Environmental Assessment For Greenville Utilities Commission Interbasin Transfer

Greenville Utilities Commission

October 2008

Greenville Utilities

ARCADIS
Infrastructure, environment, facilities

FINAL

FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT FOR THE GREENVILLE UTILITIES COMMISSION INTERBASIN TRANSFER

Pursuant to the requirements of the State Environmental Policy Act (G.S. 113A), an environmental assessment (EA) has been prepared to allow the Greenville Utilities Commission (GUC) to apply for two interbasin transfer (IBT) Certificates to provide finished water to the Town of Farmville (Pitt County), the Town of Winterville (Pitt County), and Greene County. The North Carolina Environmental Management Commission (EMC) enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules on August 1, 2002. The CCPCUA rules require groundwater users to reduce withdrawals from the Cretaceous aquifer in three phases between 2008 and 2018. Farmville, Winterville, and Greene County currently rely on the Cretaceous aquifer for their sole water supply, and therefore are significantly affected by the CCPCUA rules. These communities plan to purchase bulk finished water from GUC to comply with CCPCUA rules and continue to meet customer needs. However, the purchase of bulk finished water from GUC to the Town of Farmville and Greene County constitutes an IBT from the Tar River subbasin to the Contentnea Creek subbasin. Sale of finished water to the Town of Winterville constitutes an IBT from the Tar River subbasin to the Neuse River subbasin.

GUC is requesting an IBT Certificate for a water transfer from the Tar River subbasin to the Contentnea Creek subbasin to support the Town of Farmville and Greene County's compliance with CCPCUA rules. GUC is requesting an IBT Certificate in the amount of 8.3 mgd to meet Farmville and Greene County's maximum day demands through 2030. As part of the same Certificate, GUC requests the ability to transfer 9.3 mgd under emergency conditions to the Contentnea Creek subbasin.

GUC is also requesting an IBT Certificate for a water transfer from the Tar River subbasin to the Neuse River subbasin to support the Town of Winterville's compliance with CCPCUA rules, and to support water use in the portion of the GUC service area within the Neuse River Basin. GUC is requesting an IBT Certificate for 4.0 mgd to meet Winterville's maximum day demands through 2030. Additionally, GUC requests the ability to transfer 4.2 mgd under emergency conditions to the Neuse River subbasin.

A hydrologic analysis was performed for the Tar River to assess the hydrologic impact of the interbasin transfer of water from the Tar to the Neuse and Contentnea Creek subbasins. Results indicate that the proposed interbasin transfer from the Tar River to the Neuse and Contentnea Creek subbasins will have minimal impact on stream flow at Greenville. The differences in the flow data below the 7Q10 are not significantly different between the no IBT, average, and maximum withdrawal IBT scenarios for the current stream flow and the 2030 stream flow conditions. However, the existing periods of low flow, regardless of the significance of the resulting withdrawal scenario, may be ameliorated by the tidal influence.

No construction is proposed in conjunction with this interbasin transfer. Therefore, direct impacts to soils, topography, wetlands, protected species, or land use as a result of this proposed project are expected to be insignificant. Additionally, the proposed interbasin transfer will not result in significant indirect impacts. Significant growth in Farmville, Greene County, and Winterville is not a component of this project or a reason for developing the interbasin transfer request.

Based on the findings of the EA, the Division of Water Resources (DWR) has concluded that the proposed project will not result in significant impacts to the environment. This EA and Finding of No Significant Impact (FONSI) are prerequisites for the issuance of the requested IBT Certificates. An Environmental Impact Statement (EIS) will not be prepared for this project. This FONSI completes the environmental review record. The FONSI and EA will be available for inspection and comment for 30 days at the State Clearinghouse.

C3

NCDENR

North Carolina Department of Environment and Natural Resources

William G. Ross Jr., Secretary

Michael F. Easley, Governor

Post-it® Fax Note 7671	Date 10/14/08	# of pages ▶ 1
To MARY SADLER	From MELBA MCGEE	
Co./Dept.	Co.	
Phone # 854-5448	Phone #	
Fax #	Fax #	

MEMORANDUM

TO: Tom Fransen
Division of Water Resources

FROM: Melba McGee
Environmental Review Coordinator

RE: #1456 Greenville Utilities Commission Interbasin Transfer Pitt and Greene Counties

DATE: October 13, 2008

We appreciate the effectiveness in addressing agency comments that were received during the department's internal review. The Environmental Assessment and Finding of No Significant Impact can be forwarded to the State Clearinghouse for further state review.

Thank you for your assistance.

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Final Environmental Assessment for Greenville Utilities Commission Interbasin Transfer

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Our Ref.:
NC706015.0010

Date:
October 2008

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EXECUTIVE SUMMARY

The North Carolina Environmental Management Commission (EMC) enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules on August 1, 2002. The CCPCUA rules were developed as a control measure for groundwater use in the Cretaceous aquifer in response to decreasing groundwater level and saltwater intrusion. The rules will be implemented over a ten-year period. The goal of the rule is to allow the Cretaceous aquifer to recharge and provide sustainable groundwater supply yields. The CCPCUA rules require groundwater users located in the impacted areas to reduce withdrawals in three phases between 2008 and 2018.

The Town of Farmville (Pitt County), the Town of Winterville (Pitt County), and Greene County currently rely on the Cretaceous aquifer for their sole water supply, and therefore are significantly affected by the CCPCUA rules. These communities plan to purchase bulk finished water from GUC to comply with CCPCUA rules and continue to meet customer needs. However, the purchase of bulk finished water from GUC to the Town of Farmville and Greene County constitutes an interbasin transfer (IBT) from the Tar River subbasin to the Contentnea Creek subbasin. Sale of finished water to the Town of Winterville constitutes an IBT from the Tar River subbasin to the Neuse River subbasin.

This project consists of a State Environmental Policy Act (SEPA) Environmental Assessment (EA) to allow GUC to apply for two IBT Certificates to provide finished water to Farmville, Greene County, and Winterville. These communities are located in different watershed subbasins as defined by the EMC. The EMC regulates transfers of water from one watershed to another via the interbasin transfer regulations. Pursuant to SEPA, any project requiring an IBT Certificate also requires an EA to be completed and a Finding of No Significant Impact (FONSI) to be granted before the EMC will issue an IBT Certificate. In general, an IBT certificate is required for a new transfer greater than 2 million gallons per day (mgd) or an increase in an existing transfer greater than 25 percent, if the total including the increase is greater than 2 mgd.

GUC is requesting an IBT Certificate for a water transfer from the Tar River subbasin to the Contentnea Creek subbasin to support the Town of Farmville and Greene County's compliance with CCPCUA rules. GUC is requesting an IBT Certificate in the amount of 8.3 mgd to meet Farmville and Greene County's maximum day demands through 2030. As part of the same Certificate, GUC requests the ability to transfer 9.3 mgd under emergency conditions to the Contentnea Creek subbasin.

GUC is also requesting an IBT Certificate for a water transfer from the Tar River subbasin to the Neuse River subbasin to support the Town of Winterville's compliance with CCPCUA rules, and to support water use in the portion of the GUC service area within the Neuse River Basin. GUC is requesting an IBT Certificate for 4.0 mgd to meet Winterville's maximum day demands through 2030. Additionally, GUC requests the ability to transfer 4.2 mgd under emergency conditions to the Neuse River subbasin.

No construction is proposed in conjunction with this interbasin transfer. A Final Environmental Assessment for ten miles of finished water line and a booster pump station to support the IBT for Greene County and the Town of Farmville (2006, McDavid and Associates) has been approved with a FONSI. The Town of Winterville is already connected to the GUC water distribution system for emergency interconnections. Therefore, direct impacts to soils, topography, wetlands, protected species, or land use as a result of this proposed project are expected to be insignificant.

A hydrologic analysis (ENTRIX, revised 2008) was performed for the Tar River to assess the hydrologic impact of the interbasin transfer of water from the Tar to the Neuse and Contentnea Creek subbasins. The model accounted for existing and expected future withdrawals from, and discharges to, the Tar River (greater than 100,000 gpd). Withdrawals and discharges were simulated over time to predict the effects on flow in the Tar River at Greenville. Model simulations included the current conditions in the Tar River, the 2030 average day IBT scenario, and the 2030 maximum withdrawal IBT scenario. The results of the hydrologic modeling indicate that the proposed interbasin transfer from the Tar River to the Neuse and Contentnea Creek subbasins will have minimal impact on stream flow at Greenville. The differences in the flow data below the 7Q10 are not significantly different between the no IBT, average, and maximum withdrawal IBT scenarios for the current stream flow and the 2030 stream flow conditions. However, the existing periods of low flow, regardless of the significance of the resulting withdrawal scenario, may be ameliorated by the tidal influence. The tidal influence at Greenville is one factor that provides downstream aquatic habitat protection during low flow at Greenville. The influence of tides will naturally offset the low flow condition at the Greenville gage.

The proposed interbasin transfer will not result in significant indirect impacts. Significant growth in Farmville, Greene County, and Winterville is not a component of this project or a reason for developing the interbasin transfer request. Growth in the area is modest, at a rate of 1 to 3 percent for the larger communities (GUC, Greene County, and Farmville) and at slightly higher rates for smaller communities (Winterville).

ARCADIS

Final Environmental Assessment – Greenville Utilities Commission Interbasin Transfer

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A Interbasin Transfer Management Strategy for Greenville Utilities Commission (ARCADIS, 2008)

B Analysis of Greenville Utility Commission's Proposed Interbasin Transfer Withdrawals on Tar River Flows at Greenville, North Carolina (ENTRIX, October 2007)

C Response to Division of Water Resources Completeness Review Comments

D Response to DENR Comments

List of Acronyms

7Q10	7-day duration, 10-year frequency low stream flow
ABR	Approved base rate
AWWA	American Water Works Association
BMP	Best management practice
BOD	Biochemical oxygen demand
CAMA	Coastal Area Management Act
CAS	Cretaceous aquifer system
CCPCUA	Central coastal plain capacity use area
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CMSD	Contentnea Metropolitan Sewerage District
CO	Carbon monoxide
DAQ	N.C. Division of Air Quality
DEH	N.C. Department of Environmental Health
DENR	N.C. Department of Environment and Natural Resources
DWQ	N.C. Division of Water Quality
DWR	N.C. Division of Water Resources
E	Endangered
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMC	N.C. Environmental Management Commission
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ETJ	Extraterritorial jurisdiction
FEMA	Federal Emergency Management Agency
FSC	Federal species of concern
FONSI	Finding of No Significant Impact
GMA	Groundwater Management Association, Inc.
gpd	Gallons per day
gpcd	Gallons per capita per day
gpm	Gallons per minute
GUC	Greenville Utilities Commission
HQW	High quality water

List of Acronyms

IBT	Interbasin transfer
LWSP	Local water supply plan
MG	Million gallons
mgd	Million gallons per day
mgy	Million gallons per year
MSL	Mean sea level
NAAQS	National ambient air quality standards
NCAC	N.C. Administrative Code
NHP	N.C. Natural Heritage Program
NO_x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	U.S. Natural Resource Conservation Service (previously known as the Soil Conservation Service)
NRWASA	Neuse Regional Water and Sewer Authority
NSW	Nutrient sensitive waters
NWI	National Wetland Inventory
O_3	Ozone
O&M	Operation and Maintenance
ORW	Outstanding resource water
OSHA	Occupational Safety and Health Act
Pb	Lead
PM-10	Particles with a diameter of 10 micrometers or less
ppm	Parts per million
RCW	Red Cockaded Woodpecker
SDWA	Safe Drinking Water Act
SNHA	Significant Natural Heritage Area
SEPA	State Environmental Policy Act
SO_x	Sulfur oxides
T	Threatened
TAZ	Traffic analysis zone
TMDL	Total maximum daily load
TSP	Total suspended particulates
TSS	Total suspended solids
USDA	U.S. Department of Agriculture

List of Acronyms

USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWC	Urban Water Coalition
VOC	Volatile organic compound
WQC	N.C. Water Quality Committee
WRC	N.C. Wildlife Resources Commission
WS	Water supply
WTP	Water treatment plant
WWTP	Wastewater treatment plant

1. Proposed Project Description

1.1 Introduction

The North Carolina Environmental Management Commission (EMC) enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules on August 1, 2002. The CCPCUA rules were developed as a control measure for groundwater use in the Cretaceous aquifer in response to decreasing groundwater level and saltwater intrusion. The rules will be implemented over a ten-year period. The goal of the rules is to allow the Cretaceous aquifer to recharge and provide sustainable groundwater supply yields.

The CCPCUA rules require groundwater users located in the impacted areas to reduce withdrawals in three phases between 2008 and 2018. The required reduction amounts are based on the location of the water use, either in a dewatering zone or in a saltwater intrusion zone. The rules specify a percentage reduction in groundwater use from the Cretaceous aquifer from an approved base rate (ABR). The ABR for each groundwater user was determined by the North Carolina Division of Water Resources (DWR) based on historical annual water use from the Cretaceous aquifer system. Greenville Utilities Commission (GUC), Greene County, the Town of Farmville, and the Town of Winterville are located in the "dewatering zone." The reductions required by the CCPCUA rules for water users in the dewatering zone are as follows:

- Phase I (2008) – Permittees in the dewatering zone will be required to reduce annual water use by 25 percent from their ABR.
- Phase II (2013) – Permittees in the dewatering zone will be required to reduce annual water use by 50 percent from their ABR.
- Phase III (2018) – Permittees in the dewatering zone will be required to reduce annual water use by 75 percent from their ABR.

The Town of Farmville (Pitt County), the Town of Winterville (Pitt County), and Greene County currently rely on the Cretaceous aquifer for their sole water supply, and therefore are significantly affected by the CCPCUA rules. The Town of Farmville and the majority of Greene County are located in the Contentnea Creek subbasin. The Town of Farmville operates a 3.5 million gallon per day (mgd) wastewater treatment plant (WWTP) discharging to Little Contentnea Creek. In Greene County, wastewater is handled by on-site septic systems or small, centralized treatment systems discharging to Contentnea Creek. The Town of Winterville and the southwestern portion of Greene County are located in the Neuse River subbasin. Wastewater for Winterville is treated by the Contentnea Metropolitan Sewerage District (CMSD) via the Contentnea Creek WWTP. This plant discharges wastewater to an unnamed tributary to Contentnea Creek.

GUC, located in Pitt County, relies on the Tar River for its water supply. The majority of the GUC customer base resides in the Tar River subbasin. GUC operates the GUC WWTP discharging to the Tar River.

The Town of Farmville, the Town of Winterville, and Greene County plan to purchase bulk finished water from GUC to comply with CCPCUA rules and continue to meet customer needs. However, the purchase of bulk finished water from GUC to the Town of Farmville and Greene County constitutes an interbasin transfer (IBT) from the Tar River subbasin to the Contentnea Creek subbasin. Sale of finished water to the Town of Winterville and portion of Greene County constitutes an IBT from the Tar River subbasin to the Neuse River subbasin.

The interbasin transfer line, as determined by the EMC, is illustrated in Figure 1-1. The IBT line between the Tar River and Contentnea Creek and Neuse subbasins is located in Pitt County. The line extends through Pitt County around the perimeter of the western side of the GUC service area and around the eastern edge of the Town of Winterville. This IBT line crosses the southern end of the GUC service area. The IBT line between the Contentnea Creek subbasin and Neuse River subbasin is located approximately four miles west of Winterville and extends south on the western edge of the Towns of Ayden and Grifton to the Pitt County line.

1.2 Proposed Project Scope

This project consists of a State Environmental Policy Act (SEPA) Environmental Assessment (EA) to allow GUC to apply for two IBT Certificates to provide finished water to Farmville, Greene County, and Winterville. These communities are located in different watershed subbasins as defined by the EMC. The EMC regulates transfers of water from one watershed to another via the interbasin transfer regulations. Pursuant to SEPA, any project requiring an IBT Certificate also requires an EA to be completed and a Finding of No Significant Impact (FONSI) to be granted before the EMC will issue an IBT Certificate. In general, an IBT Certificate is required for a new transfer greater than 2 mgd or an increase in an existing transfer greater than 25 percent, if the total including the increase is greater than 2 mgd.

The CCPCUA rules require a 75 percent reduction in groundwater withdrawal phased over the next ten years. Groundwater withdrawal from the Cretaceous aquifer is the sole water supply source for Farmville, Greene County, and Winterville. Therefore, significant growth in these communities is not a component of this project or a reason for developing the interbasin transfer request. Growth in the area is modest, at a rate of 1 to 3 percent for the larger communities (GUC, Greene County, and Farmville) and at slightly higher rates for smaller communities (Winterville).

GUC is requesting an IBT Certificate for a water transfer from the Tar River subbasin to the Contentnea Creek subbasin to support the Town of Farmville and Greene County's compliance with CCPCUA rules. GUC is requesting an IBT Certificate in the amount of 8.3 mgd to meet Farmville and Greene County's maximum day demands through 2030. As part of the same Certificate, GUC requests the ability to transfer 9.3 mgd under emergency conditions to the Contentnea Creek subbasin.

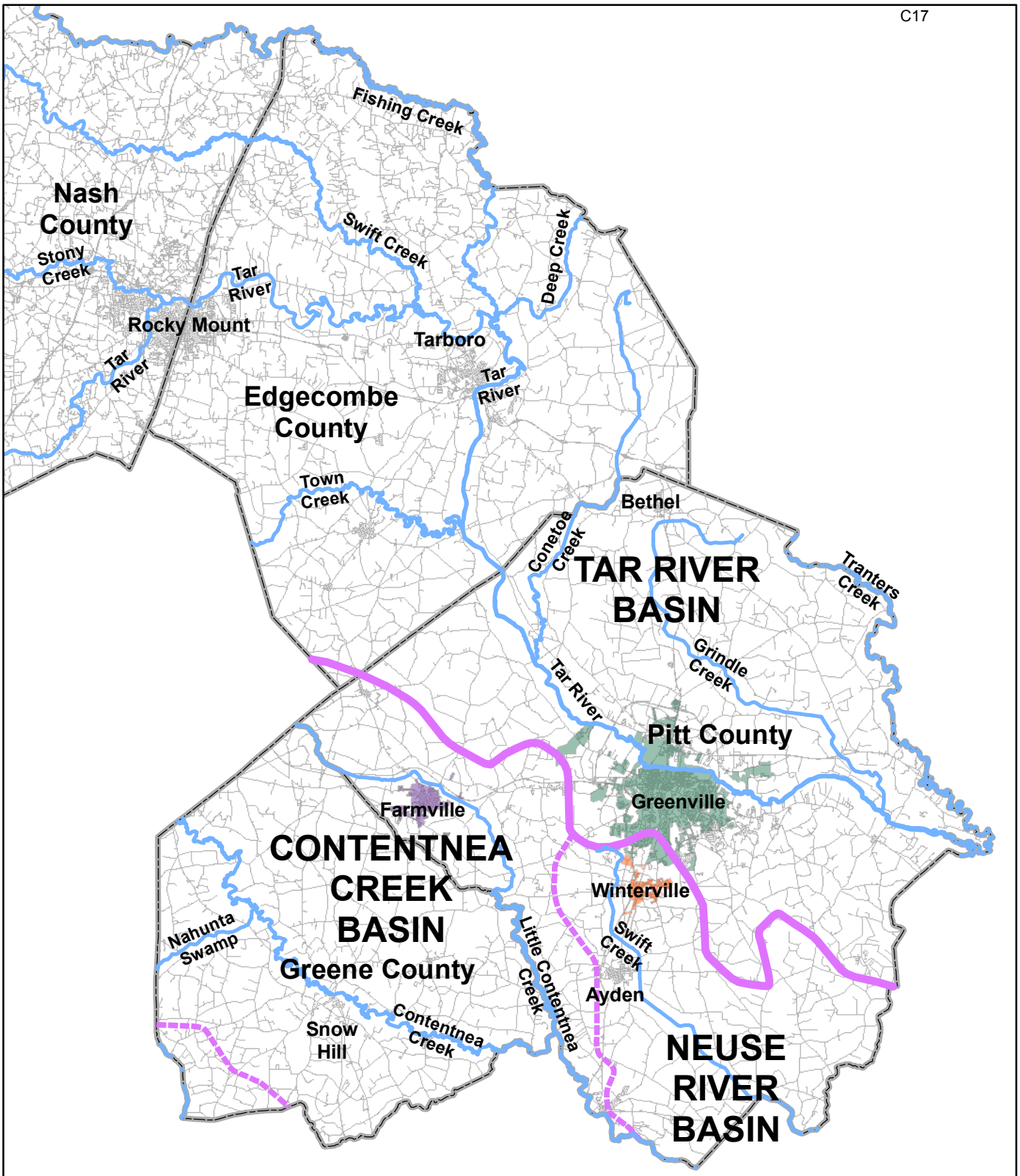
GUC is also requesting an IBT Certificate for a water transfer from the Tar River subbasin to the Neuse River subbasin to support the Town of Winterville's compliance with CCPCUA rules, and to support water

use in the portion of the GUC service area within the Neuse River Basin. GUC is requesting an IBT Certificate for 4.0 mgd to meet Winterville's maximum day demands through 2030. Additionally, GUC requests the ability to transfer 4.2 mgd under emergency conditions to the Neuse River subbasin.

This EA will include evaluations of the environmental issues related to the two IBT requests. This EA will document the need for the project, provide an analysis of the project alternatives, and describe the existing environment, predicted environmental impacts, and mitigative measures.

1.3 Project Description

The project encompasses the service areas for GUC, the Town of Farmville, the Town of Winterville, and Greene County, as provided in Figure 1-2. The service areas are entirely located in Pitt and Greene Counties. The Tar River runs on the northern edge of the City of Greenville. Upstream of the Tar River from the City of Greenville is the Town of Tarboro and the Town of Rocky Mount. Downstream of the Tar River from Greenville is Beaufort County and the estuary. Contentnea Creek runs through the eastern edge of the Town of Farmville.



