surface and ground waters from urban stormwater, landfill leachate, and accidental and/or intentional spill of household and industrial chemicals in the receiving basin could lead to declines in water quality, the potential loss of wildlife and potentially the elimination of the existing endangered species in the study area.

Direct cumulative impacts have been evaluated using DWR's hydrologic model for the Cape Fear River Basin. The model considers all major water withdrawals (water supply and irrigation) and discharges within the Cape Fear River basin, including those into and out of Jordan Lake. The model has been used to conduct analyses of the impact of the requested interbasin transfer on Jordan Lake surface water elevations, minimum releases from the dam, water quality pool levels, the target flows at Lillington, and flows at Fayetteville. The cumulative impacts of the proposed IBT increase were modeled and compared to the cumulative impacts of Alternative 1A (no increase in IBT) and the "Base Future" scenario. Cumulative impacts were evaluated using estimated 2030 withdrawals and discharges throughout the Cape Fear River basin and assuming that the Jordan Lake water supply pool was fully utilized (total withdrawals = 100 mgd). The cumulative impacts analysis show that the impacts of the proposed increase in IBT are insignificant and that any cumulative impacts are due to the increased use of the Jordan Lake water supply pool and basinwide water resources in general.

SECTION 5

Alternatives Analysis

Alternatives to the proposed increase in the interbasin transfer are discussed below and summarized in Table 17. Each alternative is assumed to be potentially feasible and incorporates consideration of physical and environmental constraints based on current available information. More detailed conceptual studies would be necessary to determine the full implementation requirements for these alternatives.

Alternative 5 is basically the proposed action but without the future implementation of a regional treatment and water reclamation facility in the Cape Fear River basin. Since the proposed action is based on the assumption that a substantial amount of water will be returned to the source basin via this facility prior to 2010, this alternative is intended to qualify environmental impacts associated without that assumption. Alternative 5 also provides a general basis for comparison with all other alternatives that assume a future regional discharge to the mainstem of the Cape Fear River.

Order-of-magnitude cost estimates were developed for each alternative in 1999 dollars using a combination of conceptual layouts, unit costs, and previously prepared cost estimates. Construction cost estimates are based on costing curves and planning-level units of construction and incorporate the following allowances:

- 7 percent allowance for contractor mobilization and demobilization
- 15 percent allowance for contractor overhead and profit
- 25 percent contingency

Total project cost is the sum of the estimated construction costs, allowance for engineering design and construction management, and lump sum allowances for permitting and land/easement acquisition where appropriate. Detailed cost-estimating spreadsheets for each alternative are shown in Appendix E.

The order-of-magnitude cost estimates have been prepared from available information for the purposes of comparing alternatives. Final project costs and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, final project costs will vary from the estimates presented here.

5.1 Alternative 1: No Action

There are two possible scenarios that fall under the No Action alternative: Alternatives 1A and 1B, described below. Both of these result in no additional increase in the IBT; however, they do not satisfy the objectives of the project.

5.1.1 Alternative 1A: No IBT Increase with No Additional Allocation of Water from Jordan Lake

Under this alternative, there is no increase in the existing 16-mgd (average day basis) Jordan Lake allocation, and the maximum current permitted IBT would remain 16 mgd (maximum day basis). Table 11 shows the resulting IBT calculations. There would be no new regional treatment and water reclamation facility, or other additional discharges to the source basin, in western Wake County.

Cary, Apex, Morrisville and the Wake County portion of RTP would be forced to meet water demands by searching for other water sources such as the Cape Fear River via a Haw River intake, purchased water from other localities (see alternatives No. 2 and No. 4 below), small community or individual wells in the region's low yield aquifers or significant water conservation and reuse programs. It is unlikely that any of these options would allow sufficient water supply to satisfy water demands based on current growth projections. Local governments would be forced to implement very stringent water conservation measures, convert to a conservation rate structure and work with industries to lower water usage. Higher water rates may pressure industries with high water demands to lower usage or move out of the service area. Local governments may also consider creating permanent rules prohibiting the use of water from the municipal water system for landscaping, and instead, require residents and businesses to either install individual groundwater wells or utilize reclaimed water for landscaping purposes (Cary, 1999). Growth will decrease sharply as a result of these policies.

TABLE 11
IBT Calculation (Maximum Day Basis) for Alternative 1A

Year	Water Withdrawal from the Haw River Basin	Consumption		Estimated Wastewater Discharge		Total Return to Cape Fear Basin	Estimated Interbasin Transfer
		Haw River Basin	Neuse River Basin	Cape Fear Basin	Neuse River Basin		
2000	19.0	3.0	2.6	0.0	13.3	3.0	15.9
2005	19.0	3.0	2.6	0.0	13.3	3.0	15.9
2010	19.0	3.0	2.6	0.0	13.3	3.0	15.9
2020	19.0	3.0	2.6	0.0	13.3	3.0	15.9
2030	19.0	3.0	2.6	0.0	13.3	3.0	15.9

5.1.1.1 Engineering Considerations

The available water supply will meet a maximum day water demand of 19 mgd, which corresponds to current water demands. This scenario assumes that future water demands would be met by a reclaimed water system and conservation efforts. This scenario includes an aggressive water conservation program to reduce ADD by 33% from projected levels by 2030. There would be no need to expand the Cary/Apex Water Treatment Plant (WTP), the Cary/Apex raw water intake on Jordan Lake, or the wastewater treatment facilities in the area (Cary North WWTP, Cary South WWTP, and Apex WWTP).

Some additional water demands may be met by the full implementation of Cary's Reclaimed Water and Wastewater Program (Camp, Dresser, and McKee; 1997). The recommended reclaimed water system would be based at the Cary North WWTP and have a total supply capacity of 3.2 mgd by 2015. However, the report outlines a total potential demand of 5.2 mgd in Cary, Morrisville, and at the RDU Airport once the program is fully implemented. The program is designed to provide non-potable water to residential customers, golf courses, and commercial customers for irrigation and to commercial and industrial customers for cooling water. The first phase of this system has been designed and is currently under regulatory review.

The cost estimate for this scenario is $11.1 million (See Appendix E).

5.1.1.2 Direct Impacts

Under Alternative 1A there would be no required changes to the existing water supply. There would be no construction, no change in water use or discharge in the source or receiving basin, and no impact on the water quality of either basin. Therefore, there would be no direct impacts in either the source or receiving basin.

Because the amount of withdrawal from Jordan Lake would not change, this scenario is similar to the Base 1998 scenario except that incremental impacts of all alternatives were evaluated assuming full utilization of the Jordan Lake water supply pool. No significant impacts were found for this scenario except those impacts related to the increased use of Jordan Lake by other water systems (Appendix B). Future growth and development is contingent upon effective water conservation in the study area.

5.1.1.3 Indirect Impacts

This no action alternative would severely limit the amount of new development in Cary, Apex, Morrisville and RTP South due to lack of water and sewer capacity. However, rapid growth of the Triangle region is expected to continue. Therefore, other areas in proximity to Raleigh, Wake County, Durham, and Orange County would be required to sustain the increases in population of the region. Many regional homebuilders and developers expect growth to continue at a rapid pace in the Triangle area (News and Observer, 1999).

Developers project that if growth is curtailed, in Cary for example, it will likely be absorbed by southern portions of Durham County, Fuquay-Varina, Garner and unincorporated areas in Wake, Franklin and Johnston Counties, among others (News and Observer, 1999). Some of the growth would be forced to occur in what are now largely rural areas which lack strong environmental programs that address urban pollution, instead of the already suburban communities of Cary and Apex which posses strong environmental programs. There would be a more obvious decrease in open space, farmland, and forest. Indirect impacts in these new development areas may include loss of wildlife habitat, wetlands, and open spaces for recreation; increased traffic congestion and associated decrease in air quality; diminished water quality due to urban runoff; stream bank erosion due to hydrological changes; and increase in sediments due to construction. Increasing the impervious surface of a region may also impact groundwater supplies by lessening the amount of water recharging the aquifers of groundwater dependent communities. Noise and the presence of chemical pollutants will also likely increase due to residents, businesses, and traffic in the new growth areas.

Indirect environmental impacts of this alternative are related to those associated with the potential use of package WWTPs, land application, and on-site septic systems due to the lack of municipal sewer infrastructure. If a new treatment and water reclamation facility is not built in western Wake County, these alternative wastewater disposal systems would be heavily relied on to support growth. However, regional soils are often unable to handle land application and subsurface waste disposal systems and allow surface and groundwater contamination. Water quality impacts from septic tanks that are likely to malfunction on the clayey soils in the Jordan Lake area may become significant problems for surface and groundwater quality. The proliferation of septic tanks coupled with area groundwater wells under these conditions could lead to contamination of well water. Many existing package treatment plants in the area are notorious for contributing to declines in water quality due to improper operation and limited treatment. Finally, it may be difficult to obtain permits from DWQ for package WWTPs, due to the usual low flow observed in the streams of the study area, thus exacerbating pressure on land application and subsurface disposal systems (USGS, 1993).

Although development near Jordan Lake under this alternative may decline in intensity and uses from what is currently planned (due to the lack of water and sewer infrastructure under this alternative), growth would not be prohibited altogether in the sensitive natural areas surrounding the WRC Gamelands. Although higher density land uses would not be feasible, large lot single family residences on individual wells and septic tanks would likely become the predominant land use, displacing open space and agricultural uses, as has been the trend for the area over the past ten years (Cary, 1996).

Development impacts and urban pollution around Jordan Lake under this alternative may decline slightly over predicted levels with higher intensity uses associated with water and sewer systems. However, some impacts would still occur, including loss of open space, wildlife habitat, wetlands, farmland and forests. Although imperviousness of the region may be reduced with low density development, which would limit the effect of stormwater runoff, nonpoint source impacts may or may not be less, depending on design of the individual developments and road systems, and the size of individual lots and homes. The amount of groundwater used by individual wells on a limited yield aquifer may be cumulatively significant.

Social impacts may also occur as a result of this alternative. Eventually, there would be increased infrastructure costs of water, wastewater, fire, police, schools, etc. In addition, there would be social impacts on Cary, Apex, and Morrisville, which may be forced to raise local taxes or try to continue to attract growth to sustain a healthy tax base and provide revenue for services. Water costs in these communities would likely also rise to promote water conservation, which will become a significant source of the water supply. Conservation measures that are more stringent than those currently in place or proposed in the future might also be required of residents and businesses. Golf courses and industries with high water use may possibly be prohibited or severely restricted, unless water reuse amounts could satisfy this water demand.

5.1.2 Alternative 1B: No IBT Expansion With Additional Jordan Lake Water Allocation

Under this no action alternative, Cary, Apex, Morrisville and RTP South would limit increases in the IBT so that they are balanced by concurrent decreases in customer demand, through very significant conservation and reuse programs and by a regional discharge to the Cape Fear River basin. This alternative may present a policy challenge, since the EMC declined to act on the currently pending Jordan Lake allocation recommendations without concurrently considering an IBT increase. This is because the allocation could not be supported by a currently permitted municipal discharge that would limit the IBT to the existing certificate amount. This alternative will limit water supply to the current capacity of 19 mgd (maximum day basis) until 2005 when a regional treatment and water reclamation facility is in operation. This option qualifies as a No Action alternative largely because it assumes, as currently planned, the eventual construction of a regional treatment and water reclamation facility in western Wake County, along with reuse and conservation measures, so that the existing IBT will not have to be increased above 16 mgd (maximum day basis).

Under this scenario, growth in the Cary, Apex, Morrisville and RTP South area would be expected to continue to occur, although at a somewhat slower rate than that currently projected. In the long-term, enough water and sewer service would be provided to future residents and businesses to accommodate growth.

The IBT calculations for this alternative are summarized in Table 12.

TABLE 12
IBT Calculation (Maximum Day Basis) for Alternative 1B

Year	Water Withdrawal from Haw River Basin	Consumption		Estimated Wastewater Discharge		Total Return to Cape Fear Basin	Estimated Interbasin Transfer
		Haw River Basin	Neuse River Basin	Cape Fear Basin	Neuse River Basin		
2000	19.0	3.0	2.6	0.0	13.3	3.0	15.9
2005	23.2	3.8	4.8	3.4	11.2	7.2	16.0
2010	29.4	4.9	6.2	9.2	9.0	14.2	15.2
2020	38.9	6.5	8.0	16.5	7.9	23.0	15.9
2030	43.8	7.1	8.3	20.9	7.5	28.0	15.8

5.1.2.1 Engineering Considerations

Under this scenario, an increase in the IBT is not requested. However, an increased water supply allocation from Jordan Lake would be needed. Implementation of water conservation and reuse would be required, as discussed in Section 5.1.1.

This scenario includes a treatment facility that discharges a highly treated effluent to the Cape Fear River below the Jordan Lake Dam. The regional treatment and water reclamation facility would reach a capacity of 18 mgd by 2030, based on projected growth and water demand patterns.

Construction of the regional facility could allow for additional withdrawals from Jordan Lake while maintaining an IBT of 16 mgd or less. No expansion to the Cary/Apex raw water intake or raw water conveyance facilities would be required since these facilities have adequate capacity. The Cary/Apex WTP would be expanded to 49 mgd (43.8 mgd plus a contingency for planning) to meet future water demands. No expansions of existing WWTPs would be required since the proposed regional treatment and water reclamation facility in western Wake County would treat future wastewater flows in the area.

The cost estimate for all capital projects in this scenario is $207 million (See Appendix E).

5.1.2.2 Direct Impacts

Under Alternative 1B there would be no required changes to the existing water supply. There would be no construction associated with the transfer of water from one basin to the other and the IBT would remain at 16 mgd. Therefore there would be no direct impacts in either the source or receiving basin.

Modeling of this alternative show that there is no significant impact from increasing the water supply withdrawals from Jordan Lake to 26.8 mgd by 2030 and offsetting the IBT by returning flows through a regional water reclamation facility discharging at a location downstream of Jordan Lake and upstream of Lillington even under drought conditions. There is little difference between the impacts of the proposed increase in IBT and Alternative 1B. Alternative 1B results in minor impacts on Jordan Lake elevations and outflows compared to the Base 1998 scenario. However, the impacts from Alternative 1B are similar to those for the "Base Future" scenario, suggesting that the impacts are mainly due to the increased use of the Jordan Lake water supply pool.