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LEGEND

- Interbasin Boundary
- Sub-basin Boundary
- County Boundary
- Major Rivers

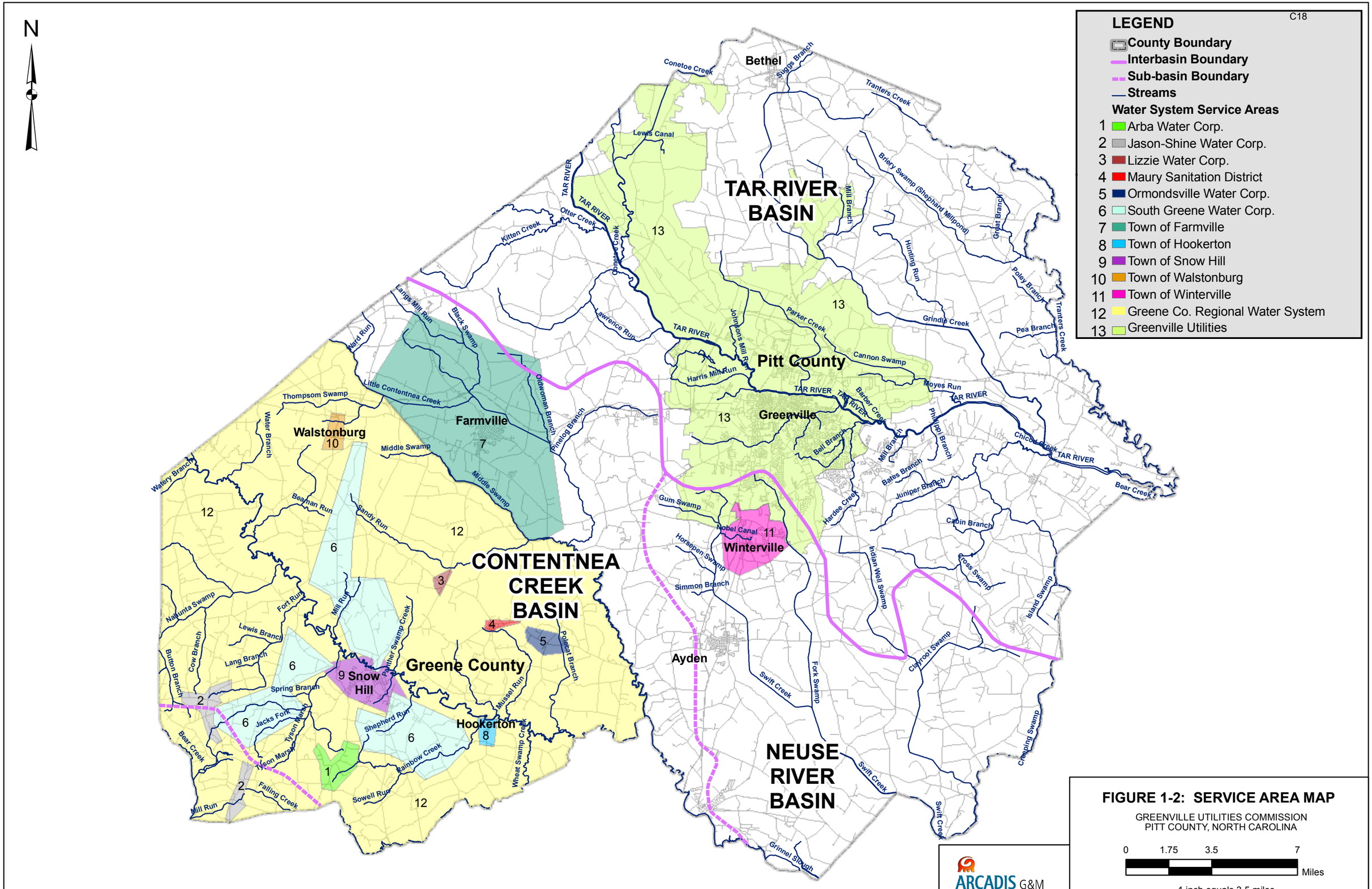
ARCADIS G&M

FIGURE 1-1: INTERBASIN TRANSFER LINE, AS DETERMINED BY THE ENVIRONMENTAL MANAGEMENT COMMISSION

GREENVILLE UTILITIES COMMISSION

PITT COUNTY, NORTH CAROLINA

0 3.5 7 14 Miles 1 inch equals 7 miles


N
LEGEND
County Boundary
Interbasin Boundary
Sub-basin Boundary
Streams
Water System Service Areas
1 Arba Water Corp.
2 Jason-Shine Water Corp.
3 Lizzie Water Corp.
4 Maury Sanitation District
5 Ormondsville Water Corp.
6 South Greene Water Corp.
7 Town of Farmville
8 Town of Hookerton
9 Town of Snow Hill
10 Town of Walstonburg
11 Town of Winterville
12 Greene Co. Regional Water System
13 Greenville Utilities
TAR RIVER BASIN
CONTENTNEA CREEK BASIN
NEUSE RIVER BASIN
Pitt County
Greene County
Bethel
Farmville
Walstonburg
Greenville
Winterville
Ayden
Snow Hill
Hookerton
Conetoe Creek
Tranters Creek
Lewis Canal
Briery Swamp (Shephard Millpond)
Mill Branch
Great Branch
Hunting Run
Poley Branch
Kitten Creek
Otter Creek
Lawrence Run
Parker Creek
Grindle Creek
Pea Branch
Johnsons Mill Run
Cannon Swamp
Harris Mill Run
Moyes Run
Barber Creek
Langs Mill Run
Black Swamp
Hard Run
Little Contentnea Creek
Oldwoman Branch
Pinelog Branch
Thompsom Swamp
Water Branch
Middle Swamp
Watery Branch
Bell Branch
Philippi Branch
Chicod Creek
Bates Branch
Juniper Branch
Bear Creek
Gum Swamp
Hardee Creek
Nobel Canal
Horsepen Swamp
Cabin Branch
Beaman Run
Sandy Run
Indian Well Swamp
Cross Swamp
Simmon Branch
Island Swamp
Nahunta Swamp
Fort Run
Mill Run
Panther Swamp Creek
Lewis Branch
Cow Branch
Lang Branch
Button Branch
Polecat Branch
Clayroot Swamp
Spring Branch
Mussel Run
Jacks Fork
Tyson Marsh
Shepherd Run
Swift Creek
Fork Swamp
Wheat Swamp Creek
Rainbow Creek
Creeping Swamp
Falling Creek
Sowell Run
Grinnel Slough
ARCADIS G&M
FIGURE 1-2: SERVICE AREA MAP
GREENVILLE UTILITIES COMMISSION
PITT COUNTY, NORTH CAROLINA
0 1.75 3.5 7
Miles
1 inch equals 3.5 miles

2. Need for the Project

The following sections address growth trends, historical water demands, and existing water facilities. Section 2.1 summarizes the overall need for the project; Section 2.2 evaluates growth trends; Section 2.3 provides an explanation of historical water demands; and Section 2.4 discusses existing water and wastewater facilities.

2.1 Summary of Need

This project consists of an EA to allow the GUC to obtain an IBT Certificate for the transfer of 8.3 mgd maximum day demand and 9.3 mgd emergency demand from the Tar River subbasin to the Contentnea Creek subbasin to support the Town of Farmville and Greene County's compliance with CCPCUA rules. GUC is also requesting an IBT Certificate for the transfer of 4.0 mgd maximum day demand and 4.2 mgd emergency demand from the Tar River subbasin to the Neuse River subbasin to support the Town of Winterville's compliance with CCPCUA rules. The CCPCUA rules require Farmville, Greene County, and Winterville to reduce groundwater withdrawals by 75 percent phased over the next ten years. Groundwater withdrawal from the Cretaceous aquifer is the sole water supply for these communities.

2.2 Growth Trends

2.2.1 Greene County

Since 1990, Greene County's population has grown by over 5,000 individuals to 20,466 residents, which is approximately a 25 percent increase according to 2006 statistics. Though largely agricultural, Greene County has a growing industrial community, which will continue to expand as the Global Transpark, a local business park, begins to take shape. According to the North Carolina State Demographics Unit, an annual growth rate of approximately 1 percent is expected to occur in Greene County between 2010 and 2030, a slightly lower growth rate than experienced before 2006. Assuming that the estimated growth rate is accurate, the County's population is projected to exceed 27,000 residents by the year 2030.

2.2.2 Town of Farmville

The Town of Farmville has experienced limited growth in the last fifteen years, with 180 additional residents added between 1990 and 2004. Farmville does not consistently record yearly census data, nor have they conducted population projections. The available population estimates are from the Local Water Supply Plan. Based on the observed historical growth percentage (0.28 percent annually between 1990 and 2004), the Town of Farmville may expect to support a population of approximately 5,000 residents by the year 2030.

2.2.3 Town of Winterville

The Town of Winterville, located south of Greenville, has experienced increased growth and development in the past fifteen years. Winterville's population more than doubled between 1990 and 2006, and grew by as much as 21.25 percent between 2000 and 2001 with the addition of 940 people. Between 2000 and 2006, Winterville's population increased at an average annual rate of 11 percent but it reached 17.1 percent between 2004 and 2005. The Town completed a water system master plan in Spring 2008. Population projections for Winterville were provided by the Town's master planning consultant. Growth in Winterville is expected to remain consistent over the next several years due to Winterville's close proximity to the City of Greenville. At an annual growth rate between 4.5 percent and 5.8 percent, Winterville's population in 2025 is expected to reach approximately 21,700 residents.

2.2.4 City of Greenville

Greenville is the largest municipality in Pitt County, making up 48 percent of the total population in July 2005, according to the North Carolina State Demographics Unit. East Carolina University, Pitt Memorial Hospital, and other businesses have attracted many residents to the area, bringing Greenville's population to 68,852 in 2005. The North Carolina State Demographics Unit has predicted that Pitt County will grow to 153,411 by 2010, and 192,493 by the year 2030. Assuming that Greenville continues to make up almost half of the County's population, the City will host approximately 100,000 residents by 2030.

GUC provides utility services to customers in the City of Greenville and some of the surrounding areas. According to 2005 census data from North Carolina State Demographics and projected values from the GUC Water System Master Plan, approximately 10 percent of the customers served by GUC live outside the City limits. GUC's service population has grown by an average annual rate of 1.91 percent between 2000 and 2005. Assuming an average annual growth rate of approximately 1.8 percent, population for the GUC service area is predicted to increase by approximately 25,000 persons between 2005 and 2020. By 2030, GUC may serve more than 110,000 customers.

Historical growth trends and growth projections for Greene County, the Towns of Farmville and Winterville, and the City of Greenville are provided in Table 2-1.

Table 2-1: Historical and Projected Population and Growth Rates

	Greenville Utilities Commission		Farmville		Greene County		Winterville	
Year	Population [1]	Annual Growth Rate, %	Population	Annual Growth Rate, %	Population [4]	Annual Growth Rate, %	Population	Annual Growth Rate, %
1990	NA	NA	4,446 [2]	NA	15,384	NA	3,053 [5]	NA
2000	69,507	NA	4,302 [2]	- 0.33	18,974	2.10	3,979 [5]	2.65
2001	NA	NA	NA	NA	19,050	0.40	4,921 [5]	21.25
2002	NA	NA	4,325 [3]	0.27	19,488	2.27	5,101 [5]	3.59
2003	NA	NA	NA	NA	19,860	1.89	5,402 [5]	5.73
2004	NA	NA	4,626 [2]	3.36	19,998	0.69	5,850 [5]	7.97
2005	76,478	1.91 [6]	NA	NA	20,167	0.84	6,942 [5]	17.11
2006	79,025	3.28	NA	NA	20,466	1.47	8,500 [7]	10.34
2010	85,067	1.84	NA	NA	21,567	1.31	NA	NA
2015	NA	NA	NA	NA	22,976	1.27	13,800 [7]	5.8
2020	101,932	1.81	NA	NA	24,485	1.27	NA	NA
2025	NA	NA	NA	NA	25,883	1.11	21,700 [7]	4.5
2030	NA	NA	NA	NA	27,378	1.12	NA	NA

1. From Greenville Utilities Commission Water System Master Plan (Black and Veatch, not yet published).
2. From Town of Farmville.
3. From 2002 Town of Farmville Local Water Supply Plan.
4. From N.C. Demographics Unit.
5. From N.C. Division of Water Resources.
6. Average Annual Historical Growth Rate (2000 – 2005).
7. Town of Winterville Water and Wastewater System Master Plan (Black & Veatch, not yet published).

NA = Data Not Available

2.3 Water Demand Projections

Historical water use data and water demand projections were collected for GUC, Greene County, the Town of Farmville, and the Town of Winterville and summarized in Table 2-2. Water demand projections provided by Greene County, the Town of Farmville, and the Town of Winterville were based on average day demands (ADD). Maximum day demand (MDD) projections were developed using historical MDD and ADD peaking factors. Water demand projections for each water system are presented in Section 2.3.1 through 2.3.4. Projected water demands were used in combination with the ABR of each municipality to determine estimated bulk purchases from GUC needed in 2008 and beyond in order for these water systems to comply with the CCPCUA rules. This Estimated Minimum Purchase is equal to the required reduction in well pumping to meet CCPCUA rules and is stated in the bulk sales contracts between GUC and its wholesale customers: Farmville, Greene County, and Winterville.

In addition, Greene County, Farmville, and Winterville have each expressed interest in the concept of "water banking" or "banking." The concept of banking is based on a water system pumping less groundwater than allowed by the CCPCUA rules by offsetting reductions using a supplemental surface water supplier such as GUC. Banking reduces groundwater withdrawals faster than the CCPCUA rules mandate, but allows the water systems to use the banked water in the future. This approach meets the reduction requirement over the first two reduction phases, and still maintains a high level of protection for the Cretaceous aquifer system.

DWR has approved the concept of banking, but required that a letter of intent be submitted by each water system interested in pursuing a "Cretaceous water bank account." Farmville, Winterville, Greene County have been approved for banking. The letters of approval for Farmville and Greene County are provided as an attachment to the IBT Management Strategy (Appendix A). Along with DWR's approval, a set of guidelines were introduced to clarify the banking system. Guidelines received by Farmville and Greene County in a letter dated July 6, 2004 included the following provisions:

- Present day through July 31, 2008 – The bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR.
- August 1, 2008 through July 31, 2013 – The bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR less Phase I reduction.
- August 1, 2013 through July 31, 2018 – The bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR less Phase II reduction.

A graphical representation of how banked water may be utilized is included in the IBT Management Strategy, Appendix A.

Table 2-2: Historical and Projected Water Demands

Year	Greenville Utilities Commission [7]		Farmville [8]		Greene County [9]		Winterville [10]	
	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Average Day Demand (mgd)	Maximum Day Demand (mgd)
1990	8.94 [1]	NA	2.17 [3]	3.20 [3]	NA	NA	NA	NA
1995	9.67 [1]	NA	1.60 [3]	2.38 [3]	NA	NA	NA	NA
2000	10.06 [1]	14.17 [1]	1.57 [3]	2.43 [3]	1.12 [5]	1.83 [5]	0.463 [5]	0.667 [5]
2005	10.03 [1]	14.71 [1]	1.66 [3]	2.74 [3]	1.19 [5]	2.22 [5]	0.706 [5]	1.32 [5]
2006	10.19 [1]	15.28 [1]	NA	NA	NA	NA	NA	NA
2007	10.34 [2]	15.51	NA	NA	NA	NA	0.80 [6]	1.44
2008	10.50 [2]	15.75	1.87 [4]	3.18	2.31 [4]	4.04	0.85	1.53
2009	10.65 [2]	15.98	1.89 [4]	3.22	2.35 [4]	4.11	0.90	1.62
2010	10.81 [2]	16.21	1.91 [4]	3.25	2.39 [4]	4.18	0.95	1.71
2015	11.19 [2]	16.78	2.01 [4]	3.41	2.60 [4]	4.54	1.20	2.16
2020	11.57 [2]	17.35	2.11 [4]	3.59	2.80 [4]	4.90	1.55	2.79
2025	11.95 [2]	17.92	2.22 [4]	3.77	3.01 [4]	5.27	1.93	3.47
2030	12.33 [2]	18.49	2.33 [4]	3.96	3.22 [4]	5.64	2.00	3.60

[1] Historical data from Greenville Utilities Commission.
[2] ADD demands based on a linear projection of historical demands (1990 – 2005).
[3] Town of Farmville Water production data.
[4] Water Supply Agreement with Greenville Utilities Commission.
[5] Data from Division of Water Resources.
[6] Data from the Town of Winterville.
[7] Per capita water use (residential, commercial, and institutional) for GUC is approximately 120 gpcd.
[8] Per capita water use for Farmville (residential) is estimated between 90 and 120 gpcd. Farmville has a large industrial percentage of water use (39%). The large industrial water use in addition to the scarcity of population data has resulted in inaccurate per capita use values.
[9] Per capita water use (residential, commercial, and institutional) for Greene County is approximately 115 gpcd.
[10] Per capita water use (residential, commercial, and institutional) for Winterville is approximately 90 gpcd.

NA = Data Not Available

2.3.1 Greene County

Greene County is currently served by ten different water systems. Greene County is acting as the lead agency on behalf of these water systems for the purposes of entering into bulk sales agreements with GUC. The water systems in Greene County are as follows:

- Greene County Regional Water System
- Town of Snow Hill
- Town of Hookerton
- Town of Walstonburg
- South Greene Water Corporation
- Maury Sanitary District
- Ormondsville Water Corporation
- Arba Water Corporation
- Lizzie Water Corporation
- Jason-Shine Water Corporation

In 2005, Greene County had an average day demand of 1.19 mgd and a maximum day demand of 2.22 mgd. By the year 2030, the County's water demands are projected to increase to 3.22 mgd on an average daily basis and to 5.64 mgd during peak day demands. Peak day demands were projected using a historical peaking factor of 1.75.

The ABR approved for Greene County is 1,079.8 million gallons per year (mgy), which translates to an average annual pumping rate of 2.96 mgd. Greene County will be required to reduce annual withdrawals by 75 percent in 2018, which equates to an average annual pumping rate of 0.74 mgd.

The County intends to bank water by pumping 50 percent of its allowed pumping rate during Phase 1 (2008 to 2013), and 75 percent of its allowed pumping rate during Phase II (2013 to 2018). Water banking will serve as a buffer for the County's water supply during peak demand periods or drought conditions, and will provide flexibility in the well operation. Between 2008 and 2018, the County will bank approximately 2,700 million gallons (MG), or 7.4 mgd of pumping capacity, and intends to distribute the capacity equally over the following 20 years (2018 to 2037). Greene County will purchase supplemental water from GUC to compensate for the reduced groundwater withdrawals.

Table 2-3 provides a summary of projected water system demands for Greene County, the allowable pumping rate, the projected purchase from GUC, and the amount of water that will be banked for future use. The amount of the Estimated Minimum Purchase equals the required reduction in well pumping to meet CCPCUA rules.

2.3.2 Town of Farmville

The Town of Farmville's average day water demand is expected to increase by 25 percent between 2008 and 2030. According to the Water Purchase Agreement with GUC, average daily demands in 2030 will be

approximately 2.33 mgd. Based on a peaking factor 1.70, maximum day demands are projected to be 3.96 mgd in 2030.

The ABR approved for Farmville is 574 mgy, which translates to an average annual pumping rate of 1.572 mgd. Farmville will be required to reduce annual withdrawals to 0.393 mgd in 2018. The Town of Farmville also intends to bank water throughout Phases I and II of the CCPCUA rule, pumping only half of what is permitted during Phase I, and 75 percent of their allotted withdrawal during Phase II. Farmville will bank a total of 1,434 MG between 2008 and 2018. It is unclear at this time whether Farmville intends to utilize its banked water over an extended period similar to Greene County, or maintain its "banked" status for periods of high demand. Table 2-4 provides a summary of projected water system demands for Farmville, the allowable pumping rate, the projected purchase from GUC, and the amount of water that will be banked for future use.

2.3.3 Town of Winterville

The Town of Winterville's current water usage is approximately 0.80 mgd. By 2026, it is expected to increase to a build-out capacity of 2.0 mgd for areas not served by Bell Arthur or Eastern Pines Water Corporation. A peaking factor of 1.80 was used to calculate a maximum day demand of 3.6 mgd by 2026.

The ABR approved for Winterville is 181 mgy, which translates to an average annual pumping rate of 0.496 mgd. Similar to Greene County and the Town of Farmville, Winterville intends to bank water in the same manner throughout Phases I and II of the CCPCUA rules. Winterville plans to pump approximately 0.185 mgd, thereby banking up to 449 MG of capacity prior to 2018. Winterville submitted a letter of intent to bank water to DWR on August 12, 2008, but has not expressed how the banked water will be utilized. Therefore, a water banking strategy similar to Greene County and the Town of Farmville was developed for this analysis. Table 2-5 provides a summary of projected water system demands for Winterville, the allowable pumping rate, the projected purchase from GUC, and an estimate of the amount of water that will be banked for future use.

2.3.4 Greenville Utilities Commission

Between 1990 and 2005, GUC's water demand increased 1.1 mgd according to historical water use data. Based on the GUC Water System Master Plan, the service area will expand to over 100,000 customers by 2020. The projected ADD in 2020 will be approximately 11.6 mgd. Peak-day demands were estimated to reach 17.4 mgd in 2020 and 18.5 mgd in 2030.

Table 2-3: Water Demand Projections and Summary of Greene County Water Operations

Year	Projected System Demand (mgd) [1]	Allowable Well Pumping Rate (mgd) [2]	Supplemental Water: Average Day Bulk Sales (mgd) [3]	Supplemental Water: Maximum Day Bulk Sales (mgd)	Supplemental Water: Estimated Minimum Purchase (mgd) [4]	Supplemental Water: Water to be Banked (mgd) [5, 6]
2008	2.31	2.22	1.20	1.82	0.74	1.11
2009	2.35	2.22	1.24	1.89	0.74	1.11
2010	2.39	2.22	1.28	1.96	0.74	1.11
2011	2.43	2.22	1.32	2.04	0.74	1.11
2012	2.47	2.22	1.36	2.11	0.74	1.11
2013	2.51	1.48	1.77	2.92	1.48	0.37
2014	2.56	1.48	1.82	2.99	1.48	0.37
2015	2.60	1.48	1.86	3.06	1.48	0.37
2016	2.64	1.48	1.90	3.13	1.48	0.37
2017	2.68	1.48	1.94	3.21	1.48	0.37
2018	2.72	0.74	2.35	4.02	2.22	0.37
2020	2.80	0.74	2.43	4.16	2.22	- 0.37
2025	3.01	0.74	2.64	4.53	2.22	- 0.37
2030	3.22	0.74	2.85	4.90	2.22	- 0.37
2035	3.43	0.74	3.06	5.26	2.22	- 0.37
2040	3.64	0.74	3.27	5.63	2.22	NA
2045	3.85	0.74	3.48	6.00	2.22	NA
2048	3.98	0.74	3.61	6.22	2.22	NA

[1] *Projected system demands provided by McDavid Associates, Inc.*
[2] *The allowable well pumping rate is based on an approved ABR of 1,079,800,000 gallons or 2,960,000 gpd.*
[3] *Average day bulk sales include water to be "banked."*
[4] *Estimated minimum purchase amounts are contractual limits and are equal to the amount of reduction required by CCPCUA rules from the ABR. In the event of curtailment, average daily volume may be adjusted.*
[5] *Distribution of banked water is proposed for 2018 – 2037.*
[6] *Negative banking denotes usage of banked water.*

Table 2-4: Water Demand Projections and Summary of Farmville Water Operations

Year	Projected System Demand (mgd) [1]	Allowable Well Pumping Rate (mgd) [2]	Supplemental Water [3] Average Day Bulk Sales (mgd) [4]	Supplemental Water [3] Maximum Day Bulk Sales (mgd)	Supplemental Water [3] Estimated Minimum Purchase (mgd) [6]	Water to be Banked (mgd) [5, 7]
2008	1.87	1.18	1.28	2.00	0.39	0.59
2009	1.89	1.18	1.30	2.04	0.39	0.59
2010	1.91	1.18	1.32	2.07	0.39	0.59
2011	1.93	1.18	1.34	2.10	0.39	0.59
2012	1.95	1.18	1.36	2.13	0.39	0.59
2013	1.97	0.78	1.38	2.57	0.79	0.20
2014	1.99	0.78	1.40	2.60	0.79	0.20
2015	2.01	0.78	1.42	2.63	0.79	0.20
2016	2.03	0.78	1.44	2.67	0.79	0.20
2017	2.05	0.78	1.46	2.70	0.79	0.20
2018	2.07	0.39	1.48	3.12	1.18	- 0.20
2020	2.11	0.39	1.52	3.19	1.18	- 0.20
2025	2.22	0.39	1.63	3.38	1.18	- 0.20
2030	2.33	0.39	1.74	3.57	1.18	- 0.20
2035	2.45	0.39	1.86	3.77	1.18	- 0.20
2040	2.58	0.39	1.99	3.98	1.18	NA
2045	2.71	0.39	2.12	4.21	1.18	NA
2048	2.79	0.39	2.20	4.35	1.18	NA

[1] *Projected system demands based on 2002 actual usage and a 1% annual growth rate.*
[2] *Pumped water volumes based on an ABR of 1,572,000 gpd.*
[3] *Supplemental water volumes rounded to nearest thousand gallons.*
[4] *Average day bulk sales include water to be "banked."*
[5] *Distribution of banked water is proposed for 2018 – 2037.*
[6] *Estimated Minimum Purchase amount is equal to required reduction in well pumping to meet CCPCUA rules.*
[7] *Negative banking denotes usage of banked water.*

Table 2-5: Water Demand Projections and Summary of Winterville's Water Operations

Year	Projected System Demand (mgd) [1]	Allowable Well Pumping Rate (mgd) [2]	Average Day Bulk Sales (mgd) [4]	Supplemental Water [3] Maximum Day Bulk Sales (mgd)	Estimated Minimum Purchase (mgd) [6]	Water to be Banked (mgd) [5, 7]
2008	0.85	0.37	0.66	1.16	0.12	0.185
2009	0.90	0.37	0.71	1.25	0.12	0.185
2010	0.95	0.37	0.76	1.34	0.12	0.185
2011	1.00	0.37	0.81	1.43	0.12	0.185
2012	1.05	0.37	0.86	1.52	0.12	0.185
2013	1.10	0.25	0.91	1.73	0.25	0.062
2014	1.15	0.25	0.96	1.82	0.25	0.062
2015	1.20	0.25	1.01	1.91	0.25	0.062
2016	1.25	0.25	1.06	2.00	0.25	0.062
2017	1.33	0.25	1.14	2.14	0.25	0.062
2018	1.40	0.12	1.21	2.40	0.37	- 0.062
2020	1.55	0.12	1.36	2.67	0.37	- 0.062
2025	1.93	0.12	1.74	3.34	0.37	- 0.062
2030	2.00	0.12	1.81	3.48	0.37	- 0.062
2035	2.00	0.12	1.81	3.48	0.37	- 0.062
2040	2.00	0.12	1.88	3.48	0.37	NA
2045	2.00	0.12	1.88	3.48	0.37	NA
2048	2.00	0.12	1.88	3.48	0.37	NA

[1] *Projected system demand was linearly interpolated by ARCADIS. The Town of Winterville provided projection values for 2016 and 2026.*
[2] *Pumped water volumes based on an ABR of 180,709,104 gallons.*
[3] *Supplemental water volumes rounded to nearest thousand gallons.*
[4] *Average day bulk sales include a percentage for banked water.*
[5] *Distribution of banked water is proposed for 2018 – 2037.*
[6] *Estimated Minimum Purchase amount is equal to required reduction in well pumping to meet CCPCUA rules.*
[7] *Negative banking denotes usage of banked water.*

2.4 Existing Facilities

2.4.1 Greenville Utilities Commission

The GUC water treatment plant (WTP) has a permitted capacity of 22.5 mgd. The WTP treats raw water withdrawn from the Tar River and pumped to a 63-million gallon pre-settling impoundment. The WTP utilizes conventional coagulation/sedimentation process, intermediate ozonation (for disinfection), and high-rate, dual-media filters. In 2002, the GUC converted from free chlorine to chloramines for disinfection. The WTP includes an alum residuals lagoon. The NPDES discharge permit (NC0082139) is unlimited in flow and discharges to the Tar River.