5.1.2.3 Indirect Impacts

Increased water use beyond the current allocation of 16 mgd without an increase in IBT will require returning water to the source basin until a regional treatment and water reclamation facility is in operation discharging to the source basin. The strict nutrient limits imposed by the Neuse River NSW Management Strategy Rules may further induce dischargers in the Cape Fear basin, especially in the New Hope Creek/Jordan Reservoir subbasin (DWQ basin for considering WWTP discharges). Although the Clean Water Responsibility Act of 1997 establishes a nitrogen limitation for discharges in the Jordan Lake watershed, existing and new dischargers are exempt from complying with this limitation until a model is completed sometime in 2002 and subsequent rule making is completed thereafter. It is expected that nitrogen limits in the Jordan Lake watershed will not be as stringent as in the Neuse River basin. Likely means of directing the water back to the source basin will be an increase in the number of package treatment plants, land application, and increased use of septic systems. As discussed above, these systems are less effective at removing pollutants than municipal plants. Eventually, due to the construction and operation of a regional treatment and water reclamation facility in western Wake County, indirect impacts may occur from this facility. These impacts are expected to be the same as those associated with the proposed action in the Utility Service Area, and they are briefly discussed in Section 4.3, Cumulative Impacts.

Under this alternative, additional availability of discharges or alternative disposal systems in the New Hope Creek/Jordan Reservoir subbasin, coupled with the cost deterrent for pumping wastewater across interbasin boundaries could facilitate growth in the western parts of the project communities. In areas of high growth pressure, development will likely

be drawn to areas with plentiful wastewater treatment capacity. The indirect impacts of this alternative are essentially the same as those in the proposed alternative. Under this alternative, continued growth and development will be facilitated. The secondary impacts of future growth and development on wetlands, land use, fish and wildlife resources, water resources, air quality, groundwater, noise, and the presence of toxic substances and hazardous materials in the environment are discussed in Section 4.

In short, increasing the Jordan Lake allocation with no IBT increase may actually facilitate land use changes and a shift of development pressures closer to Jordan Lake. Current growth control policies around the lake may be weakened (as far as possible under the Water Supply Watershed Act) to compensate for this pressure.

This shift in development pressure towards Jordan Lake could significantly impact Jordan Lake's resources, valuable wildlife and recreational/game lands and valuable water supply uses, through more intensive urbanization along the lake and its tributaries. Eighty-one percent of the source basin's wetlands surround Jordan Lake. Several threatened or endangered species exist in tributaries draining to Jordan Lake, or on lands immediately adjacent to the lake. The lake also supports 28 different species of fish, including various species of bass, sunfish and shad. Areas adjacent to the lake include several significant natural heritage areas and WRC Game Lands. For a more complete description of the natural resources of the source basin and Jordan Lake, see Section 3.1.3; and for more information on the impacts of growth in this region, see Section 4.

5.2 Alternative 2: Obtain Water From the Neuse River Basin

Under this alternative, increases in the IBT would be avoided by implementation of water conservation and reuse programs, construction of a regional discharge to the Cape Fear River basin, and purchase of finished water from the Neuse River basin. There would likely be slower growth until 2005 when a regional treatment and water reclamation facility in western Wake County is constructed. Beyond 2005, growth and development in the Cary, Apex, Morrisville and RTP South would follow the anticipated patterns shown in Section 2.1.

One option for the applicants is to increase existing water supplies from the Neuse River basin through additional purchases of finished water from the City of Durham and/or the City of Raleigh, so that the interbasin transfer amount does not increase from the existing 16 mgd IBT. This would require purchase of average day amounts of 2.4 mgd in 2000, increasing to about 5.6 mgd in 2030; maximum day amounts would be 4.0 in 2000 and 9.2 mgd in 2030. Both the City of Durham and the City of Raleigh have expressed concern for maintaining sufficient capacity to satisfy their own demands, and indicated that they do not foresee the need to provide finished water to Cary, Apex, Morrisville, and RTP South on a long-term basis.

The IBT calculations for this alternative are summarized in Table 13.

TABLE 13
IBT Calculation (Maximum Day Basis) for Alternative 2 – Obtain Water from Neuse River Basin

Year	Water Withdrawal		Consumption		Estimated Wastewater Discharge		Total Return to Cape Fear Basin	Estimated Interbasin Transfer
	Haw River Basin	Neuse River Basin	Haw River Basin	Neuse River Basin	Cape Fear Basin	Neuse River Basin		
2000	19.4	4.0	3.3	3.3	0.0	12.8	3.3	16.0
2005	23.5	4.8	4.2	6.0	3.4	9.9	7.6	15.9
2010	29.7	2.9	5.2	7.0	9.2	8.3	14.4	15.2
2020	39.3	2.5	6.7	8.7	16.5	7.4	23.3	16.1
2030	44.5	9.1	7.9	10.3	20.9	5.4	28.8	15.7

5.2.2 Engineering Considerations

Under this scenario, the same water conservation program included in the proposed action would be implemented to achieve an 18% reduction in projected ADDs by 2030, which is a less aggressive program than that assumed under the no action alternatives (1A and 1B). The resulting average water demand in 2030 is projected to be 32.8 mgd and the MDD is estimated at 53.6 mgd.

A water reclamation program would be implemented to supply the area with up to 5.2 mgd of reclaimed water for non-potable uses as discussed in Section 5.1.1. This is a slight increase from the proposed action.

This scenario includes a treatment facility that discharges a highly treated effluent to the Cape Fear River basin below the Jordan Lake Dam. The regional treatment and water reclamation facility would require reach a capacity of 18 mgd to maintain an IBT of 16 mgd through 2030 based on projected growth and water demand patterns.

Construction of the regional facility could allow for additional withdrawals from Jordan Lake, while maintaining an IBT of 16 mgd or less. Installation of additional raw water transmission mains to the Cary/Apex WTP would be required. Expansion of the Cary/Apex WTP to 49 mgd (44.5 mgd plus a contingency for planning) would also be required to meet future water demands.

The remaining water demand would be met by purchasing water from the Neuse River basin. It is assumed that finished water would be purchased from the City of Durham, the City of Raleigh, or from both water systems. To meet projected water demands and maintain an IBT of 16 mgd or less, finished water purchases of up to 9.2 mgd (maximum day basis) would be required by 2030.

The Towns of Cary and Morrisville currently have agreements with the City of Durham to purchase at least 4.0 mgd of finished water per year through 2002. The capacity for the existing connection between the City of Durham and the Town of Cary is approximately 4 mgd. Cost estimates for this scenario include upgrading the connection to a capacity of 9

mgd. The City of Durham has an existing water treatment capacity of 52 mgd. In June 1999 peak day water demand in Durham reached 45 mgd. During this peak demand period, Durham was able to provide only about 2.6 mgd to Cary and had delivery problems within their distribution system.

The Town of Cary also has a connection with the City of Raleigh with a capacity of 13 mgd. Cary has a bulk purchase agreement with the City of Raleigh to purchase up to 3.5 mgd of finished water per year through 1999. Raleigh has an existing water treatment capacity of 73 mgd. In June 1999 peak day water demand reached 67 mgd. The City of Raleigh may not have long-term capacity for providing finished water to Cary because of commitments to provide water to communities in eastern Wake County. Raleigh has indicated a desire to cease water supply to Cary in 2002.

Although the Cities of Durham and Raleigh have recently both served as regional water suppliers, their excess capacity is expected to decrease over the next ten years; therefore, these water systems may be more reluctant to sell finished water in the future. Accordingly, purchasing water from the Neuse River basin may not be a long-term solution to the water supply needs of Cary, Apex, Morrisville, and RTP South. However, there may be opportunities for the applicants to work with Raleigh and/or Durham to develop additional water supplies. For example, one long-range water supply option for the City of Durham is raising the normal pool elevation of Lake Michie (CH2M HILL, 1999). Future water supply options for the City of Raleigh and the municipalities it serves include Little River, Lake Benson, and Lake Wheeler (CH2M HILL, 1998, and Benton, D.E., 1999).

The cost estimate for all capital projects in this scenario is $207 million (See Appendix E).

5.2.3 Direct Impacts

Direct impacts of this alternative are related to the expansion of the existing interconnection between the City of Durham and the Town of Cary. Expansion of the interconnection will include the installation of larger transmission mains along existing right-of-ways in urban areas, and possibly the expansion of the existing booster pump station. Direct impacts are not expected to be significant. However, construction may impact receiving water bodies through the disruption of wetlands, habitat, and vegetation.

This alternative is similar to Alternative 1B regarding its hydrologic impact on Jordan Lake and the Cape Fear River basin; the impacts of Alternative 2 are represented by the modeling results of Alternative 1B. See Appendix B for more detailed information regarding the results of the Cape Fear River Basin model for this alternative.

5.2.4 Indirect Impacts

The City of Durham and the City of Raleigh do not currently have sufficient water supply capacity to meet the needs of their service areas and the needs of Cary, Apex, Morrisville, and RTP South. Therefore, additional supplies would need to be secured in order for purchases of finished water from the Neuse River basin continue. The impacts of developing new water supplies, expanding existing supplies, or utilizing new sources would be assessed as part of the NCEPA process for each project.

If additional water supplies cannot be secured, then this alternative option may mirror Alternative 1A after the year 2010, in that future growth and development in the area will be contingent on securing additional water and sewer capacity without exceeding the 16 mgd IBT.

Under this alternative, the study area will experience continued growth and development. The indirect impacts would be essentially the same as those of the proposed action. The secondary impacts of future growth and development on wetlands, land use, fish and wildlife resources, water resources, air quality, groundwater, noise, and the presence of toxic substances and hazardous materials in the environment are discussed in Section 4.

5.3 Alternative 3: Increase Wastewater Discharges to Cape Fear River Basin

Under this alternative, wastewater flows to the Cape Fear River basin would increase due to the relocation of wastewater discharges for the existing Apex and Cary WWTPs from the Neuse River basin. The likelihood of obtaining discharge permits for the relocated wastewater discharges is unknown, and may be discouraged by regulatory agencies, since Cary and Apex are pursuing the implementation of the new regional facility (either individually, together, or as part of a regional facility).

This scenario also includes implementation of water conservation to reduce the ADD by 18% by 2030 and a water reclamation program to produce up to 3.8 mgd of reclaimed water for non-potable uses.

The IBT calculations for this alternative are summarized in Table 14.

TABLE 14
IBT Calculation (Maximum Day Basis) for Alternative 3 – Relocate Wastewater Discharges to Cape Fear

Year	Water Withdrawal from the Haw River Basin	Consumption		Estimated Wastewater Discharge		Total Return to Cape Fear Basin	Estimated Interbasin Transfer
		Haw River Basin	Neuse River Basin	Cape Fear Basin	Neuse River Basin		
2000	23.4	3.7	3.3	3.7	12.7	7.4	16.0
2005	28.3	4.6	6.0	7.8	10.0	12.4	16.0
2010	32.6	5.4	7.0	11.9	8.3	17.3	15.3
2020	41.8	6.9	8.7	18.9	7.3	25.8	16.0
2030	53.6	8.6	10.3	29.0	5.7	37.6	16.0

5.3.1 Engineering Considerations

Relocation of the discharge from the Apex WWTP could be completed as early as 2002. Prior to 2002, this alternative would limit maximum day withdrawals from Jordan Lake to about 19 mgd until the Apex discharge is relocated, similar to the no action alternative. The regional treatment and water reclamation facility in western Wake County is expected to be

completed by 2005. All of the wastewater flows from the Cary South WWTP will be relocated to the Cape Fear River basin. However, only a portion of the flows from Cary North WWTP will need to be discharged to the Cape Fear River basin in order to maintain an IBT of 16 mgd or less. Since the costs of conveyance and pumping to the Cape Fear River basin are highest for the Cary North WWTP, and only a portion of the flows need to be diverted to maintain an IBT of 16 mgd or less, only flows exceeding 3.6 MGD would be pumped to the Cape Fear River basin (the Cary North WWTP is currently permitted at 12 MGD).

Relocation of these discharges to the source basin presents some challenges. Considering the low flow estimates for the stream in the New Hope Creek/Jordan Reservoir subbasin (USGS, 1993), with Panther Creek being the closest stream that appears to have positive flow but which is a tributary to the 303 (d) list Northeast Creek, and the potential for localized eutrophication impacts in arms of tributaries to Jordan Lake, additional flows exceeding 3.6 mgd at the North Cary discharge would have to be routed to the mainstem of the Cape Fear River. The Apex WWTP discharge would also have to be relocated to the mainstem of the Cape Fear River because of low flow estimates for tributaries to Harris Lake, and eutrophication concerns of this reservoir via the shortest route to the source basin from the existing WWTP and discharge location. Finally, the Cary South WWTP would have to be relocated to the mainstem of the Cape Fear River Basin, because the most efficient route to a stream with significant flow would be to Kenneth Branch which is also a 303 (d) listed stream. Therefore, it appears that the most environmentally sound relocation of these discharges would be to the mainstem of the Cape Fear River, below the Buckhorn Dam.

Relocation of the WWTP discharges will require up to 30 miles of gravity sewer and force main. To develop cost estimates, it was assumed that existing right-of-way would be used for sewer interceptor construction. The location is assumed to be at a site near the intersection of the boundaries of Chatham, Lee and Harnett counties. This may reduce the impacts of construction on sensitive habitats and lands, but may require a number of additional pump stations.

The total costs for capital projects in this alternative is $278.8 million (See Appendix E).

5.3.2 Direct Impacts

The relocation of outfalls would have an impact in the local environment due to construction activities. Construction generally causes increased hill slope erosion and corresponding water quality issues. Although the engineering calculations were based on the use of existing road right-of-way to minimize impacts, there will still be significant construction associated with this alternative to install a 42-inch diameter interceptor. There will be impacts on receiving water bodies due to construction activities that may disturb habitats, wetlands and potentially remove vegetation. Of particular importance would be the natural resources of Harris Lake and the Shearon Harris Game Lands, adjacent to this potential interceptor route and pump stations. More specific direct impacts for this alternative require a complete description of the route for interceptor, force mains and location of pump stations not available at this time. These direct impacts would be addressed under the appropriate NC EPA process for permitting this infrastructure and are beyond the scope of this EIS.

Modeling of this alternative show that there is no significant impact from increasing the water supply withdrawals from Jordan Lake to 32.8 mgd by 2030 and offsetting the IBT by returning flows at a location downstream of Jordan Lake and upstream of Lillington even under drought conditions. There is little difference between the impacts of the proposed increase in IBT and Alternative 3. Alternative 3 results in minor impacts on Jordan Lake elevations and outflows compared to the Base 1998 scenario. However, the impacts from Alternative 3 are similar to those for the "Base Future" scenario, suggesting that the impacts are mainly due to the increased use of the Jordan Lake water supply pool.

5.3.3 Indirect Impacts

Growth in Cary, Apex, and Morrisville will continue to occur, although it will be slowed until the relocation of the discharges is completed. Relocation of the first discharge would not likely be completed before 2002. Until this time, growth will be greatest in surrounding areas. This will lead to the types of indirect impacts described in section 5.1.1.3, related to alternative 1B. After 2002, growth would resume in the project communities. The indirect impacts of this alternative are essentially the same as those of the proposed action. Under this alternative, the study area will experience continued growth and development. The secondary impacts of future growth and development on wetlands, land use, fish and wildlife resources, water resources, air quality, groundwater, noise, and the presence of toxic substances and hazardous materials in the environment are discussed in Section 4.

Eventually, due to the construction and operation of a regional treatment and water reclamation facility in western Wake County, indirect impacts may occur from this facility. These impacts are briefly discussed in the Section 4. However, substantial analysis of these indirect impacts is out of the scope of the current EIS and they should be fully addressed through the appropriate NCEPA process associated with that project.

5.4 Alternative 4: Merger of Water and Sewer Utilities

This alternative involves the merger of the water and sewer utility operations of the Town of Cary and the City of Durham. The City of Durham has an IBT from the Neuse River basin to the Haw River basin, while Cary has an IBT from the Haw River basin to the Neuse River basin; the current net IBT is from the Neuse to the Haw. If these two systems merged, then the overall net IBT would be reduced.

This alternative assumes that the City of Durham would continue to meet its water supply needs from the Neuse River basin and the Town of Cary would continue to meet its water supply needs from the New Hope Creek/Jordan Lake subbasin (Haw River basin). Therefore, this alternative does not differ physically from the proposed action except for the expansion of the existing interconnection to provide additional reliability in the merged system.

Table 15 estimates the combined Cary/Durham IBTs from readily available information. As a result of the merger, the combined IBT is approximately 17.5 mgd from the Neuse River basin to the Haw River basin until 2030. There is no official documentation of Durham's grandfathered amount of interbasin transfer; this information has been requested by DWR as part of the 1997 water supply planning process. However, it is estimated that Durham's grandfathered IBT is in the range of 25-30 mgd. Therefore, the total IBT in 2030 resulting

from a merger of Cary and Durham could potentially be less than Durham's grandfathered IBT amount, and Cary's existing IBT from the Haw to the Neuse would be eliminated.

TABLE 15
IBT Calculation (Maximum Daily Basis) for Alternative 4

Year	Water Withdrawal from Source Basin		Consumption		Estimated Wastewater Discharge		Total Return to Source Basin		Estimated Interbasin Transfer	
	Haw River Basin	Neuse River Basin	Haw River Basin	Neuse River Basin	Haw River Basin	Neuse River Basin	Cape Fear Basin	Neuse River Basin	Haw to Neuse	Neuse to Haw
2000	23.4	47.1	9.5	10.1	21.4	29.5	30.9	39.6	0	7.5
2005	28.3	51.7	11.0	13.4	26.9	28.7	37.9	42.1	0	9.6
2010	32.6	56.4	12.3	15.1	34.9	26.7	47.2	41.8	0	14.6
2020	41.8	65.2	15.0	18.0	46.1	27.9	61.1	45.9	0	19.3
2030	53.6	71.8	17.6	20.5	53.5	33.8	71.1	54.3	0	17.5

5.4.1 Engineering Considerations

The capital requirements for this alternative are similar to those of the proposed action. The only difference is the expansion of the existing interconnection between the Durham and Cary systems. The cost estimate for this alternative includes capital funds for expanding the existing booster pump station to 10 mgd and installing a 30-inch transmission main to increase the capacity of the interconnection. The cost estimate of all capital costs for this alternative is $244.7 million (See Appendix E).

The merger of the Cary and Durham water and sewer utilities could be delayed by institutional and political challenges. The concept of merging the Cary water and sewer utility with another system has been previously discussed in the *Wake County Water/Sewer Master Plan* (CH2M HILL, 1998). The *Plan* recommended the development of a consolidated water and sewer utility in Wake County. The recommended alternative called for the development of a West Wake Utility Group consisting of Apex, Cary, Fuquay-Varina, Holly Springs, and Morrisville by 2005, and creation of a countywide utility system by 2015. The opportunities and challenges of a merger between Cary and Durham have not been previously documented.

5.4.2 Direct Impacts

This alternative is similar to the proposed action and thus, the only unique direct impacts are associated with the expansion of the system interconnection to provide for additional reliability in a merged system. The interconnection expansion would require the installation of a water transmission main on existing right-of-way in an urban or suburban area; thus, significant impacts are not anticipated. This alternative assumes that no wastewater flows from Cary, Apex, Morrisville, or RTP South would be transferred to Durham. Also, this alternative assumes that the long-term water demands of Cary, Apex, Morrisville, or RTP South would not be met by water supplies in Durham County. However, with the expansion of the system interconnection, it is assumed that finished water may be transferred between systems on a limited basis.

This alternative is the same as the proposed action regarding its hydrologic impact on Jordan Lake and the Cape Fear River basin. Therefore, the impacts of Alternative 4 are the same as those found from the proposed IBT increase and thus, this alternative was not modeled separately. See Appendix B for more detailed information regarding the results of the Cape Fear River Basin model for this alternative.

The small changes in the surface elevation of the lake indicate that there may not be significant impacts to wetlands and water quality due to these changes in lake elevation as predicted by the hydrologic model (see Appendix B) due to the following:

- Impact on wetlands would be minimal because of the small amount of decrease in lake elevations.
- Potential effects on water quality by decreasing the volume of water in the lake are expected to be minimal because of the negligible changes of the hydrologic conditions in the lake as predicted by the model.

Direct impacts to land use, air quality, groundwater resources, noise levels and toxic substances are not expected to be significant under this alternative. Direct impacts would mirror those of the proposed alternative and they are extensively addressed in Section 3 of this EIS.

5.4.3 Indirect Impacts

The indirect impacts of this alternative are essentially the same as those of the proposed alternative, since the capital projects are similar except for the expansion of the existing interconnection. Under this alternative, the study area will experience continued growth and development. The secondary impacts of future growth and development on wetlands, land use, fish and wildlife resources, water resources, air quality, groundwater, noise, and the presence of toxic substances and hazardous materials in the environment are discussed in Section 4.

5.5 Alternative 5: No Regional Treatment and Water Reclamation Facility

This alternative assumes that no regional treatment and water reclamation facility in the Cape Fear basin is constructed, and the Cary North, Cary South and Apex WWTPs will not be expanded beyond current permitted capacities. It is assumed that these WWTPs may have sufficient permitted capacity to treat the projected wastewater flows. The assumption that the existing WWTPs could not be expanded is based on the low flow statistics observed in the streams of the region (USGS, 1993), coupled with the location of sensitive species, state parks, impoundments and impaired streams, Neuse River Basinwide Management Plan strategy, and the Neuse River NSW Management Strategy Rules. As with alternative 1B, this alternative presents a policy challenge since the EMC may not approve additional Jordan Lake allocations for an estimated IBT of 45 mgd without provisions for returning water to the source basin in the long term.

Under this scenario, wastewater effluent discharges to the Cape Fear River basin remain at zero, and the quantity of the IBT increases as water withdrawals from Jordan Lake increase and are discharged through existing wastewater treatment facilities in the Neuse River

basin. The IBT in 2030 would be approximately 45 MGD (maximum day) as opposed to 25 MGD under the proposed action (Table 17).

5.5.1 Engineering Considerations

This alternative assumes that no regional treatment and water reclamation facility serving western Wake County will be constructed. Therefore, the IBT will reach a maximum under this alternative in 2030 of 45 mgd. This alternative assumes that the existing WWTPs in the study area will not be expanded. It is also assumed that future wastewater flows will be treated using the existing permitted capacity. Wastewater flows from the Apex area may need to be transferred to Cary South WWTP for treatment as the Apex WWTP is projected to reach its capacity near 2010. The total cost of this alternative is $84 million. A detailed breakdown of the cost estimate for this alternative is included in Appendix E.

TABLE 16
IBT Calculation (Maximum Daily Basis) for Alternative 5 – No Regional Treatment and Water Reclamation Facility

Year	Water Withdrawal from Haw River Basin	Consumption		Estimated Wastewater Discharge		Total Return to Cape Fear Basin	Estimated Interbasin Transfer
		Haw River Basin	Neuse River Basin	Cape Fear Basin	Neuse River Basin		
2000	23.4	3.7	3.3	0.0	16.4	3.7	19.7
2005	28.3	4.6	6.0	0.0	17.8	4.6	23.8
2010	32.6	5.4	7.0	0.0	20.2	5.4	27.2
2020	41.8	6.9	8.7	0.0	26.2	6.9	34.9
2030	53.6	8.6	10.3	0.0	34.7	8.6	45.0

5.5.2 Direct Impacts

Without a regional treatment and water reclamation facility in the Cape Fear River basin, use of privately owned package treatment plants, spray irrigation systems and septic systems could rise dramatically on the Cape Fear River basin side to accommodate growth in western Wake County. This is due to the high cost of pumping sewage across the basin boundary lines to the existing WWTPs located in the Neuse River basin. Increased numbers of these facilities may proliferate in areas closer to Jordan Lake with significant impact to the lake's water quality and the natural habitats around the lake. These package WWTPs, spray irrigation systems, and on-site disposal systems may increase nutrient loadings to Jordan Lake and they could contribute to increased productivity in the already eutrophic lake. Taste and odor problems may also have a significant impact in the Jordan Lake water supply. The potential for pathogens to be present in the lake water would increase. This is especially important because the lake serves as a source for public recreation and drinking water supply. Finally, degradation of water quality may have a significant impact on wetland habitat, aquatic plant and animal species, and may significantly affect recreational fisheries in Jordan Lake.

Modeling of this alternative of the incremental impacts using a monthly time step show that there are no significant impacts related to increasing the water supply withdrawals from Jordan Lake to 32.8 mgd by 2030 and increasing the IBT to the maximum amount compared to the proposed action. However, modeling with a daily time step under drought conditions, Alternative 5 does show minor impacts on Jordan Lake outflows and elevations, Lillington flows, and water quality pool levels compared to the proposed action. As with the other alternatives, the impacts of Alternative 5 are minor when compared to the "Base Future" scenario, suggesting that the majority of the impacts are related to the increased use of the Jordan Lake water supply pool.

Based on the modeling results (see Appendix B), there may be minor impacts to wetlands and water quality due to these changes in lake elevation compared to the proposed action, especially under drought conditions.

Direct impacts to land use, air quality, groundwater resources, noise levels and toxic substances are not expected to be significant under this alternative.

5.5.3 Indirect Impacts

This alternative will not decrease the water and sewer capacities of the region; therefore, it should not alter current growth patterns. The growth of the region would likely continue at the same rate and would primarily affect existing urban enclaves. The indirect impacts associated with growth do not differ significantly from those of the proposed action. Indirect Impacts on wetlands, land use, fish and wildlife resources, water resources/water quality, air quality, groundwater resources, noise levels and toxic substances are discussed in Section 4.

5.6 Conclusion

All of the alternatives considered, except for Alternative 5, represent measures that would keep the IBT at or below 16 MGD (the current level). The low flow statistics observed in the streams of the region; coupled with the location of sensitive species, state parks, impoundments and impaired streams, and the Neuse River NSW Management Strategy Rules (among others); preclude wastewater disposal of additional Jordan Lake allocations to be sustained by expanding the existing Cary and Apex WWTPs at their existing locations. In addition, expanding and relocating these discharges to the Jordan Lake or Harris Lake watersheds may not be environmentally attractive as compared to relocating them (without expansion) to the mainstem of the Cape Fear River and/or allocating additional sewer capacity to a regional facility assumed to discharge to the mainstem of the Cape Fear River. Therefore, to reduce or maintain the IBT at 16 MGD, most of the alternatives include facilities to transfer any additional water supply allocations from Jordan Lake back to the Cape Fear River basin through a regional treatment and water reclamation facility assumed to discharge to the mainstem of the Cape Fear River in order to meet long-term water supply demands.

Alternative 1A is the least costly alternative at $11 million, but it would not provide enough water supply to satisfy water demands based on current growth projections. It is being rejected as an alternative because it does not satisfy the objectives of the applicant. This alternative also results in shifting secondary growth impacts to more rural areas that lack strong environmental protection controls.

TABLE 17
Summary of Alternatives

	Proposed Alternative	1A No Action	1B No Action	2 Water From Neuse	3 Move WWTP Discharges	4 Merger with Durham	5 No Regional WWTP
Increase in IBT (mgd)	11	0	0	0	0	0	29
Additional Jordan Lake Allocations	Yes	No	Yes	Yes	Yes	Yes	Yes
2030 MDD Water Demands (mgd)	53.6	19	43.8	53.6	53.6	53.6	53.6
Maximum IBT (mgd)	25[1]	16	16	16	16	19 (Neuse to Haw)	45
Total Capital Cost (million)	$225.7	$11.1	$206.6	$206.9	$279	$248	$84.0
Water Reuse	3.8 mgd	3.8 mgd	3.8 mgd	3.8 mgd	3.8 mgd	3.8 mgd	3.8 mgd
Construct Regional WWTP (2030 max month capacity)	18.0 mgd	No	18.0 mgd	18.0 mgd	18.0 mgd	18.0 mgd	No
Finished Water Purchases (2030 max day demand)	No	No	No	9.2 mgd	No	No	No
Expand Cary/Apex WTP	20.0 mgd	No	9.0 mgd	9.0 mgd	20.0 mgd	20.0 mgd	20.0 mgd

1. Projected IBT in 2030 is approximately 25 mgd. The requested amount of 27 mgd includes some contingency.

Although Alternative 1B is more economical than the proposed alternative, it may actually facilitate land use changes and development pressures to move closer to Jordan Lake than currently planned in the short term. This alternative does not meet water demands for the affected communities until a regional treatment and water reclamation facility is constructed in the Cape Fear River basin. In addition, this alternative involves too much uncertainty since it may be difficult to obtain additional Jordan Lake allocations without an increase of the IBT. Therefore, this alternative is not being recommended. Other indirect and cumulative impacts of this alternative would be similar to the proposed action.

Alternative 2 would cost approximately $207 million. The Cities of Durham and Raleigh do not currently have sufficient water supply capacity to meet the needs of their service areas and the needs of Cary, Apex, Morrisville, and RTP South. Therefore, additional supplies would need to be secured in order for finished water purchases from the Neuse River basin to continue. The capital costs of developing new water supplies will increase the cost of this alternative to exceed considerably the $207 million estimate. In addition, the direct and indirect environmental impacts of expanding existing supplies or utilizing new sources could be significant. Therefore, this alternative is not recommended on the basis of cost and potentially more adverse environmental consequences than the proposed action. The indirect and cumulative impacts of this alternative would be similar to the proposed action.