GUC also operates eight groundwater wells, which are all subject to CCPCUA regulations. GUC has used the wells on an emergency only basis since December 2002 when the disinfectant at the water treatment plant (WTP) was switched from free chlorine to chloramines. These wells were only operated for sixteen days during 2006, as reported by DWR CCPCUA permit data.

This emergency use policy was implemented in response to advice from the Washington Regional Office of the N.C. Division of Environmental Health Public Water Supply Section who were concerned that mixing surface and well water with different disinfectants would lead to water quality problems in the distribution system. GUC is currently involved in a capital project that will convert all the groundwater wells to add ammonia feed in addition to the existing chlorine disinfectant systems. When this project is completed in February 2009, GUC plans to request that the wells be allowed to operate on an as-needed basis. In the long-term, the wells will be operated primarily in conjunction with the Aquifer Storage and Recovery (ASR) wells to meet peak demands, or periodically during WTP maintenance shut downs or when WTP raw water quality is poor. Utilizing the wells on an intermittent basis in response to short-term situations will allow GUC to meet the annualized groundwater withdrawal reduction requirements of the CCPCUA regulations.

Wastewater for the GUC service area is treated at the GUC WWTP. This facility is permitted for a NPDES discharge of 17.5 mgd (NC0023931) to the Tar River. The average flow rate through the WWTP was 10.3 mgd for the period from June 2006 through June 2007.

2.4.2 Town of Farmville

The Town of Farmville operates eleven groundwater wells that withdraw water from the Cretaceous aquifer. All eleven wells are subject to the CCPCUA rules. Wastewater for the Town of Farmville is treated at the Farmville WWTP. This facility is permitted for a NPDES discharge of 3.5 mgd (NC0029572) to the Little Contentnea Creek in the Neuse River basin. The average flow rate through the WWTP was 1.96 mgd for the period from June 2006 through June 2007.

2.4.3 Town of Winterville

The Town of Winterville operates three groundwater wells that are all subject to CCPCUA rules. Wastewater for the Town of Winterville is treated by the Contentnea Metropolitan Sewer District in Grifton. This facility is permitted for an NPDES discharge of 2.85 mgd to Contentnea Creek (NC0032077) in the Neuse River basin. The average daily wastewater flow rate for the Town was reported to be approximately 0.58 mgd in the 2002 LWSP. The average flow rate through the WWTP was 1.87 mgd for the period from June 2006 through June 2007.

Winterville currently purchases finished water from GUC (under the grandfathered IBT amount).

2.4.4 Greene County

Within Greene County, the Town of Snow Hill has four groundwater wells that are used on a regular basis, and one for emergency use. Snow Hill operates its own WWTP, which is permitted for an NPDES discharge of 0.5 mgd to Contentnea Creek in the Neuse River basin (NC0020842). The Town provides utilities to the South Greene Water Corporation.

The Greene County Regional Water System operates ten groundwater wells. The Town of Walstonburg purchases water from the Greene County Regional Water System. Wastewater for the Town of Walstonburg is treated by the Farmville WWTP. The average daily wastewater flow rate for the Town is approximately 35,000 gpd.

The Town of Hookerton WWTP and the Maury Sanitary Land District WWTP operate 0.06 mgd and 0.225 mgd treatment facilities, respectively. Both of these facilities discharge to Contentnea Creek. A detailed evaluation of wastewater treatment in Greene County (Snow Hill WWTP, Hookerton WWTP, and the Maury Sanitary Land District WWTP) is provided in Section 4.4.

Septic systems comprise the majority of wastewater treatment in Greene County.

3. Interbasin Transfer Request

3.1 Explanation of Bulk Sales Agreements

In order to comply with CCPCUA rules for the Cretaceous aquifer and continue to meet customer demands, the Town of Farmville, Town of Winterville, and Greene County plan to purchase bulk finished water from GUC. GUC relies on the Tar River for its water supply, and the Town of Farmville and the majority of Greene County are located within the Neuse River Contentnea Creek subbasin. Farmville and Greene County discharge wastewater into the Contentnea Creek subbasin via centralized treatment or on-site septic systems. Therefore, sales of finished water to the Town of Farmville and Greene County will constitute an interbasin transfer from the Tar River subbasin to the Neuse River Contentnea Creek subbasin. The Town of Winterville water and wastewater systems and the southwestern portion of Greene County are located within the Neuse River subbasin. Therefore, sales of finished water to the Town of Winterville and Greene County will constitute an interbasin transfer from the Tar River subbasin to the Neuse River subbasin.

GUC has signed bulk sales agreements with Farmville, Greene County, and Winterville (wholesale customers). The bulk sales agreements stipulate an Estimated Minimum Purchase, which is equal to the required reduction in well pumping to meet CCPCUA rules. Table 3-1 provides a summary of maximum day demands for GUC, the Estimated Minimum Purchases from each wholesale customer, and the resulting maximum day water demand for all four systems. In 2030, the total maximum day water demand is projected to be 22.2 mgd, not to exceed the current WTP capacity of 22.5 mgd. Therefore, a plant capacity expansion for GUC is not requested as part of this project. The bulk sales contracts also stipulate that GUC may limit distribution to Winterville, Farmville, and Greene County when GUC experiences peak demands. GUC's wholesale customers will rely on well pumping to meet demands during peak periods, and GUC will provide sufficient water during the remainder of the year to allow its customers to meet CCPCUA rules.

Table 3-1: Maximum Day GUC Demands with Minimum Bulk Purchases

Year	GUC Demands (mgd) [1]	Estimated Minimum Purchase (mgd)			Total (mgd)
		Winterville	Greene County	Farmville	
2008	15.83	0.12	0.74	0.39	17.09
2013	16.71	0.25	1.48	0.79	19.22
2018	17.28	0.37	2.22	1.18	21.05
2020	17.51	0.37	2.22	1.18	21.27
2025	18.08	0.37	2.22	1.18	21.84
2030	18.65	0.37	2.22	1.18	22.41
2035	19.22	0.37	2.22	1.18	22.98
2040	19.79	0.37	2.22	1.18	23.55

[1] *Demands include minimum bulk sales to Stokes and Bethel.*

3.2 Interbasin Transfer Request

To support the Town of Farmville and Greene County's compliance with CCPCUA rules, GUC is requesting an IBT Certificate for the transfer from the Tar River subbasin to the Contentnea Creek subbasin. GUC is requesting an IBT Certificate for 8.3 mgd to meet Farmville and Greene County's maximum day demands through 2030. As part of the same Certificate, GUC requests the ability to transfer 9.3 mgd under emergency conditions to the Contentnea Creek subbasin.

GUC is also requesting an IBT Certificate for the transfer from the Tar River subbasin to the Neuse River subbasin to support the Town of Winterville's compliance with CCPCUA rules, and to support water use in the portion of the GUC service area within the Neuse River Basin. GUC is requesting an IBT Certificate for 4.0 mgd to meet Winterville's maximum day demands 2030. As part of the same Certificate, GUC requests the ability to transfer 4.2 mgd under emergency conditions to the Neuse River subbasin.

Detailed explanations of the IBT calculations are provided in Appendix A (IBT Management Strategy). Sections 3.3 and 3.4 provide a summary of these calculations.

3.3 Transfer from Tar River Basin to Neuse River Subbasin

IBT calculations for the transfer from the Tar River subbasin (Basin ID 15-1) to the Neuse River subbasin (Basin ID 10-1) are shown in the water balance Tables 3-2 and 3-3. Transfers to the Neuse River subbasin are a result of bulk sales to the Town of Winterville and the southwestern portion of Greene County as well as water use by GUC customers located in the Neuse River subbasin. IBT calculations are based on the following:

- Peak day demands for GUC are calculated based on a MDD:ADD peaking factor of 1.50, based on historical demand trends.
- Peak day demands for the Town of Winterville are calculated based on a MDD:ADD peaking factor of 1.80, based on historical demand trends.
- Peak day demands for Greene County are calculated based on a MDD:ADD peaking factor of 1.75, based on historical demand trends.
- Consumptive water use for GUC is 20 percent based on historical operating records.
- Consumptive water use for Winterville and Greene County is assumed to be 30 percent.
- Process water use at the GUC WTP is 8 percent of raw water withdrawal based on operating records.
- The service area for the Town of Winterville is entirely within the Neuse River subbasin.

- The portion of Greene County in the Neuse River subbasin is estimated at 5 percent.
- The portion of GUC's service area in the Neuse River subbasin is estimated at 8 percent based on current water distribution system maps and the number of service connections located in the Neuse River subbasin.
- All wastewater produced in the GUC service area is returned to the Tar River Basin, with the exception of a limited number of septic tanks in the Neuse River Basin.
- All wastewater produced in the Winterville service area is discharged into the Neuse River subbasin.
- All wastewater produced in Greene County is disposed of by on-site septic systems.

In Table 3-2, the maximum day bulk sales projected for the Town of Winterville and portion of Greene County are used to determine the maximum day IBT amounts. The maximum day bulk sale represents the total peak day demands for the Winterville and Greene County service area less the average annual allowable well pumping rate.

In Table 3-3, the emergency bulk sales projected for the Town of Winterville and portion of Greene County are used to determine the emergency condition for the IBT. The emergency condition represents the total peak day demand for the Winterville and Greene County service area. This strategy will allow GUC to provide water to Winterville and Greene County in the event a catastrophic event was to occur, e.g. aquifer contamination, drought, or major mechanical or electrical failure. GUC requests that the IBT certificate be written such that notification would be required to DWR to trigger the emergency request.

Table 3-2: Water Balance Table for Maximum Day Condition from the Tar River to the Neuse River Subbasin (Town of Winterville and Greene County)

Year	GUC Water Demand	Winterville Water Demand	Greene County Water Demand	Withdrawal from Tar River	Consumptive Use									Wastewater Discharge		WTP Dis-charge	Total Return to Tar River Basin	Inter-basin Transfer
					GUC			Winterville			Greene County							
					% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	Tar River Basin	Neuse River Basin	Tar River Basin		
2005	14.71	1.32	0.11	17.43	92	2.71	0.24	0	0.0	0.40	0	0.0	0.11	11.8	0.9	1.3	15.8	1.7
2010	16.22	1.34	0.10	19.07	92	2.98	0.26	0	0.0	0.40	0	0.0	0.10	13.0	0.9	1.4	17.4	1.7
2015	16.79	1.91	0.16	20.36	92	3.09	0.27	0	0.0	0.57	0	0.0	0.16	13.4	1.3	1.5	18.0	2.3
2020	17.36	2.67	0.21	21.85	92	3.19	0.28	0	0.0	0.80	0	0.0	0.21	13.9	1.9	1.6	18.7	3.2
2025	17.93	3.34	0.23	23.21	92	3.30	0.29	0	0.0	1.00	0	0.0	0.23	14.3	2.3	1.7	19.3	3.9
2030	18.50	3.48	0.25	24.00	92	3.40	0.30	0	0.0	1.04	0	0.0	0.25	14.8	2.4	1.8	20.0	4.0
2035	19.07	3.48	0.26	24.63	92	3.51	0.31	0	0.0	1.04	0	0.0	0.26	15.3	2.4	1.8	20.6	4.0
2040	19.64	3.48	0.28	25.27	92	3.61	0.31	0	0.0	1.04	0	0.0	0.28	15.7	2.4	1.8	21.2	4.1

Table 3-3: Water Balance Table for Emergency Condition from the Tar River to the Neuse River Subbasin (Town of Winterville and Greene County)

Year	GUC Water Demand	Winterville Water Demand	Greene County Water Demand	Withdrawal from Tar River	Consumptive Use									Wastewater Discharge		WTP Dis-charge	Total Return to Tar River Basin	Inter-basin Transfer
					GUC			Winterville			Greene County							
					% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	Tar River Basin	Neuse River Basin	Tar River Basin		
2005	14.71	1.32	0.11	17.43	92	2.71	0.24	0	0.0	0.40	0	0.0	0.11	11.8	0.9	1.3	15.8	1.7
2010	16.22	1.71	0.21	19.58	92	2.98	0.26	0	0.0	0.51	0	0.0	0.21	13.0	1.2	1.4	17.4	2.2
2015	16.79	2.16	0.23	20.71	92	3.09	0.27	0	0.0	0.65	0	0.0	0.23	13.4	1.5	1.5	18.1	2.7
2020	17.36	2.79	0.25	22.02	92	3.19	0.28	0	0.0	0.84	0	0.0	0.25	13.9	2.0	1.6	18.7	3.3
2025	17.93	3.47	0.26	23.39	92	3.30	0.29	0	0.0	1.04	0	0.0	0.26	14.3	2.4	1.7	19.4	4.0
2030	18.50	3.60	0.28	24.17	92	3.40	0.30	0	0.0	1.08	0	0.0	0.28	14.8	2.5	1.8	20.0	4.2
2035	19.07	3.60	0.30	24.80	92	3.51	0.31	0	0.0	1.08	0	0.0	0.30	15.3	2.5	1.8	20.6	4.2
2040	19.64	3.60	0.32	25.44	92	3.61	0.31	0	0.0	1.08	0	0.0	0.32	15.7	2.5	1.9	21.2	4.2

3.4 Transfer from Tar River Basin to Contentnea Creek Subbasin

IBT calculations for the transfer from the Tar River subbasin (Basin ID 15-1) to the Contentnea Creek subbasin (Basin ID 10-2) are shown in water balance Tables 3-4 and 3-5. Transfers to the Contentnea Creek subbasin are a result of bulk sales to the Town of Farmville and Greene County.

- Peak day demands for the Town of Farmville are calculated based on a MDD:ADD peaking factor of 1.70, based on historical demand trends.
- Peak day demands for Greene County are calculated based on a MDD:ADD peaking factor of 1.75, based on historical demand trends.
- Consumptive water use for Farmville and Greene County is assumed to be 30 percent.
- Process water use at the GUC WTP is 8 percent of raw water withdrawal based on operating records.
- The service area for the Town of Farmville is entirely within the Contentnea Creek subbasin.
- The portion of Greene County in the Contentnea Creek subbasin is estimated at 95 percent.
- No wastewater produced in the Town of Farmville and Greene County service areas is returned to the Tar River subbasin.

In Table 3-4, the maximum day IBT amount was determined using the maximum day bulk sales projected for Greene County and the Town of Farmville. The maximum day bulk sales represents the total peak day demands for Greene County and Farmville less the average annual allowable well pumping rate.

In Table 3-5, the emergency bulk sales projected for Greene County and Farmville are used to determine the emergency condition for the IBT. The emergency condition represents the total peak day demand. This strategy will allow GUC to provide water to Greene County and Farmville in the event a catastrophic event was to occur, e.g. aquifer contamination, drought, or major mechanical or electrical failure. GUC requests that the IBT certificate be written such that notification would be required to DWR to trigger the emergency request.

Table 3-4: Water Balance Table for Maximum Day Condition from the Tar River to the Contentnea Creek Subbasin (Greene County and Town of Farmville)

Year	Farmville Water Demand	Greene County Water Demand	Total Bulk Sales to Contentnea Basin	Withdrawal from Tar Basin (associated with bulk sales only)	Consumptive Use			Wastewater Discharge		WTP Discharge	Total Return to Tar River Basin	Interbasin Transfer
					% Tar River	Tar River Basin	Contentnea Creek Basin	Tar River Basin	Contentnea Creek Basin	Tar River Basin		
2005	1.66	2.08	3.74	4.04	0	0.0	1.1	0.0	2.6	0.3	0.3	3.7
2010	2.07	1.87	3.93	4.25	0	0.0	1.2	0.0	2.8	0.3	0.3	3.9
2015	2.63	2.91	5.54	5.99	0	0.0	1.7	0.0	3.9	0.4	0.4	5.5
2020	3.19	3.95	7.15	7.72	0	0.0	2.1	0.0	5.0	0.6	0.6	7.1
2025	3.38	4.30	7.68	8.29	0	0.0	2.3	0.0	5.4	0.6	0.6	7.7
2030	3.57	4.65	8.22	8.88	0	0.0	2.5	0.0	5.8	0.7	0.7	8.3
2035	3.77	5.00	8.77	9.47	0	0.0	2.6	0.0	6.1	0.7	0.7	8.8
2040	3.98	5.35	9.33	10.08	0	0.0	2.8	0.0	6.5	0.7	0.7	9.3

Table 3-5: Water Balance Table for Emergency Condition from the Tar River to the Contentnea Creek Subbasin (Greene County and Town of Farmville)

Year	Farmville Water Demand	Greene County Water Demand	Total Bulk Sales to Contentnea Basin	Withdrawal from Tar Basin (associated with bulk sales only)	Consumptive Use			Wastewater Discharge		WTP Dis-charge	Total Return to Tar River Basin	Interbasin Transfer
					% Tar River	Tar River Basin	Contentnea Creek Basin	Tar River Basin	Contentnea Creek Basin	Tar River Basin		
2005	1.66	3.64	5.30	5.73	0	0.0	1.6	0.0	3.7	0.4	0.4	5.3
2010	3.25	3.98	7.22	7.80	0	0.0	2.2	0.0	5.1	0.6	0.6	7.2
2015	3.41	4.32	7.73	8.35	0	0.0	2.3	0.0	5.4	0.6	0.6	7.7
2020	3.59	4.66	8.24	8.90	0	0.0	2.5	0.0	5.8	0.7	0.7	8.2
2025	3.77	5.01	8.78	9.48	0	0.0	2.6	0.0	6.1	0.7	0.7	8.8
2030	3.96	5.35	9.32	10.06	0	0.0	2.8	0.0	6.5	0.7	0.7	9.3
2035	4.17	5.70	9.87	10.66	0	0.0	3.0	0.0	6.9	0.8	0.8	9.9
2040	4.38	6.05	10.43	11.27	0	0.0	3.1	0.0	7.3	0.8	0.8	10.4

3.5 IBT Management Strategy

Greene County, the Town of Farmville, and the Town of Winterville have each entered into Water Purchase Agreements with GUC in response to the CCPCUA rules. Key provisions that are similar for each contract are as follows:

- Contract terms are valid for 40 years, beginning August 1, 2008.
- The minimum daily amount that GUC is committed to provide is equal to water supply reductions required by CCPCUA rules for each customer.
- Interruption or curtailment of water supply will occur no more than 10 percent of the time (36 days per year). GUC will provide at least a 24-hour notice prior to interruption or curtailment of water service.

GUC currently has system interconnections with the Town of Winterville. GUC has constructed a 24-inch transmission main to the end of its water system for the purposes of interconnecting to the Farmville and Greene County water systems. A Final Environmental Assessment for ten miles of finished water line and a booster pump station to support the IBT (2006, McDavid and Associates) has been approved with a FONSI for Greene County and Farmville.

The intent of the IBT Certificate to have an emergency condition as well as a maximum day demand condition is to allow flexibility for GUC to meet the needs of its wholesale customers during an emergency even if it occurs during a peak demand period. GUC also intends to help its wholesale customers meet peak demands if supply is available.

When GUC experiences peak demands, GUC may limit distribution to the wholesale customers as necessary. However, GUC will supply the wholesale customers with the Estimated Minimum Purchase. Wholesale customers will rely on well pumping to meet their customer's demands during those periods, and GUC will provide sufficient water during the remainder of the year to allow its customers to meet CCPCUA rules. In the event that GUC experiences a mechanical failure, pipeline break, an unusually high demand or other situation in its water system, the Water Purchase Agreements include a provision that allows GUC to curtail or interrupt service.

GUC and its wholesale customers will be required to balance requirements of two regulations: CCPCUA rules and requirements of the IBT Certificate. CCPCUA rules limit the amount of well pumping from the Cretaceous aquifer system over an annual period (i.e. total annual volume). The IBT Certificate will limit the transfer amount on a maximum day basis. The IBT management strategy was developed to meet the requirements of two sets of rules with different criteria.

4. Alternatives Analysis

4.1 No-Action Alternative

Under the no-action alternative, GUC would not sell finished water to the Town of Farmville, Town of Winterville, or Greene County. These communities would continue to rely on their existing groundwater systems to meet the needs of their service areas. The Town of Farmville, Town of Winterville, and Greene County are all required to comply with the CCPCUA rules. These communities must to reduce their annual water use from the Cretaceous aquifer 25 percent by 2008, 50 percent by 2013, and 75 percent by 2018.

Average day demands will exceed the allowable groundwater well pumping rate in 2008 for Farmville, Winterville, and Greene County. The ADD for the Town of Farmville is 1.87 mgd for 2008 and is projected to be 2.33 mgd in 2030. The ADD in 2008 is greater than the 2008 allowable pumping rate of 1.13 mgd. The ADD for the Town of Winterville is 0.85 mgd in 2008 and is projected to be 2.0 mgd in 2030. The 2008 ADD is greater than the 2008 allowable pumping rate, indicating that there will be a capacity deficit within the service area for the first 25 percent reduction. In Greene County, the 2008 ADD is 2.31 mgd and is projected to increase to 3.2 mgd in 2030. The allowable withdrawal will reduce to 2.14 mgd in 2008 and to 0.715 mgd by 2030. Thus, in 2008 the Greene County ADD will be greater than the allowable withdrawal for the first 25 percent reduction. Table 4-1 summarizes the allowable pumping rates and average day demands for Farmville, Winterville, and Greene County. Maximum day demand projections are not provided in Table 4-1 since the average day demands exceed the capacity of these groundwater systems.