Alternative 3 is the most expensive of the evaluated alternatives, at $279 million. The relocation of outfalls would have additional direct impacts on the local environment due to construction activities, some of which may be significant. Of particular importance would be the natural resources of Harris Lake and the Shearon Harris Game Lands, adjacent to this potential interceptor route and pump stations. This alternative is too costly to be recommended since less costly and more environmentally friendly alternatives have been identified. The indirect and cumulative impacts of this alternative ultimately would be similar to the proposed action.

Alternative 4 costs more than the proposed action by over $20 million. The feasibility of this alternative is in doubt, since the opportunities and challenges of a merger of the Cary and Durham water and sewer utilities could present institutional and political challenges. Until institutional issues are resolved, this alternative will result in a drastic decrease of water supply for the affected communities in the very short term. This alternative bears too much uncertainty on the institutional framework and does not meet water demands in the short term. Therefore, this alternative is not recommended. Direct impacts are expected to be insignificant. The indirect and cumulative impacts of this alternative would be similar to the proposed action.

Alternative 5 is the second least expensive alternative to the proposed alternative, at $84 million. The most significant impact of this alternative will be the inducement for expanding the use of privately-owned package treatment plants, spray irrigation systems, and septic systems in the Cape Fear River basin to accommodate growth in western Wake County. This may lead to significant impacts to the lake's water quality and the natural habitats around the lake, including increased nutrient loadings to Jordan Lake and increased algal blooms and decreased dissolved oxygen in the already eutrophic lake. Taste and odor problems may increase in drinking water from the Jordan Lake water supply. The potential for pathogens to be present in the lake water would increase. Impacts on public recreation uses may be significant. Degradation of water quality may have a significant impact on

wetland habitat, and aquatic plant and animal species, and may significantly affect recreational fisheries in Jordan Lake.

This alternative presents a policy challenge since the EMC may not approve additional Jordan Lake allocations for an estimated IBT of 45 mgd without provisions for returning water to the source basin in the long term. In addition to these indirect impacts to Jordan Lake, the indirect and cumulative impacts of growth from Alternative 5 would be similar to the proposed project. This alternative is rejected due to these potentially significant impacts to Jordan Lake. In addition, the IBT will increase from 16 mgd to more than 45 mgd, a three-fold increase.

Except for Alternative 1A, which does not serve the purposes of the project and therefore is considered infeasible, the six alternatives proposed will not substantially reduce the expected significant impacts of the proposed project. In fact, as discussed above, a few of the alternatives actually create additional direct and indirect impacts that may be significant. Also, Alternative 1A will just shift impacts.

As discussed in Sections 3 and 4, the direct impacts of the proposed project are not considered to be significant. The most significant impacts are from growth and development that the proposed action will facilitate. All of the alternatives to the proposed project (except 1A) will create essentially the same indirect impacts associated with the facilitated growth and development in the project area, as in the proposed alternative. Therefore, none of the identified alternatives will significantly reduce the identified indirect and cumulative impacts of the project. The proposed alternative has clear advantages over all other alternatives in terms of cost, feasibility, levels of direct impacts, and meeting the water demands of the affected communities. The proposed action is the preferred alternative for the project.

SECTION 6

Mitigation of Adverse Impacts

As previously noted in Section 4.1, the proposed project is one of many planned activities that are a response to the rapid growth in the project area, rather than the cause of such growth. Nevertheless, because such projects facilitate the urban growth that is occurring, it was determined that the scope of this EIS would include the indirect and cumulative impacts associated with the development that will be facilitated by the proposed project. This section identifies and discusses pertinent federal, state and local regulations and programs which may mitigate the potential indirect and cumulative impacts discussed above in Section 4.

6.1 Summary of Federal and State Regulations and Programs

The following is a brief description of existing regulations and programs at the federal and state levels in the study area, with an emphasis on the Utility Service Area.

It addresses relevant regulations and programs from an environmental management and land use policy analysis perspective. The discussion provides a general overview of the existing regulatory and non-regulatory mitigation framework and identifies opportunities for local governments in the study area to enhance environmental protection measures that mitigate the anticipated effects of urbanization in the project area. However, this analysis does not attempt to measure the performance of these programs in managing specific environmental conditions in the field. Such an "efficiency" analysis of each of these regulations and programs is beyond the scope of this discussion.

6.1.1 Federal Regulations

6.1.1.1 Sections 404/ 401 of the Clean Water Act

There are currently two main regulatory programs that control the filling or draining of wetlands in the project area, both of which originate from the Federal Clean Water Act – Section 404, regulation of dredged and fill activities (which is enforced by the ACOE), and Section 401, certification that a project does not violate the state's water quality standards (which is enforced by DWQ). All private and public construction activities over a specific acreage that affect jurisdictional wetlands are required to obtain required wetlands permits as necessary from DWQ (Section 401 WQ Certification) and from the ACOE (Section 404 Permits).

Although the State's 401 Water Quality Certification Program and the Federal 404 Wetlands Protection Programs afford some protection for wetlands by requiring avoidance and mitigation for wetlands across the state, it is possible for permits to be issued under both the state and federal programs that allow small areas of wetlands to be lost (US EPA, 1999B).

Inadequate personnel at the state and federal level to enforce the regulations is a common problem in its adequate protection of wetlands. However, effective March 1999, DWQ stepped up the enforcement of regulations for wetlands protection, particularly those related to hydrologic conditions necessary to support wetlands function (15A NCAC

2B.0231(b)(5)), and biological integrity (15A NCAC 2B.0231(b)(6)). DWQ is joined in this initiative by the NC Division of Land Resources which will also be looking at possible violations of the State Sedimentation Pollution Control Act.

6.1.1.2 National Flood Insurance Program (NFIP)

A federal non-regulatory program that may afford some protection to stream riparian areas, wetlands and also protect water quality by restricting floodplain development is the National Flood Insurance Program (NFIP). NFIP, which is managed by the Federal Emergency Management Agency (FEMA), was created in the 1960's in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods. The NFIP makes Federally-backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. The NFIP, through partnerships with communities, the insurance industry, and the lending industry, helps reduce flood damage by nearly $800 million a year.

Floodplain management under the NFIP is an overall program of corrective and preventative measures for reducing flood damage. It includes but is not limited to emergency preparedness plans, flood control works, and floodplain management regulations and generally covers zoning, subdivision, or building requirements and special-purpose floodplain ordinances. Examples include mapping communities to identify flood prone areas, elevating buildings above the base flood and relocating structures out of the floodplain.

An important element in making flood insurance available to home and businesses owners is a community's agreement to adopt and enforce floodplain management ordinances, particularly with respect to new construction. It is up to local governments to adopt and enforce ordinances that meet or exceed the minimum floodplain management requirements of NFIP (FEMA, NFIP).

All local governments in the receiving basin project area (including Wake County, Apex, Cary, and Morrisville) are participating in the FEMA Flood Insurance Program. This program prohibits filling in the floodways. It also limits construction of buildings in the floodplain fringe area unless an engineer certifies that the bottom floor of the structure is at least one foot above the 100 year flood elevation. However, because of this provision for allowing development with raised structures (as opposed to prohibiting development altogether), some amount of development (and potential loss of wetlands and wildlife habitat and degradation to water quality) might occur (Cary, 1999).

Construction within floodplains, particularly when riverine wetlands are damaged or destroyed, can lessen the storage capacity of floodplains, contribute to higher flood levels downstream, increase turbidity, and increase erosion problems due to higher streamflow velocities. For these reasons, Cary places severe limitations on development within the 100-year floodplain (The 100-year floodplain defines the elevation that floodwaters would reach in a storm event that has an l-in-100 chance of occurring in any given year). No encroachment is allowed unless a registered engineer, architect or landscape architect certifies that the encroachment will not increase flood levels above FEMA regulatory levels. (Cary, 1996)

6.1.2 State Regulations

6.1.2.1 North Carolina Wetlands Restoration Program (WRP)

This non-regulatory program was created within DWQ to protect and mitigate wetland losses. However, WRP is primarily involved with finding and preserving specimen wetlands of good quality to mitigate specific project impacts (especially as mitigation for NCDOT projects) and also restoring existing impaired wetlands. It does not specifically provide a mechanism to protect wetlands on a regional basis from widespread urban development impacts (WRP, 1998A).

The Wetlands Restoration Program has targeted three hydrologic units, 030605 within the Cape Fear River Basin, and 030402 and 030403 within the Neuse Basin, as priority areas for wetland restoration actions. Subbasin 030605 (Jordan Lake) is considered high priority due to the combination of agricultural and urban land uses and highly erodable soils, which produce widespread NPS problems (WRP, 1998A). Subbasin 030402 (Swift Creek and Crabtree Creek) is considered high priority for WRP activities due to urban runoff and development in the upper portions of the subbasins, and agricultural activities and runoff in the lower portions of the subbasins. (WRP, 1998B). Subbasin 030403 (Middle Creek) is considered high priority for WRP activities due to point and non-point water quality problems from urbanization (WRP, 1998B).

6.1.2.2 Archaeological Protection

Archaeological resources are protected on private and public lands through the NC Archaeological Resources Protection Act, the Unmarked Human Burial and Human Skeletal Remains Protection Act, the NC Archaeological Record Program, the NC Environmental Policy Act and various federal laws. The NCEPA process triggers reviews under these acts. These laws are only applicable to projects that are state or federally approved, permitted or funded, or exist on state or federal lands. Although this often exempts many private development projects, the ACOE often catches some of these projects since they require archaeological reviews for any project that needs a Section 404 (federal wetlands) permit.

6.1.2.3 Stormwater Regulations

NPDES stormwater discharges are controlled by the federal National Pollutant Discharge Elimination System (NPDES) regulations, as enforced by DWQ under a delegation agreement with EPA. The program regulates all major discharges of stormwater to surface waters. NPDES permits are designed to reduce and eliminate pollutants in stormwater runoff from certain municipal storm sewer systems and industrial activities by requiring the development and implementation of stormwater management measures.

The NPDES Stormwater permitting system is being implemented in two phases. Phase 1 was implemented in 1991 and applied to 6 Municipal Separate Storm Sewer Systems (MS4s) in NC with greater than 100,000 people. This Phase 1 also applied to eleven industrial categories including construction activities (sites greater than 5 acres). An NPDES permit was issued to each of the 6 municipalities. In addition, the majority of industrial activity sites were covered using General NPDES permits. Currently there are approximately 3,000 sites in NC covered by individual or General NPDES permits. No local governments in the

Utility Service Area portion of the project area are subject to Phase 1 NPDES Stormwater requirements although there are probably several industrial sites.

Phase 2 rules were finalized on October 29, and published in the Federal Register on December 8, 1999. Final rules are still being reviewed; however, the rules are expected to impact between 60 to 100 MS4s in "urbanizing areas" of NC, as well as expanding the coverage for construction activities to sites over one acre. Those subject to the Phase 2 Rule would be required to apply for NPDES permit coverage and to implement storm water management programs (i.e. best management practices (BMPs). Small MS4s will be required to develop and implement a stormwater management program designed to reduce the discharge of pollutants to the "maximum extent practicable", to include six minimum control measures, and include their selection of BMPs and measurable goals for each minimum measure in their permit application. Construction activities requirements will be established by DWQ and will likely be similar to existing State sediment and erosion control plan requirements.

DWQ will evaluate EPA rules when final and establish guidelines and schedules for local government compliance. DWQ will be the enforcing agency for these rules. Applicable local governments will have three years from the date of publication of the final rule to submit the permit application to DWQ for approval. The Town of Cary is anticipating being required to develop and implement stormwater management programs under Phase 2, and has begun drafting applicable local ordinances to meet these new requirements. The Town of Apex and Wake County are also expected to be subject to the Phase 2 rules.

6.1.2.4 Erosion and Sedimentation Control

NC Division of Land Resources administers programs to control erosion and sedimentation caused by land disturbing activities on one or more acres of land. Control measures must be planned, designed and constructed to provide protection from the calculated peak rate of runoff from a 10-year storm, except for projects in HQW (High Quality Water) zones, which require control of 25-year storms. Enforcement of the program is at the state level, but can be delegated to local governments (usually counties or large municipalities) with certified erosion control programs. Wake County enforces the erosion and sedimentation control programs for the Towns of Morrisville and Apex, based on state requirements. The Town of Cary enforces its own erosion and sedimentation control program for its planning jurisdiction.

6.1.2.5 Sanitary System Overflows (SSO's)

State regulations (15A NCAC 2B.05.06) require municipalities and other wastewater treatment operators to report wastewater spills from discharges of raw sewage from broken sewer lines and malfunctioning pump stations within twenty-four hours. DWQ has adopted the following policies, effective July 1, 1998:

Municipalities and other wastewater treatment operators will be fined a minimum of $ 4,000 if they do not comply with the reporting requirement within twenty-for hours for all spills that reach surface waters or the ground exceeding 1,000 gallons regardless of whether they are contained or reach waters. A point system is used to determine whether to assess fines for reported spills.

Wastewater collection system operators were required to prepare a Spill Response Plan Evaluation by July 1, 1998, and an Operation and Maintenance Evaluation of their systems by July 1, 1999. Operators must develop a plan including a schedule to deal with any maintenance and operational deficiencies uncovered. For Spills occurring after July 1, 1999 related to maintenance or operational problems covered in the plan, the penalty will be increased.

When a serious spill occurs, wastewater collection system operators could face not only higher fines but also requirements to publish public notices in local media, undergo training, injunctive action and/or a moratorium on new connections to the system.

The NC Clean Water Act of 1999 provides for the development of permits for collection systems that would include requirements for inspections, sewer maintenance and other operational items. DWQ has developed a "shell" Wastewater Collection System Permit and is expected to issue them after July 1, 2000.

In addition, EPA is currently drafting regulations that will address sanitary sewer overflows. EPA has prepared five documents that provide draft language for proposed regulations to establish guidance and/or standard NPDES permit conditions for the following:

- Record keeping, reporting and public notification requirements for SSOs
- Capacity assurance, management, operation and maintenance requirements for municipal sanitary sewer collection systems
- Prohibitions on SSO discharges to waters of the United States
- NPDES permit coverage for satellite municipal sewer collection systems

EPA expects the proposed regulations to be published in the Federal Register in May, 2000 and promulgated by October, 2000.

In addition to the above regulations dealing with SSO's, the following performance standards apply to proposed sewer collection system and pump station permits issued by DWQ:

- The wastewater collection system shall be effectively maintained and operated at all times so that there is no discharge to land or surface waters, nor any contamination of groundwater.
- The Permittee must maintain a contingency plan for pump failure at each pump station.
- The Permittee shall maintain on hand at least one fully-operational spare pump capable of pumping the design flow rate at the appropriate total dynamic head for each simplex pump station that serves more than one building.
- Each pump station shall be clearly and conspicuously posted with a pump station identifier and an emergency contact telephone number which is able to get to an individual that can initiate or perform emergency service for the collection system 24 hours per day, seven days per week.

- An infiltration/exfiltration test shall be performed on all newly constructed sewer lines to ensure that the infiltration/exfiltration rate is less than 100 gallons per day per inch of pipe diameter per mile of pipe.
- At a minimum, an emergency power source or plugged emergency pumping connection shall be provided along with an approved contingency plan for all newly-constructed or modified pump stations.

6.1.2.6 North Carolina Clean Water Management Trust Fund (CWMTF)

The CWMTF was created by the 1996 Legislature to help finance projects that specifically address water pollution problems. The Trust Fund controls a non-regulatory program that focuses its efforts on upgrading surface waters in distress, eliminating pollution, protecting and conserving unpolluted surface waters, and establishing a network of riparian buffers and greenways for environmental, educational and recreational benefits. According to the enabling legislation, 6.5% of the unreserved credit balance remaining in the state's General Fund at the end of each fiscal year is allocated to the CWMTF for disbursement. The minimum amount available must be $30 million.

Possible use of CWMTF monies could be for wetland and/or riparian corridor identification and preservation (through acquisition and easement techniques) in the receiving basin portion of the study area to allow comprehensive protection of wetlands and riparian buffers in the project area to protect water quality and sensitive aquatic species.

6.1.2.7 Groundwater Protection

Several regulations and programs exist at the state and local levels that protect groundwater from urban growth:

- Wellhead Protection Program
- Regulation of potential contamination sources
- Management of groundwater contamination incidents
- Ambient groundwater monitoring
- Regulation of well construction

These programs may afford some protection to groundwater wells from the most common forms of groundwater pollution – point sources such as chemical manufacturing facilities, Underground Storage Tanks and accidental spills. However, more diffuse and evasive groundwater pollutants from agricultural uses (livestock facilities and chemical application on crops) and urban land uses (over-application of fertilizers and improper use of toxic household chemicals) may not be well managed under these programs.

6.1.2.8 Neuse River Basin Nutrient Sensitive Waters (NSW) Rules

The Falls Lake watershed area was classified as NSW in 1983. The entire Neuse River Basin was classified as NSW in 1988. As a result of the NSW classification, a nutrient management strategy was initially developed to manage phosphorus from point source dischargers and nitrogen and phosphorus from nonpoint sources. At that time, most of the nutrient

problems were occurring in the lower freshwater portion of the river, and phosphorous was considered the controlling nutrient. Increasing algal blooms and fish kills in the estuarine portion of the Neuse River, attributed to nitrogen overenrichment, led to a revision of the NSW strategy to address nitrogen inputs to the estuary. The Neuse River NSW Strategy Rules became effective August 1, 1998. While this revised strategy places more stringent nutrient removal requirements on point source dischargers, the strategy also addresses other sources of nutrients, including urban stormwater, agricultural sources and nutrient application management. In addition, they included special provisions to protect stream buffers to prevent further degradation of the ecological integrity of the watershed.

Riparian Buffer Issues Related to Neuse River NSW Rules

The Neuse River NSW rules require that existing riparian buffer areas be protected and maintained on both sides of surface waters, both intermittent and perennial. A 50-foot buffer consisting of 30 feet of undisturbed forest and 20 feet of grassed/vegetated area along streams must be maintained on each side of surface waters. The rule does not require restoration of buffers that no longer exist. Perennial and intermittent stream determinations are to be based on survey maps prepared by the Natural Resources Conservation Service (NRCS) or the most recent version of USGS topographic maps (7.5 minute quadrangle). The rule provides a number of exemptions. The rule also includes requirements to protect buffers as part of MS4 or other local stormwater programs by requiring buffers to be "recorded on plats as easements".

The riparian buffer requirement for protection and maintenance of existing riparian areas was adopted as a temporary rule in July 1997. Additional legislation adopted in 1998 extended the temporary status of the riparian buffer rules until several implementation issues are addressed by the EMC. The 1998 legislation also provided for the establishment of a Stakeholder Advisory Committee to assist the EMC in developing permanent rules for the protection and maintenance of existing riparian buffers, developing rules that allow compensatory mitigation in lieu of complying with the riparian buffer regulation; and developing rules that provide for the delegation of implementation of the buffer rules to units of local government.

The temporary status of the protection and maintenance of existing riparian buffers rule was extended once more effective June 22, 1999 by the EMC with the assistance and advice of the Stakeholder Advisory Committee in May 1999. Also, temporary rules that provide for compensatory mitigation became effective as of this date. Currently, the EMC is pursuing permanent rule making process for these two temporary rules. In addition, the EMC is pursuing permanent rules to delegate buffer requirements to local units of governments. It is anticipated that all the aforementioned rules will become permanently effective in August 2000.

Urban Stormwater Issues Related to Neuse River NSW Rules

The Neuse River NSW Strategy has direct implications for the Town of Cary and Wake County in the Utility Service Area of the project. Apex and Morrisville are not subject to these rules as per DWQ (Bradley Bennett, personal communication). Affected municipalities are required to develop, adopt, and implement stormwater management programs to

control nutrients to the Neuse River watershed. This mitigates impacts in the receiving basin, particularly as to nitrogen loads.

The Neuse River NSW Rules provide for the development of a model stormwater management program designed by the State and stakeholders to: a) hold nitrogen loading from new development at 70% of that contributed by 1995 land uses in the non-urban areas of the Neuse River basin (using an export coefficient of 3.6 lbs/acre/year); and b) hold the increase in peak flow leaving the site during the 1-year, 24-hour storm to what it was under predevelopment conditions. Developers could offset their TN loads by funding wetland or riparian area restoration projects through payments to the treatment and water reclamation facility (the offset payment rate is currently set a price of $11 per lb of TN for a 30-year period). A model stormwater management program was approved by the EMC in October 1999.

Cary and Wake County must develop and submit to DWQ a stormwater management plan that equals or exceeds the model plan by September 2000. These jurisdictions are also required to adopt and implement a stormwater management program by March 2001.

Specific program requirements include (TJCOG, 1999):

- New development must meet a 3.6 lbs/ac/yr nitrogen export performance standard and not increase peak runoff
- New development must protect buffers
- Public education efforts must be implemented
- Illegal discharges must be identified and removed
- Potential stormwater retrofit locations must be identified
- Existing developments must be considered in overall nitrogen reduction strategy
- Annual progress reports must be submitted

New development must comply with the following requirements (TJCOG, 1999):

- Maximum loading limits –
  - New residential development – 6.0 lbs/ac/yr
  - New non-residential development – 10.0 lbs/ac/yr
- New development must not exceed nitrogen export loading rate of 3.6 lbs/ac/yr unless excess nitrogen load is offset by payment of a fee to the Wetlands Restoration Fund for the Neuse Basin.
- BMP's must be approved by EMC and local government must assure that BMPs are properly maintained
- Local governments must review and consider innovative land use planning techniques for reducing impervious surfaces in new development

6.1.2.9 Water Supply Watershed Protection Program

The Environmental Management Commission and DWQ have administered a Water Supply Protection Program since 1986. Initially, the program was administered voluntarily by counties and municipalities pursuing protective measures for their water supply watersheds. The measures included limitations on the number and type of wastewater discharges that were allowed in the water supply watersheds.

In 1989, the North Carolina General Assembly ratified the Water Supply Watershed Protection Act, codified as General Statutes 143-214.5 and 143-214.6. This Act mandated the Environmental Management Commission to adopt minimum statewide water supply protection standards by January 1, 1991 and to reclassify all existing surface water supply watersheds to the appropriate classification by January 1, 1992. The goals of the Water Supply Watershed Protection Program include:

- the protection of surface drinking water supplies in North Carolina from Non-Point Source and Point Source pollution from urban runoff and wastewater discharges
- the provision of a cooperative program of watershed management and protection which is administered by local governments consistent with minimum statewide standards.

The DWQ manages the program through oversight of local planning ordinances and monitoring of land use activities. Local WSWS programs must be approved by the NC Environmental Management Commission (EMC). The WSWS program requires local governments to adopt the following land use controls and limitations based on watershed classifications:

- Requires limitation of impervious surfaces around water supplies unless stormwater controls are used
- Requires protection of riparian buffers (100-foot buffers in all development that exceeds the low density option, or 30-foot buffers otherwise along perennial waters)
- Limits some land uses
- Limits dischargers (NPDES permits in certain situations)
- Allows the use of clustering and density averaging to meet overall development density limits
- Watersheds that are protected under the WSWS Program have a classification of WS-I through WS-V, where WS-I has the most restrictive controls.

A large portion of the study area is within Water Supply Watersheds, particularly a significant portion of the Utility Service Area around Jordan Lake and the headwaters of Swift Creek are included. Jordan Lake is classified as WS-IV waters. WS-IV generally represents a large river or lake water supply. The entity using the water supply usually does not have control over a large area of the watershed, for this reason there is a state Water Supply Watershed Protection Program. A small "critical area" near the water supply intake can be protected, and the water requires a high degree of treatment. Municipal and industrial point source discharges are allowed in WS-IV waters.

The area defined as a WS-IV protected area extends five miles from the normal pool elevation of Jordan Lake (i.e., 216 feet above mean seal level). The Jordan Lake Watershed lies partially within the Towns of Cary, Apex, Morrisville and Wake County (RTP South). WS-IV regulations limit development density to 1 dwelling unit (du) per ½ acre lot or 24% built-upon limitation without stormwater controls.

Swift Creek is classified as WS-III waters. WS-III is a common designation for lakes and streams that are used for water supply but yet have a significant amount of activity in the watershed, with some control over the extent of development and discharges in the drainage area. Municipal and industrial point source discharges are not allowed in WS-III waters, but, public water and sewer collection lines and facilities are allowed.

The Swift Creek Watershed lies partially within the Towns of Cary and Apex. WS-III regulations limit development density to 1 dwelling unit (du) per 1 acre lot or 12% built-upon limitation without stormwater controls.

All of the local governments within the study area are subject to the Water Supply Watershed Protection Act. The WSWS programs and ordinances for each of these local governments were reviewed by DWQ staff and approved by the EMC between 1995 and 1998. Each of the local governments in the project area is considered to be in compliance with the WSWS Rules for each of the protected watersheds

6.1.2.10 Conservation Reserve Enhancement Program (CREP) Program.

The USDA and DENR have recently launched the CREP Program, with the participation of the Natural Resources Conservation Service (NRCS), the Farm Service Agency, the NC Wetlands Restoration Program, and the N.C. Clean Water Management Trust Fund to create 5,000 acres of buffers and conservation areas in the Jordan Lake watershed. This program uses financial incentives to encourage farmers to voluntarily remove sensitive land from agricultural use.

6.1.2.11 Miscellaneous Incentive Programs

Other, voluntary strategies exist at the federal and state levels that provide incentives to protect natural lands, wetlands, agricultural lands, sensitive species habitat and forest lands from development. These non-regulatory approaches include providing tax credits for donating lands to specific organizations (usually land trusts or local governments) and providing funding for various grants and trust funds to purchase or protect undeveloped lands.

Table 18 provides a comprehensive summary of the current state and federal regulatory and non-regulatory framework that provides mitigation for the growth effects of the development that is facilitated by the proposed action.

TABLE 18
Summary of Existing State and Federal Programs from Section 6.1 and the Environmental Resources They Protect

Program or Regulation	Wetlands	Land Use	Fish & Wildlife	Sensitive Species	Water Quality	Air Quality	Ground -water	Noise	Toxics
Sect. 404	X	X	X	X	X				
Sect. 401	X	X	X	X	X				
NFIP	X	X	X	X	X				X
NCWRP	X		X	X	X				
Archaeological Protection		X							
NPDES Stormwater	X		X	X	X				X
Erosion / sed.	X	X	X	X	X				
SSO Regs.	X	X	X	X	X		X		X
CWMTF	(X)	(X)	(X)	(X)	(X)				
Groundwater		X					X		X
Neuse NSW	X		X	X	X				
WSWS	X	X	X	X	X				
Land Conserv. Incentives	(X)	(X)	(X)	(X)	(X)				

X = Demonstrates clear environmental benefits
(X) = Shows potential for environmental benefits (policy only, program not mandatory, or regulation not yet adopted)

6.2 Summary of Local Regulations and Programs

Sub-sections 6.2.1 through 6.2.4 describe existing and proposed local government regulations and programs in the project Utility Service Area that will mitigate the environmental impacts of development that may be facilitated by the proposed interbasin transfer. Some of the regulations and programs are not mandatory or are only proposed at this time. These programs and regulations could change or be discontinued, although this is not expected. It should not be inferred from this discussion that any particular regulation or program is necessary for mitigation purposes or, if only proposed, that such regulation or program will be adopted and implemented as described. Section 6.2.1 summarizes programs to conserve open space. Section 6.2.2 summarizes programs to protect riparian buffers and wetlands. Section 6.2.3 summarizes pollution prevention programs. Section 6.2.4 describes the effort to build a Western Wake WWTP to serve the towns and reduce the interbasin transfer. Table 19 summarizes of these local programs.

6.2.1. Open Space Preservation

Open space provides habitat for wildlife, protects water quality if sited properly, and enhances the overall quality of life. Governor Hunt recently set a goal of conserving 20 percent of all land in new development as open space. In the study area, open space protection can provide additional land around Jordan Lake, Harris Lake, and Umstead Park

TABLE 19
Local Government Initiatives Beyond State Regulations to Protect Water Quality and Wildlife Habitat

Initiative	Open Space Plans	Land Use Plans	GMPs	UDOs	Parks and Greenway Plans	Erosion/Sediment Control	Stormwater Programs	Impervious Surface Limits	Floodplain Dev Regs	Water Conservation Ordinances	Education	Reuse Plans	Stormdrain stenciling	Incentives	Wastewater planning	Stream Restoration
Open Space Planning																
Local/state land acquisition around Jordan Lake	X	X	O	O	X											
Local/state land acquisition to connect parks and gamelands	X	X	O	O	O											
Local/state land acquisition around Umstead	X	X	O	O	O											
Implement Wake Co Open Space Study	X	X	O	O	O		O	O								
Gov. Hunt's goal to conserve 20% land in new development	O	O	O	O	O		O	O								
Regional Greenway System																
Regional Greenway that builds on American Tobacco Trail	O	O			X											
Riparian Buffers and Wetlands																
Local regulations requiring buffers as strict as Neuse rules		O	O	O		O	O									
Restoration of wetlands and buffers		O		O												X
Floodplain																
Local regulations prohibiting flood plain development		X		X					X							
Public Utilities and Services																
Consolidation of utilities in Wake Co															X	
Design and construct regional WWTP															X	
Water conservation				X						X	X			X		
Water reuse												X				
Pollution Prevention																
Local policies to prevent water pollution	X	X	X	X	O	X	X	X	X	X	X	X	X	X		

Key to Symbols:
X: Program in place
O: Town working on program to address issue or is considering program

and provide wildlife corridors between these areas. Wake County developed an open space study that the local governments can build on and help implement. Regional greenways can link open space areas.