Table 4-1: Comparison of Allowable Pumping Rates with Average Day Demands

	Farmville		Winterville		Greene County	
Year	Allowable pumping rate (mgd)	Average Day Demand (mgd)	Allowable pumping rate (mgd)	Average Day Demand (mgd)	Allowable pumping rate (mgd)	Average Day Demand (mgd)
2008	1.13	1.87	0.37	0.85	2.14	2.31
2015	0.76	2.01	0.25	1.2	1.43	2.60
2020	0.38	2.11	0.12	1.55	0.71	2.80
2030	0.38	2.33	0.12	2.00	0.71	3.22

The no-action alternative is not a viable option for Farmville, Winterville, or Greene County. The average day water demands will exceed the allowable withdrawal rates set by the CCPCUA rules for all three service areas in 2008. Without provisions for an additional water supply, the Town of Farmville, Town of Winterville, and Greene County will not be able to meet the needs of their existing service areas. Additionally, these communities will be unable to compensate for the reduced groundwater withdrawals for predicted growth to 2030.

4.2 Independent Water Supply

As an alternative to purchasing finished water from another utility, the Town of Farmville, the Town of Winterville, and Greene County could pursue the construction of an independent water supply and water treatment facility. A groundwater source from a different aquifer or surface water source are the two independent water supply alternatives. A 13.5 mgd water treatment facility would be required to meet the maximum day demand until 2030 (3.96 mgd for Farmville, 5.64 mgd for Greene County, and 3.6 mgd for Winterville).

Alternate aquifers to the Cretaceous aquifer are the principal aquifers Castle Hayne, Pee Dee, and Yorktown. The Castle Hayne aquifer is one of the most productive aquifers in North Carolina. The well yield from the Castle Hayne ranges from 200 to 500 gallons per minute (gpm). The Castle Hayne is a relatively shallow aquifer and would require a water treatment plant, most likely nanofiltration, to treat to drinking water standards. The Pee Dee aquifer is less shallow than the Castle Hayne, and well yields are typically around 200 gpm. A nanofiltration plant would also be required to treat to drinking water standards. The Yorktown aquifer is the most surficial aquifer of the three and has typical well yields of 90 gpm. A WTP and new well field were estimated to cost approximately $70 million. However, capacity use rules are already in place for the Cretaceous aquifer, and DENR is currently investigating the possibility of capacity use regulations for other aquifers. Thus, a new groundwater source may not be a viable long-term water supply alternative.

The Tar River is a surface water supply source being used by Rocky Mount, Tarboro, and GUC. However, a Tar River water supply source for Greene County, Farmville and Winterville will require an interbasin transfer and possibly an instream flow study for a new withdrawal. The second potential water supply source in Greene County is Contentnea Creek. The 7Q10 at Contentnea Creek at U.S. 258 at Snow Hill (USGS gaging station 02091241) is 11 cubic feet per second (cfs). It is most likely that this water supply source would only be able to supply these communities with a maximum day demand until 2015. The construction of major water supply infrastructure to serve less than a ten-year period is not economical and does not adhere to sound engineering or management practices. A new reservoir on Contentnea Creek would increase the feasibility of this water supply alternative to meet maximum day demands until 2030 instead of 2015. However, the challenges associated with permitting, design, and construction of a new reservoir will significantly impact the near-term need for water due to the CCPCUA rules. In addition, the construction of the infrastructure to support a new water supply reservoir and WTP was estimated to cost over $100 million.

An independent water supply alternative has been removed from consideration for several reasons. The construction of infrastructure to support a surface water supply will be cost prohibitive to these small communities. Furthermore, the first reduction in the current groundwater withdrawal will occur in 2008, leaving these communities in a water supply deficit in 2008 for the current average day demand.

4.3 Participate in Neuse Regional Water and Sewer Authority

The Town of Farmville, Town of Winterville, and Greene County have all considered membership in the Neuse Regional Water and Sewer Authority (NRWASA). The NRWASA was formed in 2000 in order to develop regional solutions for water and wastewater. Current members include the Town of Ayden, Bell Arthur Water Corporation, Deep Run Water Corporation, Eastern Pines Water Corporation, Town of Grifton, City of Kinston, North Lenoir Water Corporation, and the Town of Pink Hill.

A regional water supply study was commissioned in 2000. The study recommended that a new 15 mgd WTP with a withdrawal from the Neuse River be constructed by the NRWASA. The project is currently under construction with a planned completion date in late 2008. The plant will be located in Lenoir County west of the City of Kinston. Bids were taken for the construction of the WTP and water transmission mains. The current construction cost is over $115 million.

Raw water will be withdrawn from the Neuse River for the proposed NRWASA WTP. Therefore, an IBT Certificate would be required for the Town of Farmville and Greene County in the Contentnea Creek subbasin. This water supply alternative will not eliminate the need for an interbasin transfer. Additionally, the high cost of this capital improvements project was also cost prohibitive to these small communities. Therefore, this alternative was removed from consideration in the analysis.

4.4 Return of Water to Source Basin

Wastewater service in the area is not as widespread as water service. In Greene County, wastewater is treated at the Snow Hill WWTP, the Hookerton WWTP, and the Maury Sanitary Land District WWTP. In Pitt County, wastewater is treated at the Farmville WWTP, the Contentnea Creek WWTP, and the GUC WWTP. Wastewater from the Town of Winterville is currently treated at the Contentnea Creek WWTP. County residents within the unincorporated areas rely primarily on septic systems.

Table 4-2 provides a summary of the Greene and Pitt County WWTPs. A 2030 flow was projected for each community based on a linear extrapolation of discharge monitoring report (DMR) data from January 2002 until June 2007 or community population projections. The total wastewater plant capacity in Greene County is 0.785 mgd, of which 47 percent of this capacity is currently used. The total wastewater capacity in Pitt County is 6.35 mgd (not including GUC), of which 60 percent is currently used.

Table 4-2: Summary of Wastewater Treatment Facilities in Greene and Pitt Counties

	Snow Hill WWTP	Hookerton WWTP	Maury Sanitary Land District WWTP	Farmville WWTP	Contentnea Creek WWTP
Permit No.	NC0020842	NC0025712	NC0061492	NC0029572	NC0032077
Receiving Stream	Contentnea Creek	Contentnea Creek	Contentnea Creek	Little Contentnea Creek	Unnamed Tributary to Contentnea Creek
River Basin	Neuse	Neuse	Neuse	Neuse	Neuse
County	Greene	Greene	Greene	Pitt	Pitt
Permitted Flow	0.5 mgd	0.06 mgd	0.225 mgd	3.5 mgd	2.85 mgd
12-month Average Flow	0.195 mgd	0.027 mgd	0.144 mgd	1.96 mgd	1.87 mgd
Plant Capacity in Use	39%	45%	64%	56%	65%
Projected 2030 Flow	0.45 mgd [1]	0.10 mgd [1]	0.14 mgd [2]	~ 2.5 mgd [2]	< 4 mgd [1]
Comments		Currently under an SOC for effluent BOD, TSS, and fecal coliform			Currently under an SOC for BOD and fecal coliform

[1] *Flow projections based on growth rate per Traffic Analysis Zone (TAZ) data.*
[2] *Flow projections based on linear extrapolation of DMR data.*

Most of Greene County's population is on septic systems. Centralized wastewater treatment in Greene County is not present except for a few small wastewater treatment plants. A countywide sewer system would be required to send wastewater from Greene County back to the Tar River basin. If it is assumed that wastewater demand is 70 percent of the total water demand (less consumptive use), the current wastewater demand in Greene County is approximately 0.87 mgd. The closest existing WWTP that could treat this volume of wastewater is the GUC WWTP, which is located well over 20 miles from Snow Hill, a central location within the County. However, a centralized collection system would be required prior to pumping to the GUC facility. The second option is the construction of a new WWTP and collection system that would serve the entire county. However, effluent from a new wastewater treatment facility would also need to be pumped over 20 miles back to the Tar River basin. The construction of a countywide collection and/or treatment system, over $150 million, will be cost prohibitive to these small communities.

The Town of Farmville has a 3.5 mgd WWTP discharging to Little Contentnea Creek in the Contentnea Creek subbasin. The plant is operating between 50 and 60 percent of total capacity, and is not expected to require an expansion for the next 15 years. In order to transfer effluent back to the Tar River basin, the discharge would need to be moved approximately 8 miles to the Tar River. This infrastructure project has been estimated to cost $20 million. This alternative will also be cost prohibitive for the Town of Farmville.

Wastewater from the Town of Winterville is currently treated at the Contentnea Creek WWTP. The Contentnea Creek WWTP discharges to an unnamed tributary to Contentnea Creek in the Neuse River basin. The Town of Winterville has had discussions with GUC concerning future wastewater service, but there are currently no immediate plans to proceed with this option due to the high capital costs.

4.5 Purchase Water from GUC – Selected Alternative

The selected alternative consists of the Town of Farmville, Town of Winterville, and Greene County purchasing finished water from GUC. GUC primarily serves the City of Greenville in the Tar River basin with the Tar River as the water supply source. The Town of Farmville and Greene County are located within the Contentnea Creek subbasin. Sale of finished water from GUC to the Town of Farmville and Greene County will constitute an IBT from the Tar River subbasin to the Contentnea Creek subbasin. The Town of Winterville is located within the Neuse River subbasin. Sale of finished water from GUC to the Town of Winterville will constitute an IBT from the Tar River subbasin to the Neuse River subbasin.

Purchasing water from GUC will allow the Town of Farmville, Town of Winterville, and Greene County to meet the water demands of their service areas while still complying with CCPCUA rules. By the year 2008, the average day demand for Farmville, Winterville, and Greene County will exceed the allowable groundwater well pumping rates (refer to Table 4-1). The year 2008 is the first 25 percent reduction in the ABR for each community.

The GUC WTP has sufficient plant capacity to provide water to the City of Greenville, Farmville, Winterville, and Greene County until 2030. In 2030, the total maximum day water demand with minimum bulk purchase is projected to be 22.2 mgd and will not exceed the current WTP capacity of 22.5 mgd (refer to Table 3-1). The signed bulk sales agreements with each community stipulate that GUC may limit distribution to Winterville, Farmville, and Greene County when GUC experiences peak demands. Farmville, Winterville, and Greene County will then rely on their groundwater systems and any banked water to meet peak demand for short periods. (For the discussion of banked water, refer to Section 2.3 – Water Demand Projections).

The GUC water distribution system is also the closest in proximity to these communities. According to the Administrative Code, GUC is allowed to transfer up to 2 mgd without an IBT certificate. The proposed construction for the interconnection between GUC and the Town of Farmville and Greene County will occur in three phases. Phase 1A is 10 miles of waterline from the Frog Level area to Lang's Crossroads in Pitt County. Phase 1A also includes two new elevated storage tanks and two booster pump stations. This

project has been recently bid for $17,195,417.00. Phase 1B of the project is the Town of Farmville's water distribution system tie in at Lang's Crossroads. This project has not yet been bid; however, the engineer's estimate for this phase is $4.9 million. Phase 1C of the project is Greene County's water distribution system tie in at Lang's Crossroads. Approximately 12 miles of 16-inch pipe will tie in the Phase 1A project at Lang's Crossroad to Greene County's water distribution system in Murray via an existing elevated water storage tank. This project has not been bid; however, the engineer's estimate for this phase is $8.6 million. The total cost of the proposed IBT project is $30.7 million. The construction cost for this alternative is at least one-quarter or less than the infrastructure cost for the other water supply alternatives.

The selected alternative is the most cost effective and environmentally sound alternative to providing water to Farmville, Winterville, and Greene County. These three communities have been restricted on the use of their current groundwater source due to the CCPCUA rules. Other than the no-action alternative, any other water supply alternative will require the construction of a new water treatment plant and possibly a reservoir to meet the long-term water supply needs of these communities. Existing water treatment capacity will be used to serve these communities, thereby limiting the environmental impact of construction and the economic impact of funding a large-scale infrastructure project.

5. Existing Environment

The proposed project encompasses the service areas for GUC, the Town of Farmville, the Town of Winterville, and Greene County. Farmville, Winterville, and Greenville are located in Pitt County. Pitt and Greene Counties are located in the central eastern portion of North Carolina. The GUC service area is located within the central and northern portions of Pitt County. The Town of Farmville and the Town of Winterville are located west and south of the City of Greenville, respectively. Information on the existing environment within the service area is described in the following sections.

5.1 Topography, Geology, and Soils

5.1.1 Topography and Floodplains

Greene and Pitt Counties are situated in the Coastal Plain Physiographic Province in the eastern portion of the state. The geography of the region is the typical flat and rolling terrain of the central portion of the Coastal Plain Province.

Pitt County is depicted on the Elm City, Conetoe, Pamlico Point, Robersonville East, Falkland, Greenville Northwest, Greenville Northeast, Leggetts Crossroads, Walstonburg, Farmville, Greenville Southwest, Greenville Southeast, Grimesland, Washington, Hookerton, Ayden, Garderville, Wilmar, Grifton, Fort Barnwell, and Vanceboro, North Carolina U.S. Geological Survey (USGS) topographic quadrangle maps. Elevations within Pitt County range from approximately six foot above mean sea level (MSL) in the southeastern and central eastern portions of the county to approximately 112 feet above MSL in the northwestern portion of the county.

Greene County is depicted on the Fountain, Stantonsburg, Walstonburg, Farmville, Jason, Snow Hill, Hookerton, Ayden, La Grange, Maysville, and Kinston, North Carolina USGS topographic quadrangle maps. Elevations within Greene County range from approximately six feet above MSL in the eastern portion of the county to approximately 120 feet above MSL in the western portion of the county. Elevations within the service area range from approximately six to 100 feet above MSL.

The North Carolina Floodplain Mapping Information System was used to view the flood hazard areas within Pitt and Greene Counties. Portions of both Pitt and Greene Counties, including portions of the service area, are located within the 100-year floodplain. These areas are mainly associated with streams.

5.1.2 Geology and Soils

The geology underlying the project region consists of formations from the Tertiary and Cretaceous periods. These formations include the Yorktown Formation and Duplin Formation, undivided, from the Tertiary period and the Pee Dee Formation, Cape Fear Formation, and Black Creek Formation from the Cretaceous period. The project region is underlain by thick layers of consolidated and unconsolidated sedimentary

formations that consist of alluvial sediments brought down from the Piedmont and marine sediments deposited when ocean and estuarine waters covered the region. Materials in these formations include sand, gravel, clay, and limestone.

The process of soil development depends upon both biotic and abiotic influences. These influences include past geologic activities, nature of parent material, environmental and human influences, plant and animal activity, time, climate, and topographic position. A soil association is defined as a landscape that has a distinctive proportional pattern of soils consisting of one or more major soils and at least one minor soil. The soils within an association may vary in slope, depth, stoniness, drainage, and other characteristics. The soil associations found within the service area are described based on information obtained from the U.S. Department of Agriculture (USDA) (1977 and 1980). Thirteen soil associations are located within the service area (USDA 1977 and USDA 1980).

Seven soil associates are present within Pitt County. These are the Nolfolk-Exum-Goldsboro, Roanoke-Lakeland-Altavista, Lynchburg-Rains-Goldsboro, Lenoir-Bladen-Craven, Coxville-Exum, Bibb-Portsmouth, and Bladen-Byars associations. Soils of the Norfolk-Exum-Goldsboro association occur in broad divides and on smooth side slopes in upland areas and are moderately well drained and well-drained soils with a subsoil of dominantly friable sandy clay loam. Soils of the Roanoke-Lakeland-Altavista association occur in broad flats, in slight depressions, and on rounded divides on stream terraces and uplands and are poorly drained to excessively drained soils that have a subsoil of dominantly friable sandy clay loam or very firm clay, or that are underlain by loose sand. Soils of the Lynchburg-Rains-Goldsboro association occur on broad, smooth flats and divides and in slight depressions in uplands and are moderately well drained to poorly drained soils with a subsoil of dominantly friable sandy clay loam. Soils of the Lenoir-Bladen-Craven association occur on broad flats, on smooth divides, and in slight depression in uplands and are moderately well drained to poorly drained with a subsoil of very firm sandy clay to clay. Soils of the Coxville-Exum association occur on broad flats and divides, on smooth side slopes, and in slight depressions in uplands and are poorly drained and moderately well drained soils with a subsoil of dominantly firm sandy clay or friable clay loam. Soils of the Bibb-Portsmouth association occur on broad, smooth flats and in draws and depressions on floodplains and stream terraces and are poorly drained and very poorly drained soils underlain by very friable fine sandy loam or friable sandy loam and sandy clay loam. Soils of the Bladen-Byars association occur on smooth flats and in slight depression on uplands and are poorly drained and very poorly drained soils with a subsoil of firm and very firm sandy clay to clay.

Six soil associations are present within Greene County. These are the Norfolk-Goldsboro, Wagram-Stallings-Autryville, Rains-Lynchburg, Bibb-Johnston-Kinston, Johns-Kenansville-Lumbee, and Aycock-Exum associations. Soils of the Norfolk-Goldsboro association occur in nearly level to gently sloping upland areas and are well drained and are moderately well drained soils that contain a loamy subsoil. Soils of the Wagram-Stallings-Autryville association occur in nearly level and gently sloping upland areas and are well drained and somewhat poorly drained soils with a loamy subsoil. Soils of the Rains-Lynchburg association occur in nearly level upland areas and are poorly drained and somewhat poorly drained soils with a loamy subsoil. Soils of the Bibb-Johnston-Kinston association occur in nearly level floodplains and are poorly

drained and very poorly drained loamy soils. Soils of the Johns-Kenansville-Lumbee association occur in nearly level and gently sloping areas associated with stream terraces and are well drained to poorly drained soils with a loamy subsoil. The Aycock-Exum association occurs in nearly level and gently sloping upland areas and are well drained and moderately well drained soils with a loamy subsoil.

5.2 Existing Land Use

Land use within the service area consists of single and multi-family residential, commercial, and undeveloped open space of varying uses including farmland, pastureland, and forested areas.

Land use within the northern portion of the Pitt County service area consists of low-density single and multi-family residential, commercial/industrial, and undeveloped open space. This area has seen considerable growth in the past decade (Northwest Planning Area Land Use Plan for Pitt County, North Carolina, The Wooten Company, 2001). However, the residential, industrial, and commercial development only comprises a small fraction of this northern portion. A majority of the land use within this area consists of wooded, undeveloped land including land used for forestry purposes, and agricultural land. Public water and soils suitable for septic systems makes the northern portion of the service area attractive for low to medium-density residential growth. (DWQ prefers regional wastewater treatment systems in lieu of individual package plants). Residential growth in the northern portion of the service area mainly consists of manufactured housing in subdivisions and parks. Some industrial and commercial land use is also present.

Land use within the City of Greenville and its incorporated areas consist mainly of residential, commercial, and industrial development with some undeveloped areas present. East Carolina University is also located within the City of Greenville. The City of Greenville also has several parks and open spaces. A majority of the areas abutting the City of Greenville and the incorporated areas within the southern portion of the service area consist of wooded, undeveloped land, land used for forestry purposes, and land used for agricultural purposes.

Land use in Greene County is approximately 50 percent cultivated farmland and 50 percent wooded area. The largest jurisdiction in Greene County is Snow Hill, which is located in the south central area of the County along Contentnea Creek.

5.2.1 Forest Resources

Natural forested communities are scattered throughout the undeveloped and developed portions of the service area. The forested areas include mixed upland hardwoods, bottomland forest/hardwood swamps, needleleaf deciduous, southern yellow pine, and oak/gum/cypress forests. Approximately 32 percent of the service area consists of undeveloped, wooded land.

5.2.2 Prime and Unique Farmlands

Within North Carolina, three categories of important farmlands are recognized. These consist of prime farmland, unique farmland, and farmland of statewide importance. Approximately 38 percent of the service area consists of cultivated land. Within the service area, fifteen mapped soils are listed by the U.S. Natural Resource Conservation Service (NRCS) as prime farmland and six of the mapped soils are listed as prime farmland if drained. One of the soils mapped within the service area is listed by the NRCS as prime farmland if drained and either protected from flooding or not frequently flooded during the growing season. Six of the soils mapped within the service area are listed by the NRCS as farmland of statewide importance. None of the soils mapped within the service area are listed by the NRCS as unique farmland soils. Developed land no longer qualifies as prime or unique farmland, regardless of soil type.

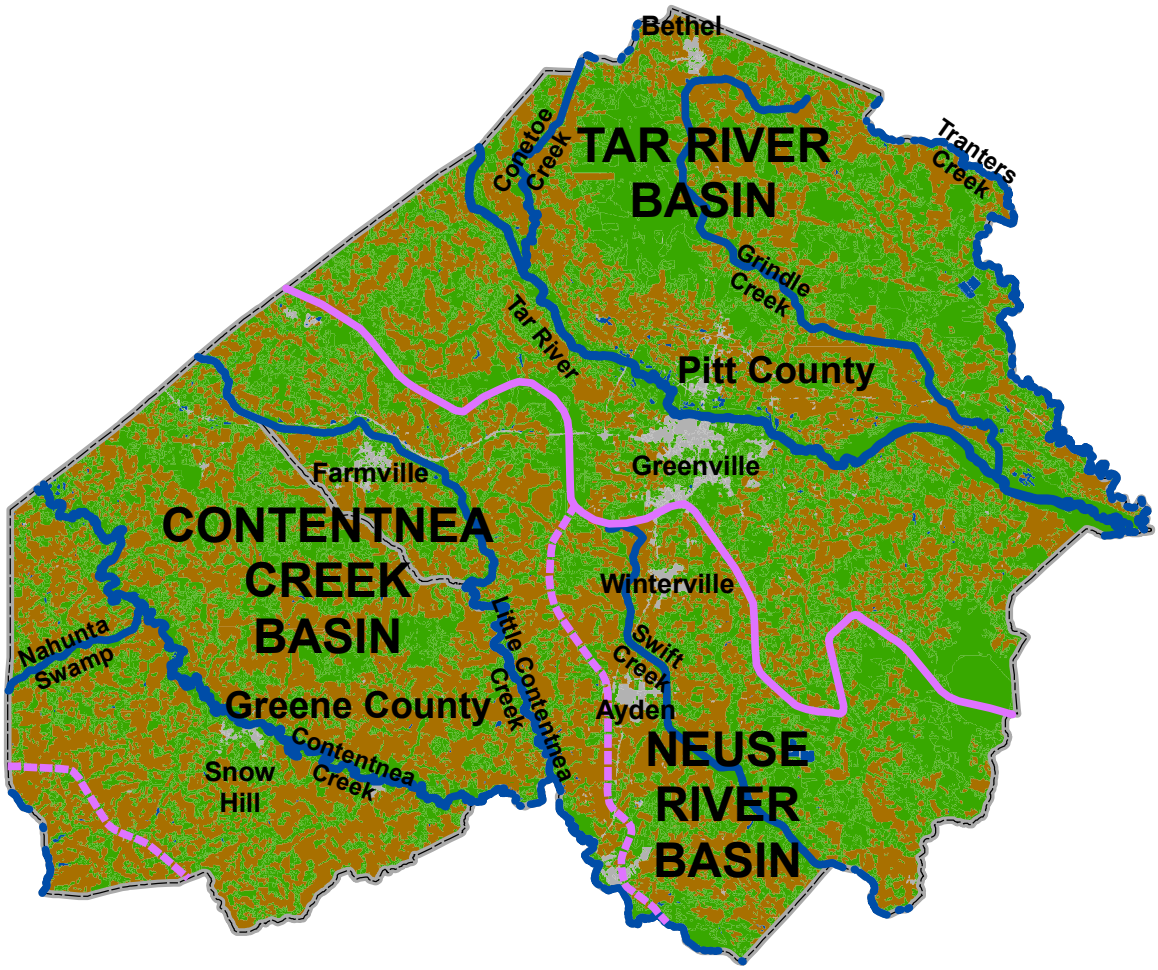
5.2.3 Public, Scenic, and Recreational Areas

No state or federal parks are located within the service area, although two areas that are owned by the federal government are located within Pitt County. The North Carolina Wildlife Resources Commission (WRC) does not list any game lands within the service area.