Cary, Apex, Morrisville, and Wake County have several programs to preserve open space. These include open space plans and initiatives, land use plans, growth management plans, unified development ordinances (UDOs), and greenway plans. Each of these initiatives is described in greater detail below.

6.2.1.1. Open Space Plans/Initiatives

Cary

On February 10, 2000, the Cary Town Council approved a $48,000 appropriation to hire a consultant to conduct ecological assessments for the Jordan Lake watershed. This assessment is the first step toward completion of an Open Space and Historic Resources Plan (OSHRP). Wake County has already completed an ecological assessment for the Swift Creek Watershed. Funding for the ecological assessments for the remaining Cary watersheds (Crabtree, Walnut and Middle Creeks) will begin in July 2000. These ecological assessments will prioritize significant resources for multiple ecological benefits, including water quality, biological diversity, and conservation or restoration of natural resources. These priorities will be established through the use of GIS analysis and field investigations (Cary, February 2000; Cary, March 2000).

On February 24, 2000, the Cary Town Council voted to approve a workplan and timeline for the OSHRP. The OSHRP will take approximately 1.5 years to complete and will include a 3-step process:

1) Agree on the open space that currently exists and evaluate existing ordinances

2) Assess where the Town wants to expand open space by preserving sensitive areas, upland farmland, and historic districts

3) Evaluate methods to obtain lands, including mandatory dedications and voluntary acquisitions through a land trust or land conservancy or the Town itself; and to obtain funding sources for public acquisitions.

The preparation of the OSHRP will be coordinated with the Town of Apex (Cary, February 2000; and Cary, March 2000).

Preparation of the OSHRP will allow open space planning coordination with WRC, State Parks, ACOE, Wake County (Parks or Planning), and other applicable state, federal and local agencies for lands around Jordan Lake, Harris Lake, and along the Cape Fear River, Crabtree Creek, and Umstead State Park. The Town is looking to the OSHRP for guidance on how to work with these and other agencies to jointly preserve open spaces in these areas.

Final cost estimates to acquire the land to implement the OSHRP will be developed as part of the plan. It is anticipated the open space program will cost approximately $15 million to implement. The Town Council has earmarked $12.3 million in existing funds to implement the OSHRP when it is completed.

Cary is evaluating Governor Hunt's goal to conserve 20 percent of the land in all new development as open space as part of the proposed OSHRP and the amended UDO (Cary, March 2000).

In addition to the OSHRP, Cary has an ambitious plan to acquire land for additional parks. Cary adopted the Parks, Greenway and Bikeways Master Plan in July 1998, and more than 17 new parks are proposed. Efforts will be made to locate these new parks adjacent to stream corridors. Cary is proposing to spend over $15 million to acquire parkland during the next decade (in addition to open space acquisition funding).

Wake County

In January 1999, Wake County began a study of open space to identify valuable landscapes that needed to be protected. A Draft Wake County Open Space Report for Falls Lake, Neuse River, Harris Lake, and Swift Creek was produced in November, 1999, and is undergoing public review. It is the intent of the County to eventually complete studies for all 12 watersheds located in the County (Wake County, November 1999). The study for Jordan Lake Watershed will be started sometime next summer (Douglass, 2000).

Each Open Space study involves two components: a comprehensive ecological evaluation and a social and cultural evaluation. During the ecological evaluation of the watersheds, biological and ecological characteristics of each area are inventoried. Subwatersheds within each area are ranked in order of ecological significance and/or threat of impact using soil types, vegetation, wildlife, other biological factors, water quality, etc. The social and cultural examination involves evaluating the watershed in terms of land use, the presence of historically or culturally significant resources, opportunities to provide recreationally accessible open space, opportunities to link greenways with municipal systems, and other human factors. Recommended recreational uses for these lands are also developed. A series of public meetings will be held to gather input on the Study recommendations, since public education and partnership building are essential components of this planning process (Wake County Open Space, 1999).

The Towns in the study area are working with Wake County on these plans. For example, the Towns may take the lead on preserving areas within their jurisdictions and communicating with the County on land availability.

Beyond planning activities, Wake County has begun acquiring land and conservation easements in the Jordan Lake watershed, including rights to create a 683-acre park bordering Harris Lake. The park will include natural areas for camping, hiking, and boating. It will also have an Environmental Education Center. In addition to the park, Wake County's recently adopted Land Use Plan Covering Part of Southwest Wake County shows proposals for 16 more local parks in the Jordan Lake area (Stoddard, 2000).

Wake County has also acquired approximately 3,000 acres of land rights in Western Wake County along Crabtree Creek and its tributaries as part of its Crabtree Flood Control projects. Included is an 1,100-acre assemblage directly north of Umstead State Park. These land acquisitions by Wake County will enhance protection of Umstead State Park and Crabtree Creek (Stoddard, 2000).

Wake County has $850,000 in its Open Space Budget and is considering an Open Space Advisory Committee request to add another $1 million as part of next year's budget. The funds are meant to acquire land or easements to help implement the County's Open Space Plan (Stoddard, 2000). These funds are also used to implement the land grant program through which the County is trying to create partnerships between municipalities. If a Town wants to acquire land, the County will provide matching funds under this program. The County hopes this will help small towns acquire open space (Douglass, 2000).

Wake County is attempting to meet Governor Hunt's goal of conserving 20 percent of land in new development through its cluster subdivision ordinance that allows a density bonus provided that sufficient open space is set aside. The ordinance requires from 15 to 25 percent of the site be outside lots and be designated as open space. The exact percentage depends on the site's proximity to towns. In addition, Wake County's lowest density zoning applies in its water supply watersheds, including the Jordan Lake watershed (Stoddard, 2000).

Research Triangle Park

In addition to Wake County's activities, the Research Triangle Foundation (the private, non-profit developer of the Research Triangle Park) has been implementing its own open space/conservation practices. In 1986, the Research Triangle Foundation began to plan the development of approximately 2000 acres comprising the Southern Portion of RTP in Wake County. The plan, prepared by the School of Design at N.C. State University and currently being implemented by the Foundation, provides for approximately 500 acres to be placed in permanent open space, called Natural Area Preserves (Rooks, 2000).

The Natural Area Preserve encompasses the flood plain and wetland areas associated with the streams which cross the property. In many areas, the Natural Area Preserve also includes additional wooded areas beyond flood plains. While most of the Natural Area Preserve encompasses environmentally sensitive areas, part of the Natural Area Preserve is made up of odd-shaped parcels that would be hard to develop unless additional adjacent property is acquired. It is possible that if adjacent land is acquired, this buildable land currently shown as Natural Area Preserve may be developed. This is a relatively small portion, however, of the total Natural Area Preserve. As the development of the southern portion of RTP proceeds and sites are sold to companies, the adjoining Natural Area Preserve will be designated officially on recorded plats and permanently restricted for open space. To date, 84 acres have been recorded as permanent Natural Area Preserve (Rooks, 2000).

Some additional areas within developable lots are designated as Surface Cover Maintenance Areas, which must be left in existing natural vegetative cover. These are drainage corridors, areas with steep slopes, or other environmentally sensitive areas. The intent of these areas is to minimize erosion or sedimentation problems during construction and to help infiltrate storm water runoff from these sites after development (Rooks, 2000).

6.2.1.2. Land Use Plans

Land use plans contain a Town's official policy on the form and pattern of future development within its jurisdiction. These plans are used to direct growth by serving as a reference to guide Town staff and official boards when developing new standards and ordinances and when considering rezoning, annexation, subdivisions, and site plans. The

plans are also used to direct public infrastructure and aid decisions for private sector investment.

Cary

Cary's existing land use plan was adopted in November 1996 (Cary, November 1996). Specific plan objectives relate to managing growth to prevent urban sprawl, protect natural resources and prevent environmental degradation:

- Preserve open space(s)
- Promote and preserve trees, urban forests, and natural open spaces during development
- Preserve and maintain Cary's water quality and resources by protecting natural stream corridors and watersheds
- Encourage traditional neighborhood design standards, with pedestrian-oriented amenities such as neighborhood recreation, open spaces, and commercial services
- Define and control suburban sprawl
- Develop neighborhood-oriented, community, and regional parks, open spaces, and greenways to adequately serve Cary's growing and existing population
- Emphasize pedestrian-oriented development to achieve a comprehensive system of bicycle lanes, greenways, and sidewalks that connect to neighborhoods, parks, schools, offices, commercial areas, and other public spaces.
- Effectively manage long-term growth through a comprehensive and proactive planning process
- Actively participate in regional planning efforts
- Support effective zoning, land use, and development regulations and enforcement.

The existing Land Use Plan for Cary is to be supplemented with a more detailed land use plan from Highway 55 west to Jordan Lake and for the northwest end of the Town near RTP. This item was presented at the annual Council/staff retreat in February 2000. The Town is currently selecting a consultant to develop the Plan.

Apex

A copy of the existing Apex 2010 Land Use Plan Update showing long-range land use projections for Apex is provided in Appendix D. This Plan was completed in 1989, and was updated in 1996. The Apex Planning Department has requested funding to update the plan again.

Morrisville

Morrisville adopted its current land use plan in November 1999 (Morrisville, 1999A). Specific objectives contained in the plan that address open space include:

- To discourage urban development in environmentally sensitive areas
- To develop an open space plan to protect open space

- To preserve floodprone areas as pedestrian and bikeway connections
- To ensure adequate open space for recreation

Wake County

The Wake County Land Use Plan is the County's long-term guide to accommodating future growth and land development that occurs within those areas of the County located outside the planning jurisdictions of its 12 municipalities and the Raleigh-Durham Airport Authority. Because much of the growth represents the expansion of the urban areas associated with the municipalities, the County Land Use Plan is closely coordinated with municipal land use plans. The Plan's General Classifications serve to identify those areas whose ultimate character is expected to be urban or non-urban, primarily based on where municipalities are expected to extend urban services and where water supply watersheds exist (Wake County, 1999).

With growth in Wake County exceeding 150% between 1960 and 1990, the County has been attempting to balance growth with a high quality of life, and determine how to foster and continue economic expansion, while at the same time maintaining the features which make this area so attractive. By 2027, the population of Wake County is projected to exceed 1 million. With these estimates, the County realized it needed to prepare a more detailed Land Use Plan (Wake County, 1999).

On July 3, 1996, the Wake County Planning Board approved a new Vision Statement, Goals, and Strategies, and then asked County Planning Staff to prepare a new Land Use Plan incorporating these recommendations. Staff prepared a land use map, land use classifications, and overall plan goals which were subsequently adopted. The Land Use Plan is currently under development, and is to be completed by July 2001, primarily through the development and incorporation of "Area Plans" (Wake County, 1999).

Pertinent sections of the County's Vision Statement, Goals and Strategies of the updated Land Use Plan are summarized as follows:

Vision Statement - Wake County will be an outstanding community of urban and rural areas, where the demand for quality and affordable growth is met, economic development and opportunity is enhanced, environmental quality and cultural heritage are maintained, and all of these objectives are balanced with protecting the property rights of landowners.

Goals and Strategies - To guide quality growth throughout the County in conjunction with affected local governments on a regional basis. The goals related to open space include (Wake County, 1999):

- To encourage maintenance of open space, scenic aspects of rural areas, entrance ways to urban areas, and transition areas between urban areas
- To encourage the conservation of environmentally significant areas and important natural and cultural resources
- To allow owners of significant farmlands and forest lands the opportunity to maintain the productivity of their land

- To provide incentives for property owners to voluntarily maintain these rural, environmentally sensitive or significant forest, farm or cultural lands, or acquire an appropriate public interest in the properties. These incentives may include such measures as design flexibility to incorporate a feature into a development while still deriving the allowed intensity of use from it, adaptive reuse of structures, land acquisition, purchase or transfer of development rights, and density credits for open space preservation or dedication.
- To maintain the quality of surface water for drinking, fishing, boating, and swimming by minimizing pollutants from storm water runoff and by allowing only appropriate land uses and densities that meet or exceed applicable State water quality regulations
- To prevent contamination of and maintain the capacity of groundwater resources
- To ensure that local governments provide adequate, properly located land for recreational and leisure opportunities

The RTP South area is located within the Research Applications (RA) Zoning District. Most divisions of parcels into separate building lots must be approved by the Planning Board as part of a lot-by-lot subdivision, where each lot to be devoted to a central use contains at least 8 acres of land area. All development must limit the amount of land covered by impervious surface (buildings, parking areas, driveways, sidewalks, etc.) to no more than 30 percent of the site area (Wake County, 1999).

6.2.1.3. Growth Management Plans

Growth management plans are another tool that can be used to preserve open space. These plans outline a Town's goals and objectives related to growth and development. The Cary Town Council adopted a Growth Management Plan on January 13, 2000. Specific objectives of the plan that address open space include the following:

- Identify a sustainable, long-term rate of growth.
- Review and revise Town policies and procedures to ensure that future land use decisions direct growth toward already-identified preferred areas, consistent with growth management goals.
- Prepare the natural resources element of the comprehensive plan to identify and prioritize areas containing sensitive and/or unique natural resources and open space, and adopt policies and tools to ensure protection for the identified areas.
- Acquire high-priority sensitive lands and open space to prevent the loss of Cary's most important natural resources.
- Support private efforts to acquire high-priority sensitive lands and open space.
- Encourage or require cluster development to protect sensitive natural resources and open space on a site-specific basis.
- Develop a system of transferable density credits that will allow owners of sensitive lands to transfer the development potential of their property to other, preferred locations.

Apex is developing a Growth Management Plan, scheduled for completion in June 2000. Since Apex is using the same consultant who developed Cary's plan, the two will likely contain similar open space planning elements.

On April 17, 2000, Wake County Commissioners agreed to create a Growth Management Task Force. This tasks force will be made up of two Board members from each Town in the County and two County Commissioners. The goal of this Task Force will be to work with a consultant to develop a Growth Management Plan by January 2001.

6.2.1.4. Unified Development Ordinances

A UDO is a comprehensive set of land use regulations that include zoning, subdivisions and site plans. Each of the Towns in the study area is updating its UDO.

Cary

The Town of Cary recently approved a detailed Annotated Outline (Clarion Associates, 2000) that provides an overview of changes proposed to its UDO. The Town's consultant will write the revised UDO based on the Outline. The UDO is targeted for completion in January 2001 (Cary, March 2000). Prior to this Outline, the Town had produced a "Diagnosis of the UDO" (Cary, October 1999B) that summarized the strengths and weaknesses of the current UDO and identified issues that should be addressed in the UDO revisions.