Nine public municipal and county parks are located within the service area. Eight of the public municipal parks are located within Pitt County and one is located within Greene County.

5.2.4 Archaeological and Historical Resources

Archaeological and historical resources are located within the service area. However, due to the size of the service area, detailed information relative to the archaeological and historical resources in Pitt and Greene Counties are not discussed in this EA as no construction is required for this project.



N

Legend

- Interbasin Boundary
- Sub-basin Boundary
- Major Rivers
- County Boundary

Land Use

- Developed
- Wooded/Undeveloped
- Cultivated
- Water Bodies/Streams

ARCADIS G&M

FIGURE 5-1: EXISTING LAND USE IN THE SERVICE AREAS

GREENVILLE UTILITIES COMMISSION
PITT COUNTY, NORTH CAROLINA

0 3.5 7 14 Miles 1 inch equals 7 miles

5.3 Water Resources

5.3.1 Drainage Basins and Surface Water Supplies

The service areas are located within the Tar-Pamlico and Neuse River basins. The northern and northeastern portions of Pitt County are located within the Tar-Pamlico basin. The southern and western portions of Pitt County and all of Greene County are located within the Neuse River basin.

The Tar-Pamlico basin service area is located in USGS Hydrological Unit 03020103 and three North Carolina Division of Water Quality (DWQ) subbasins (03-03-03, 03-03-05, and 03-03-06). The central and northern portions of Pitt County, located in the Tar-Pamlico basin, are within USGS Hydrological Unit 03020103 and DWQ subbasins 03-03-03 and 03-03-05.

The southern and western portion of Pitt County and all of Greene County is located in the Neuse River basin. The southern portion of Pitt County and the westernmost portion of Greene County are located in USGS Hydrological Unit 03020202 and DWQ subbasins 03-04-05, 03-04-08, and 03-04-09. The western portion of Pitt County and all but the westernmost portion of Greene County are located within USGS Hydrological Unit 03020203 and DWQ subbasins 03-04-07.

GUC's surface water intake is located on the Tar River in the northern portion of Greenville in the central portion of Pitt County. The area designated as a water supply watershed (in association with the surface water intake) is located north of the intake and encompasses a portion of the northern portion of Pitt County and the northern portion of the service area.

5.3.2 Surface Water Use Classifications

The DWQ classifies surface waters of the state based on their existing or proposed uses. The primary classification system distinguishes the following three basic usage categories: waters used for public water supply and food processing (Classes WS-I through WS-V), water supply (WS) waters used for frequent swimming or bathing (Class B), and waters used for neither of these purposes (Class C). Class C waters are protected for fishing, boating, aquatic life, and other uses.

The Tar River traverses Pitt County and the service area from northwest to southeast. The northern portion of Pitt County is designated as a water supply watershed due to GUC's water supply intake. The Tar River north of Greenville is designated as Class WS-IV NSW. The Nutrient Sensitive Waters (NSW) classification is a supplemental classification that has been assigned to waters that need additional nutrient management due to these waters being subject to excessive growth of microscopic or macroscopic vegetation. From the water supply intake to a point 1.2 miles downstream of the confluence with Broad Run, the Tar River is designated as Class C NSW. From a point 1.2 miles downstream of the confluence with Broad Run to Tranters Creek, which forms the eastern boundary of Pitt County, the Tar River is designated as Class B

NSW. Within Pitt County, Tranters Creek and its tributaries are designated by DWQ as Class C Sw NSW. The Sw classification denotes Swamp Waters.

Within Pitt County downstream of the raw water intake site, tributaries to the Tar River are designated by DWQ as Class C NSW. Tributaries to the Tar River upstream of the raw water intake site within the water supply watershed area are designated by DWQ as Class WS-IV NSW. A portion of the Tar River that extends from the raw water intake site upstream for 0.5 miles is designated by DWQ as Class WS-IV NSW CA. The classification CA denotes Critical Areas, which are areas that extend one half mile upstream from normal pool elevation of reservoirs or water intakes.

Within the portions of Pitt County located within the Neuse River basin, streams are designated by DWQ as Class C Sw NSW. The southern and northern portion of the boundary between Pitt and Greene Counties is formed by Little Contentnea Creek. Middle Swamp forms the boundary between Pitt and Greene Counties in the central portion of the county boundary. Contentnea Creek traverses the central portion of Greene County. Streams within Greene County are designated by DWQ as Class C Sw NSW.

Streams within the water supply watershed area are classified as WS-IV NSW. The streams within the service area that are located within the Tar-Pamlico basin are designated by DWQ as Class C NSW. Streams within the service area that are located within the Neuse basin are classified as Class C Sw NSW. No streams designated as Outstanding Resource Waters (ORW) Waters or High Quality Waters (HQW) are present within the service area.

5.3.3 Existing Surface Water Quality

The DWQ monitors water quality using physical, chemical, and biological sampling and rates each stream segment or lake with respect to its designated usage classification as follows: supporting, support threatened, partially supporting, or not supporting (DENR 2008 and DENR 2004). Biological monitoring, including benthic macroinvertebrate (benthos) and fish samples, is particularly useful in tracking water quality trends because these organisms reflect long-term interactions among many water quality and habitat parameters, including factors not detected by infrequent physical and chemical sampling.

DWQ monitoring sites for benthic macroinvertebrates and fish communities are located throughout the service area. Table 5-1 provides bioclassifications and use support ratings for streams within the service area per the 2004 Tar-Pamlico River Basinwide Water Quality Plan and the 2008 Draft Neuse River Basinwide Water Quality Plan.

Water quality issues associated with the subbasins within the service area are reported by DWQ to include non-point source discharges, elevated levels of mercury, channelization, agriculture, and concentrated animal feeding operations. According to the North Carolina 303(d) Draft Impaired Waters List dated January 10, 2008, several streams within the Neuse River basin and the Tar-Pamlico River basin in Pitt and Greene Counties are listed as impaired. These streams are as follows:

- Conetoe Creek – from Crisp Creek to Pitt County SR 1404
- Tar River – from Greenville raw water supply intake to a point 1.2 miles downstream of the mouth of Broad Run
- Chicod Creek – from source to Tar River
- Creeping Swamp – from source to Clayroot Swamp
- Contentnea Creek – from 0.7 mile upstream of Toisnot Swamp to Nahunta Swamp
- Little Contentnea Creek – from source to Contentnea Creek
- Swift Creek – from source to Clayroot Swamp
- Clayroot Swamp – from source to SR 1925
- Hominy Swamp – from source to Contentnea Creek

Point-source dischargers located throughout North Carolina are regulated through the NPDES program and are required to register for a permit. Three facilities are listed as major NPDES dischargers and three facilities are listed as minor NPDES dischargers in Pitt County. In Greene County, three facilities are listed as minor dischargers.

Table 5-1: Bioclassification and Use Support Ratings for Streams within the Service Area

Waterbody	Data Type	DWQ Subbasin	Bioclassification	Use Support Rating
Conetoe Creek	Special Benthic Community Study	03-03-03	Poor	Impaired
Grindle Creek	Benthic Community Survey	03-03-05	Good-Fair	Supporting
	Fish Community Survey	03-03-05	Not Rated	
Hardee Creek	Benthic Community Survey	03-03-05	Natural	Supporting
	Fish Community Survey	03-03-05	Not Rated	
Tar River	Benthic Community Survey	03-03-05	Not Rated	Not Rated
Chicod Creek	Benthic Community Survey	03-03-05	Severe Stress	Impaired
	Fish Community Survey	03-03-05	Not Rated	
Flat Swamp	Benthic Community Survey	03-03-06	Moderate Stress	Supporting
Tranters Creek	Benthic Community Survey	03-03-06	Moderate Stress	Supporting
Contentnea Creek (from 0.7 mile upstream of Toisnot Swamp to Nahunta Swamp)	Benthic Community Survey	03-04-07	Fair	Impaired

Table 5-1: Bioclassification and Use Support Ratings for Streams within the Service Area

Waterbody	Data Type	DWQ Subbasin	Bioclassification	Use Support Rating
Contentnea Creek (from Nahunta Swamp to Neuse River)	Benthic Community Survey	03-04-07	Not Rated	---
Nahunta Swamp	Benthic Community Study	03-04-07	Good-Fair	Supporting
Little Contentnea Creek	Benthic Community Survey	03-04-07	Fair	Impaired
Clayroot Swamp (from source to SR 1925)	Benthic Community Survey	03-04-09	Fair	Impaired
Clayroot Swamp (from SR 1925 to Swift Creek)	Benthic Community Survey	03-04-09	Good-Fair	Supporting
Creeping Swamp	Benthic Community Survey	03-04-09	Moderate	Supporting

5.3.4 Groundwater Supplies

The service area is located within the Coastal Plain physiographic province in the central eastern portion of North Carolina. The aquifers underlying the area consist of a post-Miocene age surficial aquifer and a series of Cretaceous-aged aquifers that include the Lower Cape Fear, the Upper Cape Fear, the Black Creek, and the Pee Dee aquifers, collectively referred to as the Cretaceous Aquifer System (CAS). The surficial aquifer is the shallowest aquifer and is widely used for individual residential wells throughout the state.

The aforementioned aquifers are used by numerous municipalities, private water supply sources, and individual businesses and residences for drinking water. According to a Pitt County Comprehensive Water Resources Management Plan prepared by Groundwater Management Associates, Inc. (GMA), the primary source of water supply for ten public water systems in Pitt County is groundwater. GMA concluded that 98 percent of the groundwater withdrawal in Pitt County for public water supply systems is from the Black Creek and Upper Cape Fear aquifers.

A hydrologic study was performed by GMA utilizing the data from more than 100 wells located within Pitt County. The safe yield of each aquifer was compared to current withdrawals from the aquifers. It was determined that over-development of the Black Creek and Upper Cape Fear aquifers has occurred. GMA also reported that water quality problems associated with elevated levels of fluoride and chloride are present within the Black Creek and Upper Cape Fear aquifers in the eastern portion of the county. Additionally, GMA reports that the Lower Cape Fear aquifer below Pitt County contains elevated salt concentrations that must be treated prior to public consumption. Based on GMA's study, future development of the Pee Dee and Castle Hayne aquifers within Pitt County was found to a viable option.

However, GMA determined that groundwater resources within Pitt County are limited and that they will not meet the County's future water supply needs.

On August 1, 2002, the North Carolina Environmental Management Commission (EMC) enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules. The CCPCUA rules will require groundwater users located in the impacted areas to reduce withdrawals in three phases between 2008 and 2018. The required reduction amounts are based on the location of the water use, either in a dewatering zone or in a saltwater intrusion zone. The rules specify a percentage reduction in groundwater use from the Cretaceous aquifers from the ABR.

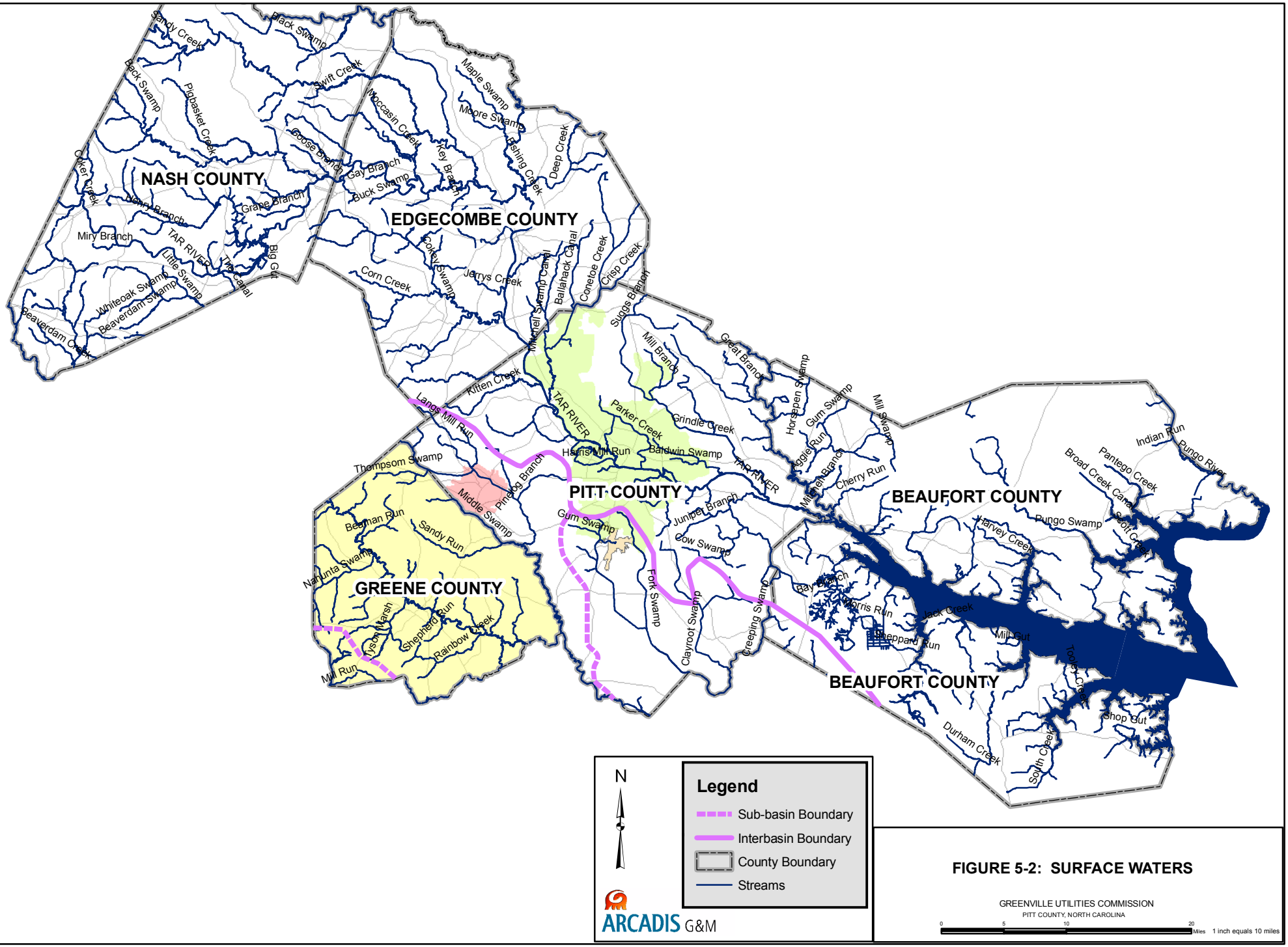


FIGURE 5-2: SURFACE WATERS

GREENVILLE UTILITIES COMMISSION
PITT COUNTY, NORTH CAROLINA

5.4 Wetlands

Wetlands, as defined by federal regulations [40 CFR 230.3(t)] and the EMC rules [15A NCAC 2B .0202(71)], are "…areas that are inundated or saturated by an accumulation of surface or groundwater 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." The boundary between wetlands and deepwater habitat is defined as the maximum depth where rooted emergent vegetation may be found. Rooted emergent vegetation is generally present at depths less than six feet below mean low water during the growing season. Riparian wetlands are those areas that border streams and other water bodies.

Wetlands are located throughout the service area and are mainly present in floodplain areas adjacent to streams and creeks. According to mapping provided by the National Wetlands Inventory (NWI), a majority of the wetlands within the service area consist of riverine, palustrine forest and palustrine scrub shrub wetlands, with numerous other types of wetlands being present in minor quantities.

5.5 Aquatic and Wildlife Habitat and Resources

5.5.1 Wildlife Habitat and Resources

The service area contains a variety of different vegetative communities based on topography, soils, hydrology, and disturbance. Terrestrial communities within the service area vary from undeveloped wooded areas to cultivated farm fields to disturbed lands. The numerous natural communities and disturbed habitats have been grouped into the following categories: (1) bottomland hardwood forest, (2) upland hardwood forest, (3) pine forest, and (4) disturbed land. The bottomland hardwood forest category is found predominantly on stream floodplains and may include some mesic low-slope woodland. The upland hardwood forest category includes mesic mixed hardwood forest and dry-mesic oak/hickory forest. Forests with greater than 50 percent of the canopy dominated by pines in either uplands or floodplains were designated as pine forest. Disturbed lands include lawns, agricultural fields, un-vegetated land, and infrequently mowed utility rights-of-way. These communities provide suitable habitat for numerous species of terrestrial species and vascular plants.

5.5.1.1 Bottomland Hardwood Forest

The bottomland hardwood community occurs in the upper portion of the floodplain, generally flat areas that are saturated for part of the year. The canopy of the bottomland hardwood community is dominated by red maple (*Acer rubrum*), loblolly pine (*Pinus taeda*), sweetgum (*Liquidambar styraciflua*), and oaks (*Quercus* spp.). The understory layer includes American holly (*Ilex opaca*), red maple, red bay (*Persea palustris*), and sweetbay magnolia (*Magnolia virginiana*). The well-developed and sometimes dense shrub layer includes blueberry (*Vaccinium elliottii*), sweet pepperbush (*Clethra alnifolia*), Virginia willow (*Itea virginica*), and giant cane (*Arundinaria gigantea*). The vine layer can be dense and typically includes poison ivy (*Toxicodendron*

radicans), common greenbrier (*Smilax rotundifolia*), and muscadine grape (*Vitis rotundifolia*). Usually, the herbaceous layer of bottomland hardwood communities is poorly developed.

Wildlife commonly found within bottomland hardwood communities includes several reptiles including the ground skink (*Scincella lateralis*), scarlet snake (*Cemophora coccinea*), corn snake (*Elaphe guttata*), and southern hognose snake (*Heterodon simus*). These snakes forage on small mammals, birds, frogs, lizards, and toads. Birds include Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), pine warbler (*Dendroica pinus*), and brown-headed nuthatch (*Sitta pusilla*). These birds generally feed on seeds and insects. Small mammals such as the nocturnal fox squirrel (*Sciurus niger*) and the larger, more visible southern flying squirrel (*Glaucomys volans*) may also be present. Larger mammals such as the eastern cottontail (*Sylvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), and white-tailed deer (*Odocoileus virginianus*) are common within bottomland hardwood communities.

5.5.1.2 Upland Hardwood Forest

The canopy of the upland hardwood community is dominated by tulip popular (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), white oak (*Q. alba*), red oak (*Q. rubra*), and sweetgum. The understory of the Upland Hardwood community includes flowering dogwood (*Cornus florida*), American holly, ironwood (*Carpinus caroliniana*), red maple, red bay, sourwood (*Oxydendrum arboreum*), and eastern hop-hornbeam (*Ostrya virginiana*). The shrub layer varies from sparse to dense and includes giant cane, blueberry, sweet pepperbush, and American witch hazel (*Hamamelis virginiana*). The herb layer is likely to contain Christmas fern (*Polystichum acrostichoides*), partridgeberry (*Mitchella repens*), sedges (*Carex* spp.), and slender spikegrass (*Chasmanthium laxum*).

The upland hardwood vegetative community is often found adjacent to bottomland hardwood and riverine swamp forest communities; therefore, they have similar wildlife and may also include the following species. The spotted (*Ambystoma maculatum*), slimy (*Plethodon glutinosus*), and many-lined (*Stereochilus marginatus*) salamanders may be found within the service area. The five-lined skink (*Eumeces fasciatus*) and worm snake (*Carphophis amoenus*) are found in hardwood forests. These reptiles feed on mainly arthropods and earthworms, respectively. The multi-layered structure characteristic of mature mixed hardwood communities supports high densities and diversities of neotropical migratory birds such as wood thrush (*Hylocichla mustelina*), ovenbird (*Seiurus aurocapillus*), Swainson's warbler (*Limnothlypic swainsonii*), worm-eating warbler (*Helmitheros vermivorus*), prothonotary warbler (*Protonotaria citrea*), hooded warbler (*Wilsonia citrina*), and white-breasted nuthatch (*Sitta carolinensis*). Small mammals such as the gray squirrel (*Sciurus carolinensis*) and golden mouse (*Ochrotomys nuttalli*) are found in the hardwood forests of the service area.

5.5.1.3 Pine Forest

Pine forests are mesic sites, located either on flat or rolling Coastal Plain sediments, that are neither excessively drained nor with a significant seasonal high water table. Pine forests commonly occur on broad

flats along interstream divides. This community often consists of large contiguous tracts of land that are leased for hunting. Many of these tracts of land are owned by timber companies and routinely logged and replanted.

The pine forest community is underlain by loamy or fine-textured soils, sometimes on sands, and is characterized as having a closed to open canopy mainly consisting of longleaf pine (*Pinus palustris*) or loblolly pine. The understory is commonly sparse and contains species such as Southern red oak, water oak, post oak, mockernut hickory and sweet gum. The shrub layer will have varying densities and is similar to wet pine flatwoods. The herbaceous layer is generally dominated by pineland three-awn grass (*Aristida stricta*), bracken fern (*Pteridium aquilinum*), old switch panic grass (*Panicum virgatum*), little bluestem (*Andropogon scoparium*), and roundhead bushclover (*Lespedeza capitata*).

Several reptiles are found in pine forest habitats including the ground skink (*Scincella lateralis*), scarlet snake (*Cemophora coccinea*), corn snake (*Elaphe guttata*), and southern hognose snake (*Heterodon simus*). These snakes forage on small mammals, birds, frogs, lizards, and toads. The red-cockaded woodpecker (*Picoides borealis*), a federally endangered species, is found in pine dorest communities. Other birds include Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), pine warbler (*Dendoica pinus*), and brown-headed nuthatches (*Sitta pusilla*). These birds generally feed on seeds and insects. Small mammals such as the nocturnal fox squirrel (*Sciurus niger*) and the larger, more visible southern flying squirrel (*Glaucomys volans*) may also be found within the service area.

5.5.1.4 Disturbed Land

Three main types of disturbed land are found in the service area: cutover, farm field, and maintained areas. Cutover areas are generally dominated by immature loblolly pine, sweetgum, red maple, and tulip poplar with blueberry, American holly, and flowering dogwood being present within the shrub layer. The vine layer of the cutover area is dominated by common greenbrier. Vegetation within the maintained areas includes Bermuda grass (*Cynodon dactylon*), crabgrass (*Digitaria* sp.), clover (*Trifolium* spp.), dandelion (*Taraxacum officinale*), foxtail grass (*Sertaria italica*), bead grass (*Paspalum* sp.), as well as other forbs commonly found in maintained/disturbed areas.

Disturbed lands such as those within the service area are typically drier than wooded land and do not support a wide variety of amphibian species. The reptiles are limited to snakes, lizards and skinks such as those inhabiting the pine-dominated woodlands. Other reptiles found may include the southern cricket frog (*Acris gryilus*), squirrel treefrog (*Hyla squirella*), Carolina anole (*Anolis carolinensis*), and eastern fence lizard (*Sceloporous undulatus*). Common birds of pasture, fallow fields, and hedgerows include eastern bluebirds (*Sialia sialis*), eastern meadowlark (*Sturnella magna*), Northern bobwhite quail, American goldfinch (*Carduelis tristis*), towhee (*Pipilio erythrophthalmus*), field sparrow (*Spizella pusilla*), barn swallow (*Hirundo rustica*), American robin (*Turdus migratorius*), and red-tailed hawk (*Buteo jamaicensis*). Typical mammals include the eastern mole (*Scalopus aquaticus*), eastern cottontail, raccoon (*Procyon lotor*), opossum, least shrew (*Cryptotis parva*), and white-tailed deer.

5.5.2 Aquatic Habitat and Resources

Aquatic habitats are present within the service area. These aquatic habitats range from small headwater streams and wetlands to large third and forth order streams and floodplain communities. The diversity of aquatic habitat available supports a variety of aquatic fauna within the service area.

The most important physical factors that affect freshwater organisms are temperature, light, water current, and substrate (Voshell, 2002). As stream order increases, these factors change and have an effect on the type of organisms present within each aquatic community. Benthic species typically found dominating the smaller headwater and second order streams include various shredders such as mayflies (Ephemeroptera), stoneflies (Plecoptera), craneflies (Nematocera), and case maker caddisflies (Trichoptera). Shredders are most abundant in first and second order streams because these streams usually have an abundance of coarse particulate organic material entering the stream, which provides a food source for these organisms. Filter feeders and collector-gatherers are most abundant in higher order streams due to the abundance of fine particular organic matter and may include species such as common net spinner caddisflies (Trichoptera), true flies (Diptera), and water boatmen (Heteroptera). Predator species in streams of all orders within the service area include damselflies (Zygoptera), dragonflies (Anisoptera), hellgrammites (Megaloptera), and water striders (Heteroptera). Bivalves are most abundant in medium to large rivers and prefer a stable substrate consisting of gravel or a combination of gravel and sand. Crayfish (Decapoda) habitat is also present within the service area.

In general, streams in the service area provide suitable habitat for fish such as bluegill (*Lepomis macrochirus*), tessellated darter (*Etheostoma olmstedi*), redfin pickerel (*Esox americanus*), dusky shiner (*Notropis cummingsae*), redbreast sunfish (*L. auritus*), warmouth (*L. gulosus*), largemouth bass (*Micropterus salmoides*), pirate perch (*Aphredoderus sayanus*), and American eel (*Anguilla rostrata*). Many benthic macroinvertebrates are expected to inhabit the streams. Benthic invertebrates common in swamp streams are the caddisflies (*Nyctiophlax moestus*) and (*Pycnopsyche* sp.) and the mayflies (*Stenonema modestum*), (*Leptophlebia* sp.), (*Caenis* sp.), and (*Eurylophella doris*) (DENR, 2004).

The streams within the service area support anadramous fish such as hickory shad (*Alosa mediocris*), American shad (*A. sapidissima*), alewife (*A. psuedoharengus*), blueback herring (*A. aestivalis*), striped bass (*Morone saxatilis*), and American eel (*Anguilla rostrata*). Within the Tar-Pamlico River basin, the Tar River and several of its tributaries are listed as anadromous fish spawning areas. The tributaries to the Tar River within Pitt and Greene Counties that are listed as supporting anadromous fish include portions of Otter Creek, Kitten Creek, Conetoe Creek, Tyson Creek (King Creek), Meeting House Branch, Hardee Creek, Chicod Creek, Grindle Creek, and Tranters Creek. Within the Neuse River basin, Contentnea Creek and several of its tributaries are listed as anadromous fish spawning areas. The tributaries to Contentnea Creek within Pitt and Greene Counties listed as supporting anadromous fish include portions of Rainbow Creek, Wheat Swamp Creek, Beaverdam Run, Panther Swamp Creek, Polecat Branch, and Little Contentnea Creek.

5.5.3 Significant Natural Areas

Natural Heritage Protection (NHP) designates significant natural areas if those areas contain rare or protected species, high quality examples of relatively undisturbed natural communities, or unusual geological features. They may be on public or private land and their designation as a natural area by NHP does not confer protection. No significant natural heritage areas (SNHAs) are listed by NHP within Greene County. Several sites are listed as significant natural areas within Pitt County. The following sites are listed as nationally significant natural areas that contain examples of natural communities, rare plant or animal populations, or geologic features that have the highest quality or are the best of their kind in the nation: Tar River Basin Megasite, Lower Tar River/Swift Creek Macrosite, Lower Tar River Aquatic Habitat, and Bethel/Grindle Hardwood Flats. Two sites, the Neuse River Floodplain and Bluffs and Voice of America Site B, are listed as being statewide significant natural areas that contain similar ecological resources, which are among the highest quality occurrences in North Carolina. Eight sites are listed as regionally significant natural areas that contain natural elements that may be represented elsewhere in the state by better quality examples.

5.6 Rare and Protected Species or Habitats

Some populations of fauna and flora have been, or are, in the process of decline due to either natural forces or their inability to coexist with humans. Federal law (under the provisions of Section 7 of the Endangered Species Act (ESA) of 1973, as amended) requires that any action likely to adversely affect a species classified as federally protected be subject to review by the U.S. Fish and Wildlife Service (USFWS). Other species may receive additional protection under separate state laws. As of January 2008, the USFWS identified three species as federally Endangered (E) and ten species as Federal Species of Concern (FSC) potentially occurring in Pitt and Greene Counties. The NHP list of May 2008 included the aforementioned species and identified an additional 14 species receiving protection under state laws. The protected species listed for Pitt and Greene Counties are provided in Table 5-2.

Table 5-2: Protected Species Listed for Pitt and Greene Counties

Scientific Name	Common Name	State Status	Federal Status	County
Vertebrates				
Acipenser brevirostrum	Shortnose sturgeon	E	-	P
Alligator mississippiensis	American alligator	T	-	P
Ambloplites cavifrons	Roanoke bass	SR	FSC	P
Ammodramus henslowii susurrans	Eastern Henslow's sparrow	SR	FSC	P
Anguilla rostrata	American eel	-	FSC	G, P
Condylura cristata pop. 1	Star-nosed mole	SC	-	P
Crotalus horridus	Timber rattlesnake	SC	-	P
Haliaeetus leucocephalus	Bald eagle	T	BBPA	P
Heterodon simus	Southern hognose snake	SC	FSC	P
Lampetra aepyptera	Least brook lamprey	T	-	P
Lanius ludovicianus	Loggerhead shrike	SC	-	G, P
Lythrurus matutinus	Pinewoods shiner	-	FSC	G, P
Necturus lewisi	Neuse River waterdog	SC	-	G, P
Noturus furiosus	Carolina madtom	SC (PT)	FSC	G, P
Picoides borealis	Red-cockaded woodpecker	E	E	G, P
Sistrurus miliarius	Pigmy rattlesnake	SC	-	P
Trichechus manatus	West Indian manatee	E	E	P
Invertebrates				
Alasmidonta undulata	Triangle floater	T	-	P
Elliptio roanokensis	Roanoke slabshell	T	-	P
Elliptio steinstansana	Tar River spinymussel	E	E	P
Fusconaia masoni	Atlantic pigtoe	E	FSC	P
Lampsilis cariosa	Yellow lampmussel	E	FSC	P
Lasmigona subviridis	Green floater	E	FSC	P
Leptodea ochracea	Tidewater mucket	T	-	P
Ligumia nasuta	Eastern pondmussel	T	-	P
Orconectes carolinensis	North Carolina spiny crayfish	SC	-	G, P
Strophitus undulatus	Creeper	T	-	P
Vascular Plants				
Sagittaria weatherbiana	Grassleaf arrowhead	SR-T	FSC	P

Table 5-2: Protected Species Listed for Pitt and Greene Counties

Scientific Name	Common Name	State Status	Federal Status	County

P = Pitt County

G = Greene County

Key to Federal Status:
E – Endangered. A taxon "in danger of extinction throughout all or a significant portion of its range."
T – Threatened. A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
FSC – Federal species of concern. A species under consideration for listing, for which there is insufficient information to support listing at this time.
BGPA – Bald and Golden Eagle Protection Act. The bald eagle was de-listed from the Federal List of Threatened and Endangered wildlife and the primary law protecting the bald eagle became the BGPA.

Key to State Status:
E – Endangered: "Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy" (GS 19B 106:202.12).
T – Threatened: "Any resident species of plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (GS 19B 106:202.12).
SC – Special Concern. Any species of plant in North Carolina which required monitoring but which may be collected and sold under regulations adopted under the provisions of the Plant Protection and conservation Act (GS 19B 106:202.12).
SR – Significantly Rare (only an NHP designation): Species which are very rare in North Carolina, generally with 1-20 populations in the state, generally substantially reduced in numbers by habitat destruction. These species are generally more common somewhere else in their ranges.
P – Proposed. A species that has been formally proposed for listing as endangered, Threatened, or Special Concern, but has not yet completed the legally mandated listing process.
-T – Throughout. These species are rare throughout their ranges (fewer than 100 populations total).

5.6.1 Vertebrates

Shortnose sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon, a member of the family *Acipenseridae*, is a small species of sturgeon and seldom exceeds 3.25 feet in length. They have an elongated, flattened body and a subterminal mouth with barbells, which are suited to their bottom-feeding and generally benthic existence. Current threats to habitat are from discharges, dredging, or disposal of materials into rivers, or related development activities involving estuarine, riverine, and other mudflats. The shortnose sturgeon is found sporadically in most river systems along the east coast from Canada to Florida (NMFS 1998). The sturgeons are anadromous fish, but the adults seldom travel from their natal river and associated estuary. Thus, each river's population is genetically distinct. The primary habitat of the shortnose sturgeon is preferably deep pools with soft substrates and vegetated bottoms. The shortnose sturgeon spawn in fast moving freshwater, riverine reaches with gravel bottoms. No populations of the shortnose sturgeon are known to be present within Pitt County. The shortnose sturgeon is not listed for Greene County.

American alligator (*Alligator mississippiensis*)

The American alligator is 6 to 17 feet long. It has a broad, rounded snout, which distinguishes it from the American crocodile (*Crocodylus aeutus*), a federally endangered species. Coloration of the alligator is generally black, having light markings of yellowish crossbands on the young that may persist into adulthood. These alligators are residents of the great river swamps, lakes, bayous, marshes, and other water bodies of Florida and the Gulf and Lower Atlantic Coastal Plains. Nests consist of mounds of

vegetative debris in which the eggs are buried between spring and early autumn; incubation is 65 days. At hatching, most young are between 8 and 9 inches long. No populations of the American alligator are known to be present within Pitt County. The American alligator is not listed for Greene County

The American alligator is listed as "threatened due to similar appearance" to provide protection to the American crocodile, a species which it closely resembles. The American crocodile is a tropical species and is not found in saltwater habitats this far north of Florida. The American alligator is not protected under Section 7 of the ESA.

Roanoke bass (*Ambloplites cavifrons*)

The Roanoke bass, a member of the Centrarchidae family, is 5.7 to 16.9 inches long. It has a short, robust body that is dark olive brown in color. Dark spots that tend to form rows occur along the sides of the body and they have five or six anal fin spines. The Roanoke bass has an unscaled or partially scaled cheek and many iridescent gold to white spots on the head and upper body (Rohde et. al. 1994).

The Roanoke bass is endemic to the Tar and Neuse River drainage basins in North Carolina. It is typically found in cool and warm creeks and small to medium rivers that have moderate to low gradient and a rock and gravel bottom. The Roanoke bass is rarely found in lakes and impoundments. The male Roanoke bass makes a saucer-shaped nest in sand or gravel in May and June. The female lays 3,000 to 11,000 eggs in the nest, which is then guarded by the male until the fry leave. The Roanoke bass reaches maturity at two years old. The Roanoke bass diet consists of fish and aquatic invertebrates including crayfish and insects. The Roanoke bass has been documented in the Tar River in the northwestern part of the City of Greenville in Pitt County. The Roanoke bass is not listed for Greene County.

Eastern Henslow's sparrow (*Ammodramus henslowii susurrans*)

The eastern Henslow's sparrow is approximately five inches long with a large flat head and short spiky tail. The bird's coloration consists of a greenish-buff head, dark tail, and wings with chestnut markings, streaking on chest and flanks, and a white belly. The preferred habitat of this species consists of large areas of grasslands, weedy moist meadows, shrubby fields, and overgrown pastures. The eastern Henslow's sparrow has been documented at two locations within the eastern part of Pitt County and at one location west of the City of Greenville. The eastern Henslow's sparrow is not listed for Greene County.

American eel (*Anguilla rostrata*)

The American eel has an elongated, snakelike body with a small, pointed head. The American eel has no pelvic fins, but has one long dorsal fin that extends more than half of the body. The dorsal fin is continuous with the caudal and anal fin. Coloration varies with age and ranges from yellow to olive-brown during the adult form that lives in freshwater. The adult males are dark brown and gray dorsally, with a silver to white ventral side. Adults reach lengths up to five feet (Page & Burr 1991). The American eel is a catadromous species that spawn in the Atlantic Ocean and ascends stream and rivers in North and South America. The

American eel is found in the Atlantic Ocean, Great Lakes, Mississippi River, the Gulf Basin, and south to South America. American eel lives in freshwater as adults, usually in larger rivers or lakes, primarily swimming near the bottom in search of food. This eel hunts mainly at night and resides in crevices or other shelter to avoid light during the day, and often buries in substrate consisting of mud, sand, or gravel (Landau 1992). No populations of the American eel are known to be present within Pitt and Greene Counties.

Star-nosed mole (*Condylura cristata*) – population 1

The star-nosed mole is a small, blackish-brown mole that is readily identified by the 22 fleshy appendages that surround its nostrils. This mole eats mainly aquatic invertebrates, but it also eats earthworms, small fish, and crustaceans. Its preferred habitat is wet soils in forested floodplains and swamps, wet meadows, and other open woods near water. The star-nosed mole is common in the mountains of North Carolina and widespread but rare in the Coastal Plain. No populations of the star-nosed mole are known to be present within Pitt County. The star-nosed mole is not listed for Greene County.

Timber rattlesnake (*Crotalus horridus*)

The timber rattlesnake measures 36 to 72 inches at maturity. Dorsal ground color of individuals in southeastern Virginia and most of the Carolinas is typically brown, gray, or pinkish with a reddish or brown middorsal stripe. The rattlesnake's favorite habitats include rocky hillsides, fields along forests, river valleys and swamps, low pinewoods, and pocosins. Stump holes and surface cover are common hiding places. The timber rattlesnake may be active day or night. No populations of the timber rattlesnake are known to be present within Pitt County. The timber rattlesnake is not listed for Greene County.

Bald eagle (*Haliaeetus leucocephalus*)

The mature bald eagle (usually more than 4 years of age) may be identified by its large white head and short white tail. The body plumage is dark brown to chocolate-brown in color. Bald eagles may easily be distinguished from other birds by their flat wing soar. They are primarily associated with large bodies of water where food is plentiful. Eagle nests are found in close proximity to water (usually within 0.5 miles) with a clear flight path to the water, in the largest living tree in an area with an open view of the surrounding land. Human disturbance may cause nest abandonment. The breeding season for the bald eagle begins in December and January. Fish are the major food source, although forage items include coots, herons, wounded ducks, and carrion. The bald eagle has been documented at three locations within Pitt County, including one location in the northeastern part of the County, one location in the southeastern part of the County, and one location northwest of the City of Greenville. The bald eagle is not listed for Greene County

As of July 6, 1999, this species is currently under consideration by the USFWS for a proposed de-listing of their threatened status. However, this raptor will still be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act, and populations will continue to be monitored for at least another five years under provisions of the ESA.

Southern hognose snake (*Heterodon simus*)

The southern hognose snake grows to a length of 13 to 22 inches. Dark blotches with pale interspaces characterize the brown, tan, or gray dorsal ground color of this snake. The dorsal scales are keeled and the snout is upturned. These snakes are found across the eastern and southeastern portions of North Carolina and the coastal plain of South Carolina. Within these regions, the snake inhabits xeric communities with coarse sands or porous loamy soils including sandhills and pine and wiregrass flatwoods. The southern hognose snake has been documented at one location within the Greenville City limits in Pitt County. The southern hognose snake is not listed for Greene County.

Least brook lamprey (*Lampetra aepyptera*)

The adult least brook lamprey has a 7-inch long, eel-shaped body with a deeply notched dorsal fin. Adults are dark tan above and lighter below prior to spawning. During spawning, adults become blue-black in color. The lamprey occurs in clear, small to medium-size streams in the Neuse and Tar River basins with a sand/gravel substratum for spawning. The larvae require quiet backwater areas with a mud/silt substratum. The least brook lamprey has been documented in Kitten Creek in the northwestern part of Pitt County. The least brook lamprey is not listed for Greene County.

Loggerhead shrike (*Lanius ludovicianus*)

The loggerhead shrike is a 7-inch-long bird with a heavy hooked beak, black mask, and flat head. These birds of prey catch small rodents, insects, and other birds and often impale their catch on thorns or barbed wire. The loggerhead shrike is found across the state. Heavily vegetated hedgerows are utilized as nesting habitat, and foraging is conducted in nearby open fields. No populations of the loggerhead shrike are known to be present within Pitt and Greene Counties.

Pinewoods shiner (*Lythrurus matutinus*)

The pinewoods shiner is a small (to 3.5 inches) fish, with a slim elongate body. It is blue-gray in color with a whitish belly. This fish is found only in creeks to small rivers of the Tar and Neuse River drainages of North Carolina. It inhabits the mid-water area of sandy to rocky runs and pools. Populations of the fish are known to in the Neuse and Tar-Pamlico River basins in Pitt and Greene Counties. The pinewoods shiner has been documented in Tyson Creek (King Creek), Moyes Run, and Conetoe Creek, within Pitt County. The pinewoods shiner has also been documented in Nahunta Swamp and Tyson Marsh in Greene County.

Neuse River waterdog (*Necturus lewisi*)

The Neuse River waterdog is a large, aquatic salamander with external gills. It is dull, rusty brown in color with dark brown to blue-black spots. It is found only in larger streams and rivers of the Neuse River basin of North Carolina. This stream dweller requires relatively high oxygen levels and water quality, and is generally found among large accumulations of submerged leaves in eddies or backwaters of streams. The Neuse River waterdog has been documented at eight locations throughout Pitt County and at one location in eastern Greene County.

Carolina madtom (*Noturus furiosus*)

The Carolina madtom is a 2 to 5-inch long tan-colored catfish. They have a wide black stripe on the side and four black saddles across their back. This madtom occurs in the Coastal Plain and lower Piedmont of the Neuse River drainage. They prefer shallow, low gradient, riffles and runs over fine to coarse sand, gravel, and detritus of small to medium rivers. The Carolina madtom has been documented in Little Contentnea Creek, along the border between Pitt and Greene Counties.

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker (RCW) is a medium-sized bird with entirely black and white plumage, except for small red streaks on the nape of the male. The back of the RCW is striped, and the bird has a large white cheek patch surrounded by a black cap, nape, and throat. This woodpecker's diet is composed mainly of insects, including ants, beetles, wood-boring insects, caterpillars, and corn earworms, if available. The RCW lays its eggs in April, May, and June; the eggs hatch approximately 38 days later.

The RCW is found in the southeastern United States. It is unique among woodpeckers because it nests exclusively in living pine trees. The RCW uses open, old-growth stands of southern pines, particularly longleaf pine, for foraging and nesting habitat. Slash, pond, or loblolly pines will also be utilized if longleaf is not available. The preferred forested stand contains at least 50 percent pine and lacks a thick understory. These birds usually excavate nests in pines greater than 60 years old and contiguous with pine stands at least 30 years of age. Living pines infected with red-heart disease (*Formes pini*) are often selected for cavity excavation because the inner heartwood is usually weakened. Cavities are located from 12 to 100 feet above ground level and below live branches. These trees may be identified by candles, large encrustations of running sap that surrounds the tree. Clusters consist of one to many of these candle trees. The foraging range of the RCW may extend 500 acres and must be contiguous with suitable nesting sites. The RCW has been documented at one location in northeastern Pitt County and one location in southeastern Pitt County. No populations of the RCW are known to be present within Greene County.

Pigmy rattlesnake (*Sisturus miliarius*)

The pigmy rattlesnake measures 15 to 26 inches in length. These rattlesnakes are characterized by large scales on top of their heads and a conspicuous pit between the eye and nostril. The snake has dorsal color ranging from gray to red with prominent dark brown or black splotches. Some individuals exhibit a red stripe along the middle of the back. The tip of the tail is white or yellow and generally brighter in juveniles than in the adults. These snakes are found from Hyde County, North Carolina, south throughout most of South Carolina. The habitat is composed of pine flatwoods and sandy, open woodlands with pines, wiregrass, and scrub oaks, and is frequently near cypress ponds and other bodies of water. Activity occurs during both day and night, but the snakes are often found under logs and other surface cover. The pigmy rattlesnake has been documented at one location in southeastern Pitt County. The pigmy rattlesnake is not listed for Greene County.

West Indian manatee (*Trichechus manatus*)

The West Indian manatee is a Sirenian, which are sometimes called sea cows. They are large mammals that spend their entire lives in water. These manatees are about 10 feet long and can weight as much as 1,000 pounds. Their forelimbs are modified to form flippers, their hindlimbs are reduced to nothing more than a vestigial pelvis, and their tail is enlarged and flattened horizontally to form a fluke or paddle. Their nostrils are located on top of their snouts and are opened by valves when they surface to breathe about every 3 to 4 minutes. The lips are large and mobile, and they are covered with stiff bristles. Manatees are herbivores whose main food sources are submerged, emergent, and floating aquatic plants, but they will occasionally eat small fish. They can consume as much as 10 percent of their body weight in wet vegetation each day. Manatees spend their time eating, resting, and traveling. Between October and April, or months when the water temperature falls below 70°F, they may be found in warm coastal waters or near warm water outfalls around southern Florida. During summer months, they may migrate as far north as coastal Virginia in search of an adequate food supply (USFWS 1993). The West Indian manatee has been documented at one location in the Tar River within the City of Greenville and one location in the Tar River in the easternmost portion of Pitt County. The West Indian manatee is not listed for Greene County.

5.6.2 Invertebrates

Triangle floater (*Alasmidonta undulata*)

The triangle floater is a medium sized freshwater mussel that reaches approximately 3 inches at maturity. The triangle floater has a subtriangular to ovate shell that is thicker at the anterior end than at the posterior. A distinct posterior ridge is present and strong ridges run parallel with the growth lines. The exterior of the triangle floater shell is smooth and shiny, and is yellowish greenish with broad green or blackish rays that become black with age. The triangle floater is found only on very stable substrates, including silt, in small rivers and headwater streams with moderate flow. No populations of the triangle floater are known to be present within Pitt County. The triangle floater is not listed for Greene County.

Roanoke slabshell (*Elliptio roanokensis*)

The Roanoke slabshell is a large freshwater mussel with branched papillae that reaches 6 inches at maturity. The Roanoke slabshell is characterized by the presence of small folds centrally located on the shell's periostracum of most individuals, certain of the incurrent papillae being subdivided into smaller papillae, and irregularly developed branchial septa. The Roanoke slabshell is rather sessile with only limited movement in the substrate. Passive downstream movement may occur when mussels are displaced from the substrate during floods. The Roanoke slabshell is usually found in near-shore trough habitats in sand/gravel substrates. No populations of the Roanoke slabshell are known to be present within Pitt County. The Roanoke slabshell is not listed for Greene County.