Key growth management and environmental protection recommendations of the UDO Outline and Diagnosis are listed as follows:

- Amending the Recreation and Conservation District to emphasize preservation of natural resources with only limited development allowed. Necessary modifications will include updating the permitted uses for the district to allow only parks and other low-impact uses that preserve most land in an undeveloped state. Greenway trails and utility/road crossings also will be permitted.
- Amending the Open Space Development Overlay District to encourage open space (or cluster) development in all areas of town, not just in the Reservoir Watershed Protection District (as currently restricted). This amendment will define zones with mandatory open space requirements, the required amounts of open space in those zones, and conditions for land surrounding the protected open space.
- Adding new sections to the UDO to enhance required interconnections of sidewalks, trails, and bicycle paths across all land uses to provide alternative transportation options.
- Strengthening the regulation that requires tree protection during construction to protect more interior trees and vegetation on development sites. Land owners may be required to identify sensitive natural resources on development sites where no development may occur. More intensive development may occur outside the sensitive area.
- Adopting Traditional Neighborhood Development regulations to facilitate this type of development which maintains open space
- Incorporating cluster development provisions into the new UDO to encourage clustered development throughout the town. The amended UDO will require that open space and

cluster development be mandatory for properties adjacent to conservation corridors (Cary, March 2000).

- Identifying preferred growth areas that contain existing or planned concentrations of employment or infrastructure, and then focus new, higher-density development, both residential and non-residential, in and around those preferred growth areas.

Apex

Apex has produced a Draft Unified Development Ordinance (UDO) that includes several improvements to its Zoning Ordinance and Subdivision Ordinance (Apex, January 2000). This final Draft UDO is scheduled for a public hearing on April 18. Approval by the Town Board is anticipated in May 2000 (Apex, January 2000).

The Draft UDO (see Apex, January 2000) has several requirements similar to Cary's draft UDO that conserve open space:

- **Planned Unit Developments (PUDs).** New incentives are proposed to encourage the use of PUDs; the PUDs must provide open space and protect environmentally sensitive features.

- **Resource Conservation Area (RCA).** This is a proposed set of regulations for protecting natural resources that include specific standards for protecting significant trees and vegetation and restricting development on steep slopes. The RCA process is intended to preserve the visual and aesthetic qualities of the Town; to encourage site design techniques that preserve the natural environment and enhance the developed environment; to control erosion, slippage, and sediment run-off into streams and to increase slope stability; and to protect wildlife habitat and migration corridors.

- **Open Space.** A new section of the Draft UDO will require that all residential development over a certain threshold dedicate a minimum percentage of the total site acreage as private open space to provide park and recreational facilities for the residents and to preserve open space and sensitive natural areas. Although flexibility in the location of the open space will be given to the developer, significant natural or scenic resources onsite (e.g. wetlands) will be required to be preserved as part of this requirement (Apex, January 2000).

- In addition to these UDO requirements, the Apex Code of Ordinances currently contains an option that provides incentives for preserving open space around environmentally sensitive areas in subdivisions. The incentives include eliminating normal lot size, lot width and setback restrictions as long as densities are not increased. To qualify, a development must preserve at least 10 percent of the development's open space, and these preserved areas must protect environmentally sensitive areas, wildlife habitat, provide recreation opportunities, or preserve natural or cultural amenities (Apex, 1999A).

Morrisville

The Town of Morrisville is updating its zoning ordinance. The Town Board specifically listed buffers and density requirements as its priorities in this rewrite. Morrisville is considering buffers between residential and non-residential areas, and the Town may preserve more open space (Morrisville, 2000).

The Conservation/Buffer Zoning District was established in the Morrisville Zoning Ordinance to protect and preserve park lands, wilderness areas, open spaces, floodplains, scenic areas and historic sites, open ranges, watersheds and water supplies; to conserve fish and wildlife; and to promote forestry and grazing lands; and, when used in conjunction with another zoning district, to provide a natural buffer between that district and the surrounding districts. Currently, a Conservation District is located along Crabtree Creek upstream of Lake Crabtree (Morrisville, 1999B).

The Morrisville Subdivision Ordinance states that every residential subdivider must dedicate a portion of the development for public parks, recreation, greenways and open space sites. If a dedication is not feasible, offsite land or a payment in lieu of dedication may be provided (Morrisville, 1999C).

6.2.1.5. Greenway Plans

Cary, Apex, Morrisville and Wake County have been working together as well as with the Triangle Land Conservancy, the Triangle Greenways Council, and the NC Division of Parks and Recreation (Trails) to ensure connectivity of their greenways and other trails on a regional basis. There are plans to link the Towns' greenways with the American Tobbacco Trail as well as Umstead Park trails, Lake Crabtree, and Lake Johnson. The Southwest Wake County land use plan that has been adopted includes a regional greenway system of approximately 46 miles to continue Town greenways.

Cary adopted the Parks, Greenway and Bikeways Master Plan in July 1998. The plan includes approximately 70 miles of planned greenways and 50 miles of bikeways. The Town is planning on developing approximately 2 miles of greenway per year at a cost of $250,000 per mile. Land needed for the greenway system is acquired by Cary through easements and acquisition at the time of site development according to approved maps within the Greenway Master Plan. Land owners are compensated by the Town at fair market value and that is often exceeded by up to 50 percent.

Apex has a Master Greenway Plan that shows where greenways and parks are planned. Apex requires developers to dedicate all lands where a proposed greenway is planned.

Morrisville's Parks and Recreation Department is requesting funds to develop a Greenway Master Plan. Morrisville is also attempting to hire staff to conduct greenway planning and to ensure that greenway plans are implemented.

6.2.2. Riparian Buffers and Stream Restoration

Riparian buffers are important mechanisms to protect surface water quality for water supply, aquatic life support, and recreation. Some of the study area is located within the Neuse River Basin where 50-foot buffers are now required. There are initiatives in the Towns to obtain delegation of the Neuse River Basin buffer rule as well as to extend some of the Neuse River Basin requirements into the Cape Fear Basin within their jurisdiction. This section describes the initiatives in the study area to protect riparian buffers and restore streams.

6.2.2.1. Riparian Buffers

Each of the local governments currently has buffer rules in place to meet the requirements of the Neuse River Basin rules and the Water Supply Watershed Protection rules described in Section 6.1. In addition, there are rules that exceed what is required, and plans are in place to extend the buffer requirements. These initiatives are outlined by local government.

Cary

Cary currently requires a minimum of 30 feet of riparian buffer along all streams and creeks with drainage areas greater than 50 acres that are outside the Neuse River Basin and not within a water supply watershed. The Growth Management Plan contained a task to expand buffer requirements to protect water supply watersheds. While Cary already has adopted watershed protection regulations that go beyond state-required minimums, additional measures are recommended to ensure that the quality of drinking water from Lake Jordan is preserved. A variety of protective measures, including controls on septic systems, stormwater drainage controls, and larger stream buffers than those currently in place, will be discussed during the UDO amendment process (Clarion Associates, 2000).

Cary recognizes that maintaining a potable water supply is crucial to safeguard the health of its citizens and ensure long-term economic prosperity. A "Critical Water Quality Area" has been established for the Jordan Lake Watershed. This designates a 1-mile buffer around the lake for lands not under ACOE jurisdiction and places certain restrictions on development within the watershed. Established Town policy is not to extend water and sewer services into the 1-mile buffer; this presents a limitation on development densities in the area (Cary, 1996).

Cary is considering amending the UDO to require consistent (50-foot) riparian buffers throughout the Town, regardless of river basin boundaries. Cary is planning to seek delegation of the Neuse River Buffer program from the EMC. The Town is proposing to increase the erosion control program budget and staff to take on this responsibility (Cary, March 2000).

Apex

Apex has expressed interest in extending the Neuse River Basin buffer requirement into the Cape Fear Basin as well as extending the buffer requirement to smaller streams (Apex, March 2000).

Morrisville

Morrisville is in the process of acquiring 10 acres of land along Crabtree Creek that are in the floodway for wetland and riparian conservation (Morrisville, 2000).

Morrisville's Zoning Ordinance states surface waters shall be bordered on each side by a natural 15-foot buffer, and this is applied outside the Neuse River Basin. Only a small portion of Morrisville's area is in the Cape Fear River Basin. According to its planning staff, Morrisville has been applying the 50-foot Neuse River Basin buffer in most of this area. Morrisville has not yet considered modifying Town ordinances for the Cape Fear River to match the Neuse River Buffer rules, but is willing to consider doing so for ease of implementation (Morrisville, 2000).

Wake County

Wake County Watershed regulations require undisturbed vegetative buffers along streams in every water supply watershed, including the Jordan Lake Watershed. The required buffer widths range from 60 to 100 feet (Stoddard, 2000).

The County is currently working on several ordinances that would extend the County's buffer rules beyond what is required in the Neuse River Basin rules. In addition, the County is drafting ordinances to extend the water supply protection areas (Douglass, 2000).

6.2.2.2. Stream Restoration

Cary and Wake County are undertaking stream restoration initiatives. Cary has budgeted matching funds to be used for application to the Clean Water Management Trust Fund for streambank restoration.

The Wake County Soil and Water Conservation District, together with other county agencies, is starting a program to restore streams, wetlands and riparian buffers damaged by hurricanes and human activities. This program involves bioengineering and an understanding of stream behavior to return streams to as natural a condition as possible. Re-establishment of riparian buffers and the protection/restoration of wetlands, where feasible, are essential to successful restoration efforts in the Cape Fear River and Neuse River watersheds. Grants, state/federal cost share programs, and stream mitigation programs are currently the major funding sources for these efforts (Stoddard, 2000).

6.2.3. Pollution Prevention

Preventing pollution before it occurs is more efficient than restoring a waterbody. Thus, the local governments have established several mechanisms in addition to the open space preservation strategies and buffer strategies that were outlined above. These pollution prevention strategies include:

- Erosion and sediment control
- Stormwater programs
- Limitations on floodplain development
- Water conservation, wastewater reuse
- Other efforts

6.2.3.1. Erosion and Sediment Control

Sediment is the leading cause of stream degradation in North Carolina (NCDWQ, 1999B). Prevention of soil loss protects aquatic life habitat and maintains stream water quality. Section 6.1 summarized the state requirements for sediment and erosion control. Local programs in effect in the study area that exceed these requirements.

Cary currently requires individual home builders to implement stormwater best management practices to keep sediment on individual home building sites. Many other communities' erosion control ordinances allow individual homes to avoid sedimentation control requirements since they are often under the state's 1-acre threshold for regulation. This program has been time-consuming for the Town to implement, but is considered to have successfully eliminated a substantial amount of sediment transport to local streams (Horstman, 2000).

To curb water pollution, Wake County has adopted and administers its own Sediment and Erosion Control Ordinance, conserving soil and curbing sediment pollution of water supplies.

6.2.3.2. Stormwater Programs and Impervious Surface Limitation

Cary

Cary currently employs one stormwater engineer who reviews existing stormwater problems, and two development review engineers that address flooding prevention for new developments. Cary recently hired a new stormwater specialist that will assess Town services for compliance and develop a stormwater and water quality education program. The Town's goal is to have six to seven staff members for stormwater compliance with NDPES Phase II, Neuse River Nutrient Rules, and floodplain protection (Cary, March 2000).

Cary currently requires a maximum of 70 percent impervious surface area for new development, and the Town Council will be asked to reduce this amount to 60 percent (Horstman, 2000). In addition, Cary is considering requiring that: 1) the maximum impervious surface and BMPs for water supply watershed development apply Town-wide, and 2) the Neuse River Basin NSW stormwater controls apply throughout its jurisdiction (Horstman, 2000). Cary is also looking at the amended UDO to recommend R-80 zoning with minimum 80,000-square foot lots for water supply watersheds to reduce impervious surfaces. Currently the largest lot size currently required in the Town is 40,000 square feet. Cary is also proposing, through the UDO amendments, to expand the impervious surface limits and low density BMP requirements for developments further out from Jordan Lake and in the Middle Creek watersheds.

Apex

Apex is planning to hire a new stormwater engineer or transfer an employee from another program to implement NPDES Phase II stormwater requirements (Apex, March 2000).

Morrisville

The Stormwater Runoff Management Policy for Morrisville establishes minimum requirements and procedures to control the adverse effects of increased stormwater runoff associated with land development (Morrisville, 1999E). The policy requires the proper management of stormwater runoff to:

- Minimize damage to public and private property
- Ensure a functional drainage system
- Reduce the effects of development on land and stream channel erosion
- Assist in attaining and maintaining water quality standards
- Reduce local flooding and drainage problems
- Maintain as nearly as possible the pre-developed runoff characteristics of the area
- Facilitate economic development by mitigating associated flooding and drainage impacts

Morrisville estimates that at least 60 percent of its planning jurisdiction has no storm drains or curb and gutter systems. As a result, the stormwater passes through ditches that provide stormwater treatment. There are no plans to change this (Morrisville, 2000).

Wake County

The Watershed Protection Overlay District limits impervious surface coverage from new development to 30 percent of a site's area (24 percent if the development has curb and gutter systems). The County has elected to meet the Water Supply Watershed Protection Program requirements under its "Low-Density Option," which does not require engineered stormwater controls on developing sites (Wake County, 1999).

In addition to Wake County's requirements, the Master Plan for the Southern Portion of RTP calls for the sites to be limited to a maximum impervious surface area cover of 30 percent. In addition the plan calls for construction of a series of wet detention ponds to provide a regional storm water detention system for the southern portion of RTP. Studies by the School of Design indicated that these detention ponds would reduce pollution 70 percent or more. To date, two wet detention ponds have been completed and a third is under design. Both of the completed ponds treat the first one inch of runoff from their drainage areas to prevent water quality degradation from storm water throughout the Southern Portion of RTP and also from some adjoining areas that are within the drainage basin but outside RTP (Rooks, 2000).

6.2.3.3. Floodplain Development Regulations

Regulating development in floodplains serves two main purposes:

1) Limiting damage from storms, and
2) Preventing water quality degradation

The local government ordinances that limit development within the floodplain exceed FEMA requirements.

Cary

Cary's floodplain ordinance has prohibited any residential development in the 100-year floodplain since 1978. This includes prohibiting development where the 1st floor elevation is above the 100-year floodplain. All residential lots must have a minimum amount of the total square footage outside of the floodplain, which makes lots along the floodplain deeper and discourages cutting trees from the floodplain to enlarge back yards. Cary allows non-residential development in floodplains if the first floor is above the floodplain elevation, but only through a special use permitting process which discourages most development from occuring in the floodplain (Cary, March 2000).