Tar River spinymussel (*Elliptio steinstansana*)

The Tar River spinymussel is a small mussel, up to 2.8 inches, with a subrhomboidal shell. It is one of only three freshwater mussels in the world with spines. The juveniles have up to 12 spines and an outer shell of orange-brown with greenish rays; adults tend to lose spines as they mature and their shells are darker with inconspicuous rays. The interior nacre is yellow to pinkish anteriorly and bluish white to iridescent posteriorly. This mussel is endemic to the Tar and Neuse River drainages of the lower Piedmont and upper Coastal Plain of North Carolina. It lives in silt free, unconsolidated gravel or coarse sand usually in shallow water of fast flowing medium sized streams, but will utilize deep water with appropriate substrates. Two populations are known to exist in two tributaries of the Tar River. No populations of the Tar River spinymussel are known to be present within Pitt County. The Tar River spinymussel is not listed for Greene County.

Atlantic pigtoe (*Fusconaia masoni*)

The Atlantic pigtoe is a freshwater mussel and the adults are essentially sessile. Some passive movement downstream may occur. The Atlantic pigtoe inhabits relatively fast waters with high quality riverine/large creek habitat. The Atlantic pigtoe is typically found in headwater or rural watersheds in sand or gravel substrates below riffles. The Atlantic pigtoe has been documented in the Tar River, northwest of the City of Greenville in Pitt County. The Atlantic pigtoe is not listed for Greene County.

Yellow lampmussel (*Lampsilis cariosa*)

The yellow lampmussel is a medium-sized freshwater mussel with a rounded inflated shell, yellowing and smooth periostracum with rays that are restricted to the posterior slope, if present. The shell of the yellow lampmussel is heavy with well-developed dentition. The adults of the yellow lampmussel are essentially sessile, although some passive movement downstream may occur. The yellow lampmussel is typically found in large streams and rivers in areas underlain by sand and gravel and in areas with good current. The yellow lampmussel has been documented in the Tar River in eastern Pitt County. The yellow lampmussel is not listed for Greene County.

Green floater (*Lasmigona subviridis*)

The green floater is a freshwater mussel that inhabits quiet, meandering parts of hydrologically stable small rivers and smaller streams and is most often found in slow water or pools and eddies where the substrate is gravelly or sandy and the currents are slow. The green floater is 2 to 2.5 inches in length, is subovate, ovate, triangle-ovate, or trapezoid in shape. The triangle floater has a thin, fragile shell with a small, rounded posterior ridge and has a beak that projects only slightly above the hinge line that may be double looped. The green floater has numerous dark green rays of varying width, a periostracum that is dull yellow to brownish-green, and dull bluish-white nacre. No populations of the green floater are known to be present within Pitt County. The green floater is not listed for Greene County.

Tidewater mucket (*Leptodea ochracea*)

The Tidewater mucket is a freshwater mussel that inhabits ponds, canals, and slow-moving sections of rivers, including artificial impoundments. The Tidewater mucket is usually found in water bodies close to, but not necessarily connected to the ocean. The Tidewater mucket is found in a variety of substrates that include silt, sand, gravel, cobble, and occasionally clay. No populations of the tidewater mucket are known to be present within Pitt County. The Tidewater mucket is not listed for Greene County.

Eastern pondmussel (*Ligumia nasuta*)

The eastern pondmussel is a freshwater mussel that inhabits protected areas of coastal lakes, slackwater areas of rivers, and canals. The eastern pondmussel is found in a wide range of substrates. No additional information pertaining to the eastern pondmussel is available for inclusion in this report. The eastern pondmussel has been documented within Pitt County in Mitchell Swamp Canal and Chicod Creek. The eastern pondmussel is not listed for Greene County.

North Carolina spiny crayfish (*Orconectes carolinensis*)

The North Carolina spiny crayfish is a relatively small, cylindrical crayfish. Its carapace ranges from tan to forest green with a dark, often mottled saddle, and orange, crimson, and black highlights. It has strong cervical, branchiostegal, and marginal spines with occasionally hepatic spines or tubercles. These crayfish are endemic to the Neuse and Tar-Pamlico River basins in North Carolina. They occupy the entire Tar-Pamlico watershed, but are absent from some parts of the Neuse watershed. The preferred habitat consists of small to large streams usually under cover and rock substrates. They reproduce in a wide range of spring and fall months. The North Carolina spiny crayfish has been documented in Little Contentnea Creek between Pitt and Greene Counties and at three locations in the Tar River east of the City of Greenville.

Creeper (*Strophitus undulatus*)

The creeper is freshwater mussel that can reach approximately 4 inches in length in North Carolina. The shell of the creeper is elliptical and moderately compressed. The shell is thin when the creeper is young and thickens and becomes somewhat inflated as the creeper matures. The periostracum is generally smooth and shiny. The creeper ranges in color from yellowish to dark brown. Green rays may extend over the entire surface of the shell. The creeper has been found throughout its range from headwater streams to large rivers and lakes to a depth of 13 feet. No populations of the creeper are known to be present within Pitt County. The creeper is not listed for Greene County.

5.6.3 Vascular Plants

Grassleaf arrowhead (*Sagittaria weatherbiana*)

Grassleaf arrowhead is an aquatic plant with arrowhead lanceolate shaped leaves from 8 to 12 inches in length and up to one inch in width narrowing at the base. The leaves have five to seven longitudinal veins,

with the interior veins coalescing with the central rib and ending at the pointed tip of the leaf. The cross venation of the leaves is pronounced. No populations of the grassleaf arrowhead are known to be present within Pitt County. The grassleaf arrowhead is not listed for Greene County.

5.7 Air Quality

The North Carolina Division of Air Quality (DAQ) monitors compliance with National Ambient Air Quality Standards (NAAQS). The principal air quality pollutants emitted are particulates (TSP and PM-10), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), and lead (Pb). The major emission sources are fuel combustion for transportation and heating, power generation, industrial processes, waste incineration, forest fires, open burning of yard waste and construction debris, and non-industrial solvent use (EPA 1990). Ground-level ozone (O_3) is created by the photochemical reaction of hydrocarbons (including VOCs) and NO_x with ultraviolet sunlight.

DAQ and the U.S. Environmental Protection Agency (EPA) have established ambient air quality standards for each pollutant based on hourly, daily, quarterly, or annual averages, depending on the pollutant's physical properties, chemical dynamics, human physiological responses, and monitoring technology (DAQ 1998). Primary air quality standards are those established for protection of public health. For some pollutants, secondary standards are established to protect against adverse effects on soil, water, crops, vegetation, animals, materials, climate, visibility, and personal comfort. Pitt and Greene Counties are designated as an attainment area for all six criteria pollutants.

A new 8-hour ambient ozone standard of 0.08 parts per million (ppm) was adopted by the DAQ in 1997. DAQ has a monitoring site in Farmville and reported that there were no ozone exeedence days in 2006.

5.8 Noise Levels

Noise is subject to the federal Noise Control Act of 1972 (PL-92-574) and Quiet Communities Act of 1978 (PL-95-6009), which require standards of compliance and recommend approaches to abatement for stationary noise sources such as airports, highways, and industrial facilities. The service area consists of developed and undeveloped areas that exhibit day-to-day normal noise conditions. Current noise levels within the service area have not been quantified.

6. Predicted Environmental Impacts

Construction activities are not proposed in association with this EA. Construction activities associated with this project have been addressed in a previously approved EA (2006, McDavid and Associates).

6.1 Topography and Soil Impacts

No direct impacts to topography and soils will result from the interbasin transfer. The construction of the waterline and booster pump station to facilitate the interbasin transfer was approved in 2006 via a Final Environmental Assessment (McDavid and Associates). No other construction activities relative to the IBT are proposed at this time.

6.2 Land Use Impacts

No direct impacts to land use will occur from the proposed interbasin transfer. The most significant indirect impact of any growth in the service area may be land use changes within the currently open/vacant urban areas. The impacts of land use changes may include the direct loss of the resource from conversion to urban uses. As land uses change and populations increase, public lands such as parks may experience periods of overuse, especially during summer months. Potential impacts may occur from allowing incompatible land uses adjacent to recreational and natural areas and overusing parks and open spaces. However, this interbasin transfer project is primarily a replacement water supply project to allow the Town of Farmville, Greene County, and the Town of Winterville to comply with the CCPCUA rules. Significant growth in these areas is not a component of this project or a reason for developing the interbasin transfer request.

6.2.1 Forest Resources Impacts

The proposed project will not directly impact forested areas. Indirect and cumulative forestry resource impacts from growth in the service area are expected to be minimal.

6.2.2 Prime or Unique Farmland Impacts

Prime or unique farmlands are present with the service area. However, no construction or land disturbing activities will occur relative to the proposed project; therefore, direct impacts to prime or unique farmlands will not occur. Indirect impacts to prime or unique farmlands from the proposed project are anticipated to be insignificant.

6.2.3 Public, Scenic, and Recreational Areas Impacts

Direct impacts to public, scenic, or recreational areas will not occur because of the interbasin transfer. Significant growth in these areas is not a component of this project or a reason for developing the interbasin transfer request.

6.2.4 Archaeological or Historical Resources Impacts

Construction activities are not proposed in association with this proposed project, therefore direct impacts to archaeological or historical resources are not expected. Indirect impacts to archaeological or historical sites will be insignificant.

6.3 Water Resources Impacts

6.3.1 Groundwater Impacts

This interbasin transfer project will not negatively affect groundwater quality or quantity. The purpose of this interbasin transfer project is in direct response to the CCPCUA rules that require groundwater users to reduce groundwater withdrawals over the next ten years. The CCPCUA rules were developed as a control measure for groundwater use in the Cretaceous aquifer in response to decreasing groundwater level and saltwater intrusion. Greene County, Farmville, and Winterville are directly affected by the CCPCUA rules and are required to take their first reduction in 2008.

6.3.2 Surface Water Impacts

A hydrologic analysis was performed to assess the impact of the proposed interbasin transfer of water from the Tar to the Neuse and Contentnea Creek subbasins on flows in the Tar River (ENTRIX 2008). The hydrologic analysis included:

- Development of a long-term flow record at Greenville from existing USGS flow records.
- Generation of flow duration and other flow statistics to characterize the Tar River discharge at Greenville under existing conditions and 2030 future water use scenarios.
- A hydrologic accounting model using the long-term flow record, projected water usage, and wastewater discharge for multiple municipalities within the lower Tar River basin to determine future flow conditions with and without the GUC IBT.

ENTRIX (2008) developed a spreadsheet-based hydrologic model to account for all existing and projected future withdrawals from, and discharges to, the Tar River (greater than 100,000 gpd). Withdrawals and

discharges were simulated over time to predict the effects on flow in the Tar River at Greenville. The model accounted for all withdrawals and discharges from the Rocky Mount dam downstream to the GUC WWTP discharge. The flow record developed for the Greenville gage was used as the base flow record for the simulations. Model simulations included the following scenarios:

1. Current flows with no IBT
2. Current flows with 2030 average day IBT
3. Current flows with 2030 Maximum Withdrawal IBT
4. Predicted 2030 flows with no IBT
5. Predicted 2030 flows with 2030 average day IBT
6. Predicted 2030 flows with 2030 Maximum Withdrawal IBT

In March 2008, DWR requested that additional conservatism be built into the hydrologic analysis for the proposed IBT via two specific changes to the model input data. The first change requested by DWR was to subtract the 2002 GUC water withdrawals from the Tar River at the Greenville flow record for current conditions and 2030 conditions. This exercise double counts GUC water withdrawals for a number of years. The second change was to set up the model with the GUC wastewater discharge reduced by the amount of the maximum IBT. The results of these scenarios will be particularly conservative because the total volume of the GUC wastewater discharge will be removed from the Tar River in the 2002 scenario and for most months in the 2030 scenario. In reality, GUC would continue to treat and discharge wastewater effluent from its service area to the Tar River. Table 6-1 provides an explanation of the modeling scenarios.

Table 6-1: Explanation of Modeling Scenarios Used in the Tar River Water Balance

	GUC Water Demand (mgd)	Neuse River Subbasin IBT (mgd)	Contentnea Subbasin IBT (mgd)	Total Water Use (mgd) [2]	WTP Capacity (mgd) [3]	Comment
Current Conditions [1]						
No IBT	10.91	0	0	10.91	23.76	modeling scenario
Average Day IBT	12.83	2.0	3.9	18.73	23.76	modeling scenario
Maximum Withdrawal IBT	18.65	3.9	9.6	32.15	23.76	modeling scenario
2030 Conditions [1]						
No IBT	12.83	0	0	12.83	23.76	modeling scenario
Average Day IBT	12.83	2.0	3.9	18.73	23.76	modeling scenario
Max Day IBT	18.65	3.8	8.5	30.95	23.76	[4]
Maximum Withdrawal IBT	18.65	3.9	9.6	32.15	23.76	modeling scenario

[1] *The daily water withdrawal data used for each model scenario have been underlined. The model runs evaluated the influence of 2030 average day IBT and 2030 maximum withdrawal IBT on both current flow and projected 2030 flow.*

[2] *The total withdrawal indicated in this column represents a yearly average. Total withdrawals were modeled by month using a composite monthly factor. The composite monthly factor was determined using six years of daily water withdrawal data from the Greenville Utilities Commission.*

[3] *The water treatment plant capacity of 22 mgd plus 8 percent process water.*

[4] *The maximum day IBT scenario was not modeled in the water balance. In the 2030 condition, both the maximum day IBT and maximum withdrawal IBT scenarios exceed the water treatment plant capacity. Therefore, the water treatment plant capacity (plus process water) was used as the worst-case (maximum withdrawal) condition. There are three reasons to support this assumption: 1) the maximum day for the Neuse River subbasin, the Contentnea subbasin, and GUC are not expected to occur on the same day, 2) GUC's water purchase agreement contracts stipulate that GUC reserves the right to curtail water to Farmville, Winterville, and Greene County given the appropriate notice, and 3) Farmville, Winterville, and Greene County expect to use their banked water during periods of high water demand.*

ENTRIX tabulated and graphed the model results for each scenario in order to quantify and demonstrate the influent of the proposed IBT withdrawal on current and future flow conditions. The Technical Memorandum (TM) – *Analysis of Greenville Utility Commission's Proposed Interbasin Transfer Withdrawals on Tar River Flows at Greenville, North Carolina* (ENTRIX, 2008) is located in Appendix B. The model results summarize the following statistics:

- Minimum, maximum, mean, the 95th, 50th, and 5th percentiles for flow.
- Flow that is equaled or exceeded for a specific percent of time (0 percent through 100 percent).
- Low flow details (25 to 16,000 cfs): percent of time and average number of days flow is below a specific range.
- Percent of time on an annual basis that daily flows go below the 7Q10 flow and below 80 percent of the 7Q10 flow for the period of record.
- Average number of days per year that daily flows go below the 7Q10 flow and below 80 percent of the 7Q10 flow.

For ease of reference, the summary of the statistical results from the TM (ENTRIX, 2008) are presented in Tables 6-2 and 6-3. The lowest Tar River flow conditions are observed at the Greenville gage, the location downstream of the GUC water intake but upstream of the WWTP discharge. The effects of the proposed IBT appear to be negligible for both locations at average flow levels and higher. However, the effect of the proposed IBT appears to be slightly greater at the minimum-recorded flow of record where the stream flow becomes negative under the maximum IBT scenarios for 2030 conditions.

Tables 6-2 and 6-3 summarize the percent of time and the number of days (annually) that flows would be below the summer 7Q10 and below 80 percent of the 7Q10. At the Greenville gaging station, flows would be expected to drop below the 7Q10 1.3 percent of the time (4.7 days) each year for current conditions and 1.4 percent of the time (5.0 days) for 2030 conditions. With an average IBT withdrawal, flows are predicted to be below the 7Q10 1.6 percent of the time (5.8 and 5.9 days, respectively) for current and 2030 conditions. This percentage increases to 1.8 percent of the time (6.5 days) for the maximum expect IBT withdrawal.

At the location downstream of the WWTP, flows are predicted to drop below the 7Q10 1.0 percent of the time (3.7 days) for current conditions and are predicted to drop below 1.3 percent of the time (4.7 days) for 2030 conditions. For the average IBT withdrawal, flow would be expected to drop below the 7Q10 1.3 percent of the time (4.6 days) for the current conditions and 1.6 percent of the time (5.7 days) for 2030 conditions. The percentages increase to 1.5 percent and 1.7 percent of the time (5.4 and 6.3 days, respectively) for the current maximum IBT and 2030 maximum IBT, respectively. At the downstream location under the most conservative scenario where wastewater withdrawals are reduced by the amount

of the IBT, the current flows are predicted to be below the 7Q10 1.8 percent of the time (6.4 days) and 2.1 percent of the time (7.7 days) in 2030.

The results of the hydrologic modeling indicate that the proposed interbasin transfer from the Tar River to the Neuse and Contentnea Creek subbasins will have minimal impact on the existing stream flow at Greenville. The similarity in percentages and total number of days predicted below the 7Q10 between the No IBT, Average, Maximum, and two times the Maximum IBT scenarios indicate that the projected IBT quantities appear to have very little impact on flows in the Tar River at Greenville.

The estimated effects on Tar River flows associated with GUC's proposed IBT are based on projected flows estimated from the best available USGS hydrologic data for the lower Tar River. The flow data from the USGS gage at Tarboro were used to develop the long-term flow record for the Tar River at Greenville. Since the synthesized long-term flow record develop for Greenville (based on a 77 year flow record) was based on regression analyses, the predicted flow are more accurate on a weekly, monthly, or annual basis than individual days. The model is likely to accurately predict flow conditions over time and the distribution of flows over time. The flow estimated provided throughout the ENTIRX TM (2008) should be interpreted as net freshwater flows delivered by the Tar River to the tidally-influenced section of the lower Tar River near Greenville.

It is challenging to fully understand and quantify the flow characteristics for the Tar River at Greenville. Current USGS techniques for low-flow analyses do not provide a means of accounting for tidal effect. The lower Tar River is influenced by tides to a point just upstream of the USGS gage at Greenville. The amount of tidal influence is variable and depends on weather, tidal phase, and river flow. The presence of tides in the Tar River at Greenville is more pronounced during low-flow periods. Monitoring conducted by GUC in 2002 and 2007 has demonstrated that the salt wedge moves further upstream during low flow conditions than during high flow conditions.

Under the model conditions where withdrawals and interbasin transfers have a small effect on net downstream river flow, tidal influences may be greater than the net amount of flow being delivered from upstream. The tidal influence from critically low periods may substantially ameliorate the impacts of IBT withdrawals. The tidal influence at Greenville was cited by GMA (2003) as one factor that provides downstream aquatic habitat protection during low flow at Greenville.

Table 6-2: Summary of Flow Statistics (Flow in cfs and Percentiles) for Greenville Gaging Station and Downstream of Greenville WWTP (ENTRIX, 2008)

Flow Statistics (cfs) [1]	Greenville Gaging Station [2]						Downstream of Greenville WWTP [3]							
	Current Scenarios			Future 2030 Scenarios			Current Scenarios				Future 2030 Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
Maximum	31,866	31,855	31,849	31,872	31,860	31,854	31,878	31,866	31,860	31,849	31,875	31,863	31,858	31,840
Minimum	24	11	4	20	7	-1	38	25	17	4	17	5	-3	-15
Average	2,524	2,513	2,505	2,525	2,513	2,505	2,537	2,526	2,518	2,506	2,529	2,518	2,509	2,492
Percentiles														
95th	9,033	9,023	9,014	9,035	9,025	9,016	9,046	9,036	9,027	9,014	9,038	9,028	9,018	9,001
50th (Mean)	1,1398	1,387	1,381	1,397	1,384	1,375	1,410	1,398	1,393	1,381	1,403	1,390	1,380	1,365
5th	229	216	210	228	215	208	242	229	222	210	231	219	211	194

[1] Based on long-term flow record of the Tar River at Tarboro extrapolated downstream.
[2] Flow at Greenville, NC, downstream of GUC water supply intake and upstream of Greenville wastewater discharge.
[3] Flow at Greenville, NC, downstream of Greenville wastewater discharge
* This scenario increases the Greenville withdrawal by the Max IBT amount and decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the amount was entered as zero.

Table 6-3: Summary of Flow Statistics (Annual Percent of Time and Average Number of Days) for Greenville Gaging Station and Downstream of Greenville WWTP (ENTRIX, 2008)

Flow Statistics (cfs) [1]	Greenville Gaging Station [2]						Downstream of Greenville WWTP [3]							
	Current Scenarios			Future 2030 Scenarios			Current Scenarios				Future 2030 Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
Percent of Time (per Year)														
7Q10 (109 cfs)	1.3%	1.6%	1.8%	1.4%	1.6%	1.8%	1.0%	1.3%	1.5%	1.8%	1.3%	1.6%	1.7%	2.1%
7Q10 x 80% (87.2 cfs)	0.9%	1.1%	1.2%	0.9%	1.1%	1.3%	0.7%	0.9%	1.0%	1.2%	0.8%	1.1%	1.3%	1.6%
Average Number of Days (per Year)														
7Q10 (109 cfs)	4.7	5.8	6.4	5.0	5.9	6.5	3.7	4.6	5.4	6.4	4.7	5.7	6.3	7.7
7Q10 x 80% (87.2 cfs)	3.3	3.9	4.5	3.3	4.1	4.9	2.5	3.2	3.6	4.5	3.1	3.8	4.6	5.8

[1] Based on long-term flow record of the Tar River at Tarboro extrapolated downstream.
[2] Flow at Greenville, NC, downstream of GUC water supply intake and upstream of Greenville wastewater discharge.
[3] Flow at Greenville, NC, downstream of Greenville wastewater discharge
* This scenario increases the Greenville withdrawal by the Max IBT amount and decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the amount was entered as zero.

6.3.3 Water Quality Impacts

Impacts to water quality as a result of the proposed project are not anticipated. The NPDES permit for the GUC WWTP is not being modified as a result of the proposed IBT. Additionally, the results of the hydrologic modeling (Section 6.3.2) indicate that the proposed interbasin transfer from the Tar River to the Neuse and Contentnea Creek subbasins will have minimal impact on the existing stream flow at Greenville. It follows that water quality will not be significantly impacted.

6.4 Wetlands Impacts

No direct impacts to wetlands will occur from the proposed project. Wetlands and vegetated riparian areas are valuable since they preserve biological diversity, protect wildlife, provide natural open spaces, protect water quality, stabilize stream banks, control erosion, and prevent flooding damage. Significant growth in these areas is not a component of this project or a reason for developing this interbasin transfer request. Any impacts that may be associated with development could include filling or draining of wetlands for construction of roads, private or public building sites, or utilities.

6.5 Aquatic and Wildlife Habitat and Resources Impacts

No direct impacts to aquatic or terrestrial habitats will occur from the proposed interbasin transfer. Significant growth in these areas is not a component of this project or a reason for developing the interbasin transfer request.

6.6 Rare and Protected Species or Habitats Impacts

Table 6-4 summarizes the impacts to threatened and endangered species that may potentially occur from the proposed project. Construction activities are not proposed in association with this project; therefore, no direct impacts will occur to rare or protected species. Potential habitat for state and federally protected species is present in Pitt and Greene Counties. Indirect impacts to state and federally protected species are expected to be insignificant.