Very little property damage has occurred in Cary as a result of flooding because these strict regulations have kept most development out of the floodplains. Some nuisance flooding (e.g. over roads) has occurred (Cary, March 2000). To address this, the Town adopted an amendment to its subdivision and site plan ordinances on August 12, 1999, requiring delineation of "backwaters" (areas where floodwaters back up onto adjacent lots where culverts, pipes, or bridges restrict heavy stormwater flows). Such a delineation will be used to ensure that structures are located away from this "backwater" area to prevent flooding problems at culverts in subdivisions and also to prevent floodplain areas from being used to meet minimum lot size requirements (Cary, 1999; and Barker, personal communication).

In addition to this "backwaters" amendment, Cary staff are considering proposing that all residential lots be platted outside of floodplains and stream buffers. This would prevent clearing of buffers by homeowners, since it would result in deeper lots with the floodplain/buffer portion outside of the legal lot boundaries. Staff would like to introduce this proposal to Council in the next few months (Cary, March 2000).

Although Cary's UDO currently allows some filling of floodplains, the revised UDO would eliminate this provision, prohibiting filling of floodplains (Horstman, 2000).

Cary's UDO currently requires flood studies for all developments greater than 50 acres. The areas defined as 100-year floodplain are further upstream from existing FEMA boundaries to account for outdated FEMA maps. To address this, Cary has hired a consultant to remap several areas. Approximately 20,000 feet of stream have been studied and two redrawn maps are currently in review by FEMA.

Apex

Apex flood plain development ordinances are similar to FEMA requirements and are enforced through civil and criminal penalties. This ordinance will be revised when the draft UDO is approved. Apex's Draft UDO proposes to prohibit all residential development in the flood fringe area, even if the first floor is above the 100-year floodplain. The draft UDO would allow non-residential development only on a case-by-case basis (subject to site plan approval and inclusion of flood mitigation techniques) and allow certain recreational uses (e.g. playing fields) in the flood fringe. Such proposals would protect water quality, open space and fish and wildlife habitat along surface waters (Apex, 1999B). The Draft UDO proposes that commercial development have the first floor at least 2 feet above the 100-year flood, (1 foot higher than normally required for NFIP/FEMA) (Apex, January 2000).

Morrisville

The Subdivision Ordinance requires that lands subject to hazards such as flooding, excessive erosion, or slides not be platted for residential or other uses in such a way as to present a danger to life or property or the public health, safety, or general welfare (Morrisville, 1999C).

6.2.3.4. Water Conservation

Water conservation reduces the amount of water that reaches the wastewater treatment plants, thereby reducing point source pollutant loads and decreases the amount of interbasin transfer needed. This section outlines water conservation practices being implemented by the Towns.

Cary's Water Conservation Program has a threefold approach to achieving water conservation by Cary citizens and businesses: voluntary, regulatory, and incentive mechanisms. The program currently has three full time staff (Water Conservation Coordinator, Conservation Assistant, and Water Conservation Technician) and operates through the Public Works and Utilities Department. A formal Conservation Plan addressing long-term water needs and conservation program goals was adopted by the Town Council on April 13, 2000 (Platt, 2000).

Voluntary – Cary's voluntary water conservation program focuses on education. Cary's Water Conservation Team has developed a broad spectrum of initiatives to educate the public about water and water conservation issues. Currently, Cary's Water Conservation Team currently employs a number of educational programs designed to reach individuals, families, neighborhoods, and schools. These include direct mailings, community newsletters, general newspaper and utility bill inserts, television ads, flyers, annual distribution of Annual Drinking Water Quality Reports to all citizens, and providing web site information. Other educational activities included providing workshops on water conservation gardening, giving presentations to local civic groups, organizing and developing elementary school activities involving water conservation lessons, distributing low-flow showerheads and aerators at community functions, and conducting indoor water use audits for residents upon request (Platt, 2000).

The Water Conservation Team also participates in special promotional campaigns that target specific educational goals. For example, the "Beat the Peak '98" program focused on outdoor water conservation practices. A brochure and can were mailed to all residents. The can resembled a tuna can, and was used by citizens to determine when their lawns had received 1 inch of water in a week. The Towns of Apex and Morrisville also use this education program. Another program of "Beat the Peak '98" was the Block Leader Program, a grassroots communication effort. In this program, block leaders received training and then taught water conservation and recycling to their neighbors. Conservation materials were made available to neighborhoods through the Block Leaders. Other future educational programs will target nutrient usage (Platt, 2000).

To address the special needs of Cary's automatic irrigation customers and the landscaping/irrigation industry, the Water Conservation Team sponsors workshops targeted at improving techniques and practices. The Irrigation Association conducts some of the workshops in conjunction with Town staff (Platt, 2000).

Regulatory - Cary's Town Manager is authorized by ordinance to invoke water conservation or rationing measures and to develop and enforce those conservation measures when a water emergency exists. The Town Council approved a Water Shortage Response Plan that outlines the Town's policy to implement water conservation measures in May 2000. Voluntary, mandatory, and water shortage emergency measures may be imposed on all town water customers and other persons who use town water for the duration of the water emergency.

If restrictions or bans are placed on certain types of water use, police officers and the Water Conservation Team enforce the restrictions or bans. The first violation results in a written notice ordering that the violation be corrected within a specified time. If the violation is not corrected, any of the following penalties may apply: civil penalties, criminal penalties, termination of water service, injunctive relief, or any appropriate equitable remedy issuing from a court of competent jurisdiction.

Cary ordinances also prohibit wasting water. Wasting water is defined as water that falls on impervious surfaces or accumulates on the surface of the ground and leaves the property and enters gutters, storm drains, ditches, and other conveyances. Penalties and other enforcement action may be imposed if wasting water is repeated or flagrant.

Both Cary and Apex require rain sensors on new automatic irrigation systems that receive town water. Once 0.25 inches of rainfall has occurred, the irrigation system must automatically shut off.

Cary has proposed an ordinance that will reduce turf grass plantings and require more natural, drought-tolerant landscaping that requires less irrigation water (Cary, March 2000). As part of its zoning ordinance review, Morrisville is also looking at landscape requirements that would encourage xeriscaping.

Cary has proposed an ordinance that would ban new irrigations systems in medians; existing systems would be grandfathered.

Incentives – Cary's Water Conservation Team provides rebates for water conservation devices, such as early closing toilet flappers that cut water consumption from toilet use (Platt, 2000). Cary also has three tiers of rates for residential customers that provide incentive to use less water. A rate of $2.74 per 1,000 gallons is charged for use up to 4,000 gallons, a rate of $3.23 per 1,000 gallons is charged for use between 4,000 and 8,000 gallons, and a charge of $4.40 is charged for each 1,000 gallons above 8,000. Cary is developing a fourth tier that will be presented to the Town Council in May 2000. The fourth tier will charge a higher rate for residences that exceed the typical water use for a single family house and lot size. A second tier will also be proposed for nonresidential properties using more than an average amount of water, based on an lot size and typical winter (non-irrigation) use. Cary currently charges a higher amount for water used for irrigation, and this rate would be increased to the highest tier under the proposed changes (Goodwin, 2000).

As in Cary, the Town Managers of Apex and Morrisville can enforce water conservation measures during emergencies. Both towns also charge more for irrigation water than the base rate.

Although Wake County does not have a water system of its own, it encourages municipalities to conserve and reuse water through its water/sewer funding policy. The County may offer financial aid to municipalities for certain water and sewer improvements including projects for conservation and reuse. The Wake County Soil and Water Conservation Service has, as part of its mission, the conservation of clean surface water (Stoddard, 2000).

While there is no requirement to do so, most sites within RTP are using native species in their landscaping to reduce irrigation needs and operation costs (Rooks, 2000).

6.2.3.5. Water Reuse

Reusing wastewater reduces the use of potable water and reduces the amount of wastewater that is discharged through a wastewater treatment plant, thereby reducing point source loading to surface waters. Reuse efforts are ongoing in Cary and Apex. Cary is in the process of implementing 1.6-mgd (MDD) reclaimed water system at the North Cary WWTP. Several major customers have been identified and have agreed to participate in the program. Additional users will be included in the system when the distribution lines are installed. The first phase of the system has been designed, and has been permitted. The

system is projected to be operating at the 1.6-mgd level in 2002, and to increase to 3.2 mgd by 2015.

Additionally, Cary has designed a water reuse project at the South Cary WWTP. Several parks, schools, and ball fields have been identified as potential reuse customers. The expected rate of reuse from the South Cary WWTP is about 0.6 mgd MDD in 2001. This project is currently under regulatory review.

Apex is currently investigating wastewater reuse with two industries next to the WWTP: Cooper Tools and Ready Mix Concrete. Both facilities are analyzing the wastewater to ensure it will meet their quality needs (Apex, March 2000).

6.2.3.6. Other Pollution Prevention Programs

In addition to water conservation education programs described above, other education activities are ongoing within the three towns. Cary does storm drain stenciling to educate its citizens about the impacts of pouring pollutants down storm drains. The Morrisville Town Board sends briefs to the citizens each month which often include environmental education.

Apex has eliminated grass clipping collection to save landfill space and promote healthier lawns that need less water. Apex is also budgeting and developing a compost bin program that will enable citizens to purchase compost bins at a reduced price. The compost can be used as mulch, which will reduce the amount of water needed by plants and reduce weeds without the use of herbicides.

Cary has a connectivity ordinance for roads that requires a certain number of connections between a development and the surrounding roads. Residential subdivisions must also have a certain ratio of linking roads to end-points, including cul-de-sacs. This helps prevent pollution in two ways:

1) People can take a more direct route to their destination, cutting down on traffic congestion and air pollution.

2) The number of cul-de-sacs, which have higher levels of impervious surface than roads, is limited (Cary, March 2000).

Prior to the enactment of the Water Supply Watershed Protection Rules adopted by the EMC in 1992, the municipalities of Cary, Raleigh and Garner agreed to protect the Swift Creek watershed within the Swift Creek Land Management Plan (SCLMP). The SCLMP was first adopted by the Wake County Board of Commissioners on April 2, 1990. Each of the other municipal governments which were parties to the plan then adopted the plan during the next several months, agreeing to its concepts, policies and standards. The Wake Board of Commissioners then adopted the resulting Swift Creek Land Management Plan (SCLMP) document as an amendment to the Wake County General Development Plan on January 27, 1992 (Wake County, 1999). Cary has agreed not to expand further into the Swift Creek Watershed, and the portion of the watershed within the Town's jurisdiction has been designated as a Reservoir Watershed Protection District, with restrictions on development density. A large portion of the Swift Creek floodplain to the east of Regency Parkway has been set aside as conservation and recreational land, including Hemlock Bluffs State Park and Lochmere Park (Cary, 1996).

6.2.4. Western Wake Regional WWTP

Wake County and communities in western Wake County have been discussing the concept of a regional WWTP to accommodate Cary, Apex, and Holly Springs. Each of these communities currently has its own WWTP discharging into fairly small streams. Under the regional concept, the Towns would build one treatment facility that would discharge to the Cape Fear River Basin. This regional approach will eliminate the point source discharges to the small streams and will also decrease the interbasin transfer since the largest plants that would go off-line currently are located within the Neuse River Basin.

6.3 Other Potential Mitigation Measures

This section contains a list of factors to be included in the EA or EIS prepared for future water and sewer infrastructure projects to help ensure that the potential direct environmental effects of these projects are fully evaluated and mitigated. It is aimed to identify opportunities to enhance existing and proposed environmental protection regulations at the local level. These opportunities were identified based on the discussion presented in Sections 6.1 and 6.2 to complement the existing environmental protection regulatory framework. The evaluation of existing regulatory and non-regulatory mitigation indicates that numerous rules and programs have been or are under consideration to be adopted to protect the natural resources of the study area from the effects of urbanization. These regulations and programs, and the environmental resources they protect, are summarized in Table 18 for state and federal programs, and Table 19 for local programs. Therefore, only a limited number of opportunities that complement this mitigation have been identified. Pursuit or adoption of any of these enhancement opportunities noted in this section, however, is not a condition for approval of the IBT project addressed in this EIS.

6.3.1 Water and Sewer Infrastructure EA/EIS Conditions

The following are suggestions for subsequent EA and EIS documents for water and sewer treatment and conveyance systems in the source or receiving basin to help ensure that potentially significant primary/direct impacts are adequately addressed:

- Locations, types, extent, and importance of wetlands, forest lands, prime agricultural land and public lands in the proposed disturbance / construction zone and analysis of projected impacts to these resources from proposed direct construction impacts
- Since projected land uses for the Utility Service Area were not available in GIS format at the time this EIS was prepared, future EA and EIS documents for water and sewer infrastructure projects should contain this information (if available) coupled with existing land uses or land cover data for each proposed project and its service area. This analysis should include a discussion of how the project complies with local plans and zoning and is consistent with planned land uses for the area.
- Acreages and types of sensitive aquatic or terrestrial species or their habitats, and game and non-game non-sensitive species that may be lost or degraded because of construction or operation of the infrastructure, with analysis of what can be done to avoid or offset these impacts. Alternative site designs, selection, alignments, or utility designs should be proposed to mitigate significant impacts to sensitive species or

habitats. Particular attention should be given to the Jordan Lake, Swift Creek, and Middle Creek watersheds, and suspected locations of other sensitive species that could be impacted by construction of the utilities.

- Specific design and operational guidance that will be used to avoid system failures and toxic spills into surface waters should be provided, with specific attention given to avoiding sewage releases, sewage overflows and leaks during power outages, storm events and accidental breaks in the lines, equipment and pump stations. Specific attention must be given to methods designed for any project activities near Jordan Lake, Swift Creek and Middle Creek, and other sensitive habitats identified to reduce the probability for spills within those sensitive areas.

SECTION 7

Agency Involvement

A final scoping document was completed based on comments received from a draft submitted to the State Clearinghouse. The draft document was submitted in September 1997 and comments were received in October 1997. Table C-1 in Appendix C lists the agencies that responded, the dates of the responses, the concerns that were presented, and the section of the EIS that addresses the concerns. These comments were reviewed and the final scoping document was completed in cooperation with DWR.

In addition to the comments received through the Clearinghouse, a number of meetings and contacts were made with many resource agencies before and after formal comments from the Clearinghouse were received. Particularly, organizations that responded to the State Clearinghouse scoping process of 1997 were contacted again in October 1999..At this time, these organizations were notified of the EIS process and were provided one additional opportunity to submit comments..

Table C-2 in Appendix C lists the agency, date of the meeting, date of comments received, concerns discussed, and section of the EIS that addresses these concerns. Pre-scoping and scoping meeting summaries provided in Appendix C provide details regarding key issues discussed, locations of the meetings, and the parties in attendance.

Finally, a draft EIS was submitted to DENR in January 2000. A summary of the comments and the full text of the letter is presented in Appendix C and Table C-3.

SECTION 8

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