Table 6-4: Summary of Impacts to Threatened and Endangered Species

Scientific Name	Common Name	Habitat Available in Service Area	Recorded NHP Observations in Service Area	No Direct Impacts Are Expected	No Indirect Impacts Are Expected	Direct Impacts May be Possible	Indirect Impacts May Be Possible
Vertebrates							
Acipenser brevirostrum	Shortnose sturgeon	X		X	X		
Alligator mississippiensis	American alligator	X		X	X		
Ambloplites cavifrons	Roanoke bass	X	X	X			X
Ammodramus henslowii susurrans	Eastern Henslow's sparrow	X	X	X			X
Anguilla rostrata	American eel	X		X	X		
Condylura cristata pop. 1	Star-nosed mole	X		X	X		
Crotalus horridus	Timber rattlesnake	X		X	X		
Haliaeetus leucocephalus	Bald eagle	X	X	X			X
Heterodon simus	Southern hognose snake	X	X	X			X
Lampetra aepyptera	Least brook lamprey	X	X	X			X
Lanius ludovicianus	Loggerhead shrike	X		X	X		
Lythrurus matutinus	Pinewoods shiner	X	X	X			X
Necturus lewisi	Neuse River waterdog	X	X	X			X
Noturus furiosus	Carolina madtom	X	X	X			X
Picoides borealis	Red-cockaded woodpecker	X	X	X			X
Sistrurus miliarius	Pigmy rattlesnake	X	X	X			X
Trichechus manatus	West Indian manatee	X	X	X	X		
Invertebrates							
Alasmidonta undulata	Triangle floater	X		X	X		
Elliptio roanokensis	Roanoke slabshell	X		X	X		
Elliptio steinstansana	Tar River spinymussel	X		X	X		
Fusconaia masoni	Atlantic pigtoe	X	X	X			X
Lampsilis cariosa	Yellow lampmussel	X	X	X			X
Lasmigona subviridis	Green floater	X		X	X		
Leptodea ochracea	Tidewater mucket	X		X	X		
Ligumia nasuta	Eastern pondmussel	X	X	X			X
Orconectes carolinensis	North Carolina spiny crayfish	X	X	X			X

Table 6-4: Summary of Impacts to Threatened and Endangered Species

Scientific Name	Common Name	Habitat Available in Service Area	Recorded NHP Observations in Service Area	No Direct Impacts Are Expected	No Indirect Impacts Are Expected	Direct Impacts May be Possible	Indirect Impacts May Be Possible
Strophitus undulatus	Creeper	X		X	X		
Vascular Plants							
Sagittaria weatherbiana	Grassleaf arrowhead	X		X	X		

6.7 Air Quality Impacts

No construction activities will occur relative to the proposed project; therefore, no direct impacts to air quality will occur. Indirect impacts to air quality within the service area from growth will be minimal.

6.8 Noise Level Impacts

No construction activities will occur relative to the proposed project; therefore, the noise level with respect to the existing condition will not change.

6.9 Introduction of Toxic Substances Impacts

No construction activities will occur relative to the proposed project; therefore, the introduction of toxic substances will not occur.

7. Mitigative Measures

This proposed interbasin transfer project will not induce growth as this project is not being pursued for the management of growth. Rather, this project is requested to allow existing communities with groundwater systems to continue to serve their existing customers and future customers until 2030. Growth in the area is modest, at a rate of 1 to 3 percent for the larger communities (GUC, Greene County, and Farmville) and at slightly higher rates for smaller communities (Winterville).

The following programs are summarized for the communities who have expressed interest in obtaining water from GUC. These programs are discussed in this EA for overall completeness and to support the growth projections presented in Section 2.

7.1 City of Greenville

7.1.1 Land Use Planning and Environmental Resource Protection Initiatives

The City of Greenville adopted its first comprehensive plan in 1981, but has had mechanisms in place for regulating land development since 1947. On February 12, 2004, the City adopted an update to the 1992 Horizons Plan, the City's comprehensive plan. The Horizons Plan creates a set of goals, objectives, policies, and actions to guide local planning, development, and redevelopment efforts. The Plan provides a policy guide that will be used by local officials when making decisions on matters related to the development of the City.

The Horizons Plan defines twelve land use categories, including conservation, very low density residential, low density residential, medium density residential, high density residential, office/institutional/multi-family, office/institutional/medical, medical transition, medical core, mixed use/office/institutional, commercial, and industrial. Each land use category has associated zoning districts in the City's Zoning Ordinance, which specifies allowable land uses.

The Horizons Plan implementation actions are broken into eight topics, which reflect policy statements on the land use issues that will affect Greenville during the planning period. Implementation strategies relative to land use planning and growth include:

- Provide a land use form that optimizes resources by allocating land for its most suitable use, avoiding conflicting land uses, preserving the City's character, and providing open spaces, vistas, and agricultural areas.
- Manage the physical development of Greenville to protect its resources and simultaneously promote responsible industrial and retail growth.
- Consider adopting performance standards to encourage development at a rate that parallels the availability of infrastructure and services.

- Conservation/open space land uses should be provided in areas where there is the potential for flooding or the need for buffering for incompatible land uses.
- Incorporate the principle of "smart growth" into the City's land use regulatory scheme.
- Preserve open space, agricultural areas, historically significant structures, landmarks, and other features that reflect the City's heritage.

The City of Greenville is dedicated to protecting, preserving, and enhancing the quality of the City's natural resources. The Horizons Plan emphasizes the City's commitment to stormwater control, water quality protection, wetlands preservation, floodplain management, air quality, and waste management. Specific natural environment implementation strategies found in the Plan include:

- Adopt regulations to provide for conservation of open space and encourage recreational, agricultural, or other low-intensity uses within the floodplain.
- Discourage improvements of any kind in undisturbed areas within the 100-year floodplain. These areas should be designated for open space corridors, greenways, and other low-intensity uses.
- Make wetlands acquisition a priority in future expansions of Greenville's parks and recreation areas.
- Revise stormwater regulations so that stormwater runoff controls are required for projects draining to flood prone areas.
- Preserve threatened and endangered species habitats through preservation of significant wetlands and other sensitive areas.

7.1.2 Zoning

The Greenville Zoning Ordinance provides regulations for the development of the City and ETJ in a manner that will promote the health, safety, and general welfare of its citizens. The Zoning Ordinance divides the City into 32 separate zoning districts, including overlay districts, in order to regulate the location and intensity of land usage, regulate areas for open space, and provide for improved environmental protection. There are eleven residential zones or overlays; seven medical zones, two of which are residential; eleven commercial or industrial zones; a water supply watershed overlay; a historic district overlay; and a conservation district overlay. In order to control development, minimum lot sizes have been established for each zoning district. Table 7-1 summarizes the requirements for residential lot areas.

Regulations concerning overlay districts are applicable in addition to any other district regulations. The City has established the water supply watershed overlay to protect and manage surface water supply watersheds. This district has been further divided into water supply watershed – critical (WS-C) and water supply watershed – protected (WS-P). All new development within the overlay requiring a sediment and erosion control plan must comply with the zoning regulations. Within the WS-C overlay, single-family

residential lots must not be less than 0.5 acres or 20,000 square feet. All other development must not exceed 24 percent built-upon area. Within the WS-P overlay, single-family lots must not be less than 0.5 acres or 20,000 square feet, or 15,000 square feet for projects without curb and gutter street construction. All other development must not exceed 24 percent built-upon area or 36 percent built-upon area for projects without curb and gutter street construction. Vegetative buffer areas and stormwater BMPs are required within this zone to protect water quality, and certain land uses are prohibited.

The conservation district overlay was established to provide for permanent open space and desirable buffers between proposed uses and incompatible adjacent land uses, environmentally sensitive areas, or hazardous areas. No buildings, structures, parking, or other impervious surfaces may be constructed within the conservation overlay areas.

7.1.3 Open Space Plans/Initiatives, Greenways, and Riparian Buffers

The City of Greenville's Recreation and Parks Department owns and maintains over 960 acres of parkland among 25 parks and recreational facilities. This includes River Park North, a 324-acre park that includes a nature center, camping facilities, and boating. The City desires to ensure that all residents have access to open space and recreation activities close to where they live. Specific open space goals found in the Horizons Plan include:

- Provide park and open space opportunities in all neighborhoods.
- Promote, preserve, and protect Greenville's natural environment.
- Continue the construction of greenway projects in the City.
- Continue to acquire more open space for the enjoyment of citizens.

The Greenville Zoning Ordinance also provides open space requirements. The ordinance establishes the conservation overlay district, which prohibits the construction of any building, parking, or impervious area within the conservation area. The ordinance also requires that at least 30 percent of the net area of multi-family developments be reserved for open space, and no more than 50 percent of this area can be designated for recreational use. All Planned Unit Developments are required to have at least 25 percent of the gross area reserved as common open space.

Greenville adopted a Parks and Recreation Master Plan in 2000, which recommended the development of two new community parks, five neighborhood parks, and fifteen mini-parks. This plan was used in the preparation of the City's Greenway Master Plan.

Table 7-1: Density Limits in City of Greenville Zoning Ordinance

Zoning District	Description	Minimum Lot Size
RA-20	Low density, single-family residential and agricultural	Single-family, without public water: 20,000 ft^2 Single-family, with public water: 10,000 ft^2 Two-family, without public water: 25,000 ft^2 Two-family, with public water: 15,000 ft^2
R-15S	Low density, single-family residential	15,000 ft^2
R-9S	Medium density, single-family residential	9,000 ft^2
R-9	Medium density, single or two-family residential	Single family: 9,000 ft^2 Two-family: 13,500 ft^2 Other uses: 9,000 ft^2
R-6S	Medium density, single-family residential	6,000 ft^2
R-6	High density, single or multi-family residential	Single family: 6,000 ft^2 Two-family: 6,000 ft^2 Multi-family: 2,300 ft^2 for 1 bedroom, 2,900 ft^2 for 2+ bedroom Other uses: 6,000 ft^2
R-6A	Medium density, single or multi-family residential	Single family: 6,000 ft^2 Two-family: 9,000 ft^2 Multi-family: 4,500 ft^2 for 1 bedroom, 5,500 ft^2 for 2+ bedroom Other uses: 6,000 ft^2
R-6N	High density single-family and limited two or multi-family residential	Single family: 6,000 ft^2 Two-family: 9,000 ft^2 Multi-family: 2,300 ft^2 for 1 bedroom, 2,900 ft^2 for 2+ bedroom Other uses: 6,000 ft^2
R-6MH	High density single-family (including mobile homes), two-family, and multi-family	Single family: 6,000 ft^2 Two-family: 6,000 ft^2 Mobile home: 6,000 ft^2 Multi-family: 2,300 ft^2 for 1 bedroom, 2,900 ft^2 for 2+ bedroom
MR	High density, single or multi-family medical residential	Single family: 6,000 ft^2 Two-family: 6,000 ft^2 Multi-family: 2,300 ft^2 for 1 bedroom, 2,900 ft^2 for 2+ bedroom Other uses: 6,000 ft^2
MRS	Low density, single-family medical residential and agricultural	Single-family, without public water: 20,000 ft^2 Single-family, with public water: 10,000 ft^2
OR	High density, two and multi-family residential and office	Two-family: 7,500 ft^2 Multi-family: 2,300 ft^2 for 1 bedroom, 2,900 ft^2 for 2+ bedroom Other uses: 7,500 ft^2
CDF	High density, residential and commercial mix	Single family: 6,000 ft^2 Two-family: 6,000 ft^2 Multi-family: 2,300 ft^2 for 1 bedroom, 2,900 ft^2 for 2+ bedroom Other uses: none

Future Land Use Plan Map

City of Greenville, NC

Adopted February 12, 2004

Map composed by the Planning & Community Development Department on August 18, 2004.

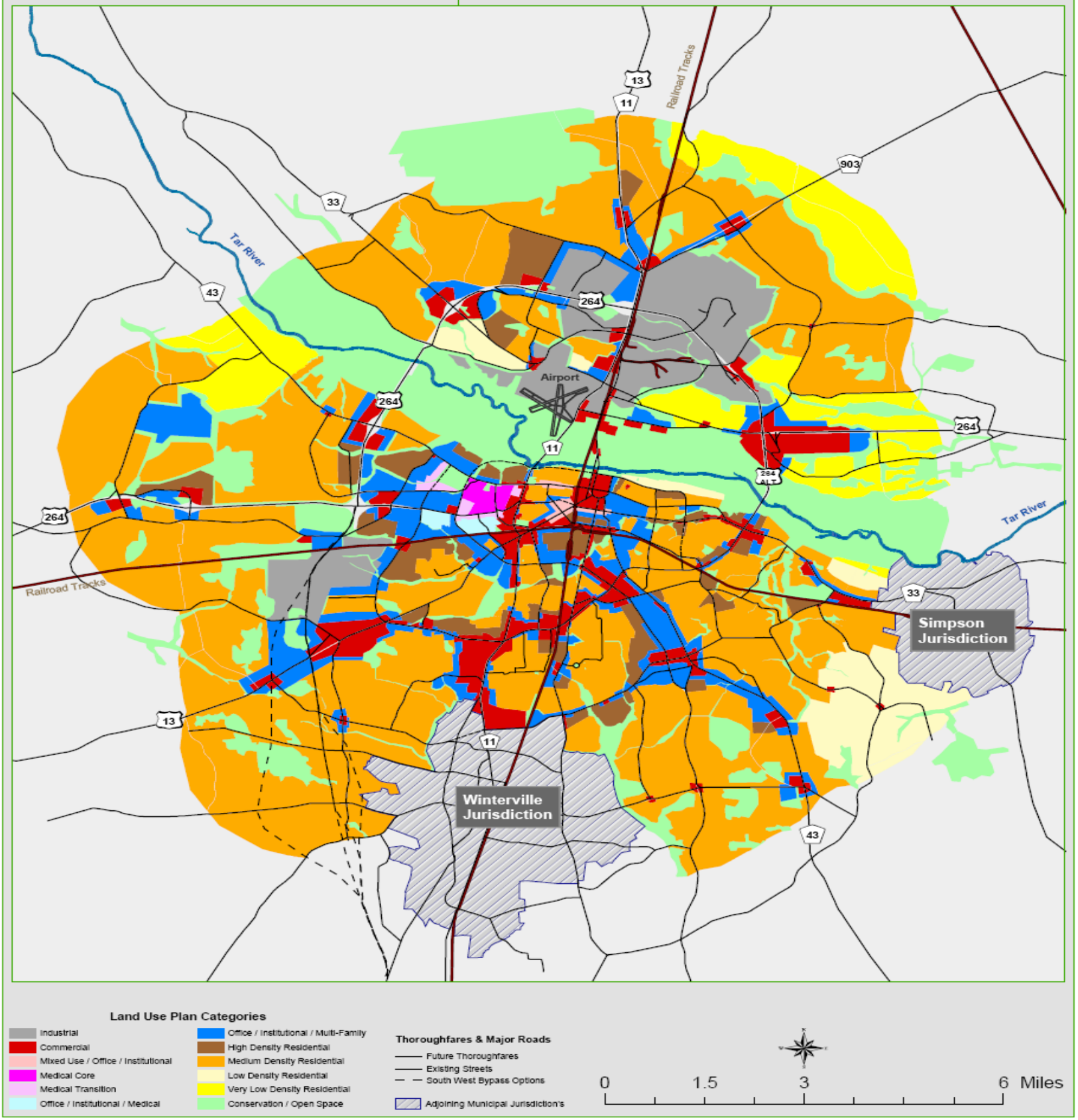


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Figure 7-1: Future Land Use Map for the City of Greenville

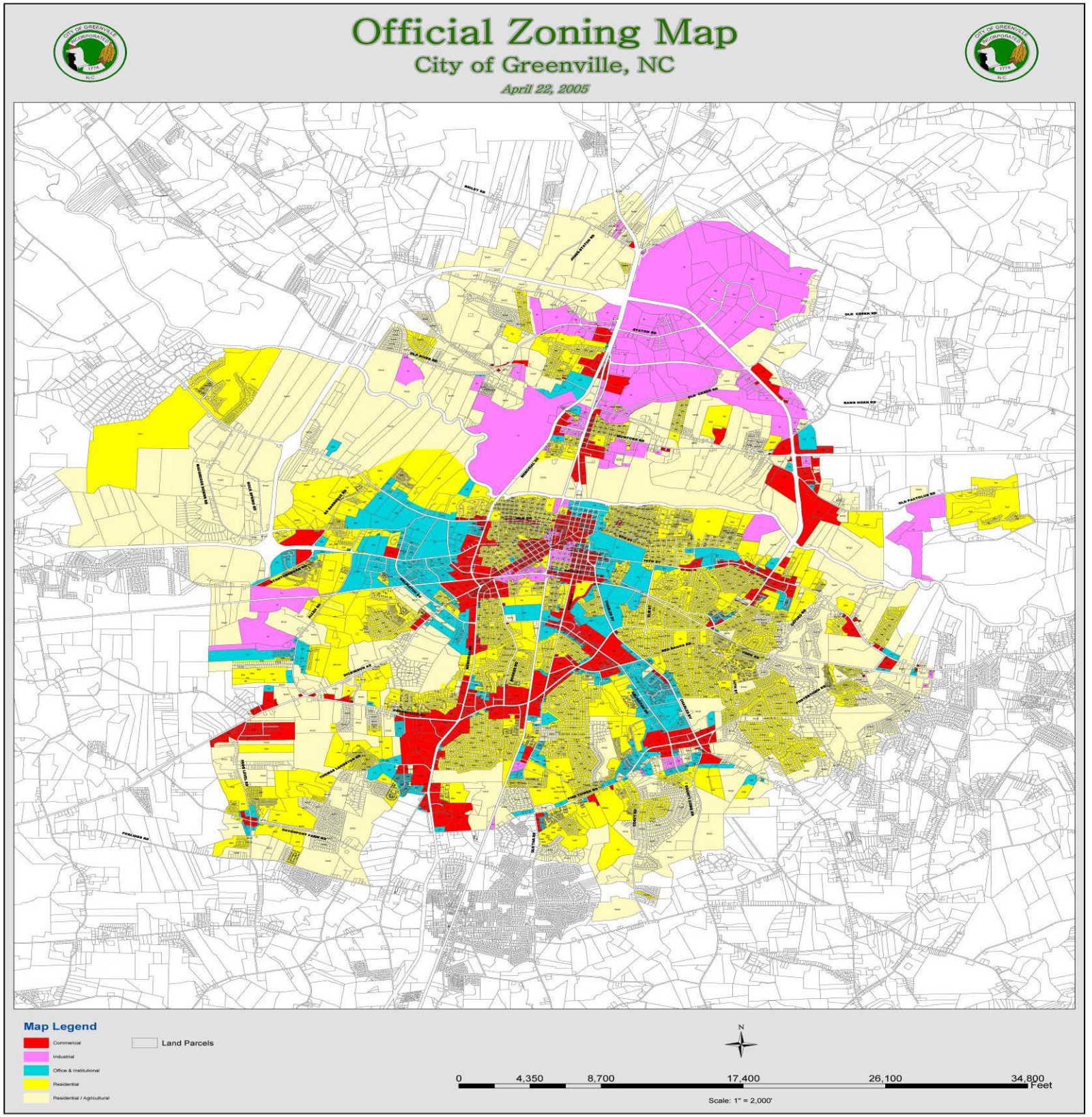

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Figure 7-2: Zoning in the City of Greenville

7.1.4 Greenway Plan

Greenville adopted a new Greenway Master Plan on March 14, 2004, which was an update to a greenway plan completed in 1991. This plan reflects the City's commitment to creating a system of trails that can be used for natural area protection, alternative transportation, and recreational opportunities. The new plan includes the majority of the original greenway routes proposed in the 1991 plan. New options are proposed to replace routes that are no longer feasible, to facilitate access to the primary routes, and to create loops.

There are 42 individual corridors that make up Greenville's proposed greenway system for a total of approximately 102 miles. Two segments had been completed at the time the plan was adopted, and construction of additional corridors is planned to extend beyond the next 16 years. The Greenway Master Plan details opportunities, constraints, and costs associated with each corridor.

7.1.4.1 Riparian Buffers

The Tar-Pamlico Riparian Buffer Protection Rule (15A NCAC 2B .0259) requires 50 foot riparian buffers be maintained on all sides of intermittent and perennial streams, ponds, lakes, and estuarine waters in the basin. This Rule is incorporated into the City of Greenville's Stormwater Management and Control Ordinance. The City will disapprove any new development activity proposed within this buffer, unless approved by DWQ.

7.1.5 Erosion and Sedimentation Control

Sediment is the leading cause of stream degradation in North Carolina (DENR, 1999). Prevention of soil loss protects aquatic life habitat and maintains stream water quality. The City first enacted a Soil Erosion and Sedimentation Control Ordinance in 1989, which establishes a performance-oriented program requiring protection of adjoining natural resources and properties from the effects of accelerated erosion, both during and after construction.

The City of Greenville Soil Erosion and Sedimentation Control Ordinance regulates certain land-disturbing activities to control accelerated erosion and sedimentation in order to prevent the pollution of water and damage to lakes, watercourses, and other public and private property. No erosion and sediment control plan is required for land disturbances less than one acre; however, a land-disturbing permit is required for any activity disturbing more than 5,000 square feet. Several management measures have been adopted as part of the Soil Erosion and Sedimentation Control Ordinance, including:

- Avoid increases in surface runoff volume and velocity by including measures to promote infiltration to compensate for increased runoff from areas rendered impervious.

- Avoid increases in stormwater discharge velocities by using vegetated or roughened swales and waterways in lieu of closed drains and high velocity paved sections.
- Provide energy dissipaters at outlets of storm drainage facilities or reduce flow velocities to the point of discharge. These may range from simple rip rapped sections to complex structures.
- Protect watercourses subject to accelerated erosion by improving cross sections and/or providing erosion-resistant lining.

The Soil Erosion and Sedimentation Control Ordinance includes a table of maximum permissible velocities of stormwater discharges for 13 different soil materials and types. The ordinance requires that construction be conducted such as to minimize the area to be exposed at any one time and to stabilize soils as rapidly as possible. For HQW zones, uncovered areas must be limited to less than 20 acres at a time. Erosion and sedimentation control measures, structures, and devices must be designed to provide protection from the runoff of the twenty-five year storm. The ordinance requires sediment basins to have a settling efficiency of at least 70 percent for the 40 micron soil particle and requires that all land-disturbing activities be provided with ground cover, devices, or structures sufficient to restrain erosion within fifteen working days.

7.1.6 Stormwater Programs and Impervious Surface Limitation

The draft Phase II NPDES stormwater rules were finalized in December 1999. This regulation builds upon the existing Phase I program by requiring that smaller communities be permitted. These communities had to apply by March 2003. The Phase II rules require that small municipal separate storm sewer systems (MS4s) develop and implement a stormwater program with the following measures: (1) public education and outreach on stormwater impacts; (2) public involvement and participation; (3) illicit discharge detection and elimination; (4) construction site stormwater runoff control; (5) post-construction stormwater management for new development and redevelopment; and (6) pollution prevention and good housekeeping for municipal operations.

On April 1, 2001, the Tar-Pamlico Stormwater Rule (15A NCAC 2B .0258) became effective. The Rule established requirements for local programs based on the Tar-Pamlico Nutrient Sensitive Water Strategy's goal of reducing nitrogen loading by 30 percent from 1991 levels and holding phosphorus loading at 1991 levels. The City of Greenville and Pitt County were required to comply with this rule and to develop and submit a local stormwater program to DWQ.

The Tar-Pamlico Stormwater Rule is applicable to the portion of Greenville's City limits located within the Tar-Pamlico River Basin. The City also enforces this Rule within areas of the ETJ within the basin, to the extent authorized by the State. Areas of the City and the ETJ within the Neuse River Basin must also comply with these requirements, and must meet requirements for controlling phosphorus releases.

The City developed a Stormwater Management Program that operates as a Stormwater Utility in 2002 in order to meet the requirements of the Phase II NPDES and the Tar-Pamlico Stormwater rules. The overall objective of this program is to improve the water quality of stormwater runoff that enters the natural waters located in and around the City. The City prepared a Stormwater Management Program Document, which details the requirements of the Tar-Pamlico Stormwater Rule. Local stormwater management programs are required to address new development review and approval, illegal discharges, retrofit locations, and public education. New development is required to meet an average nitrogen loading limit of 4.0 pounds per acre per year and a phosphorus load of 0.4 pounds per acre per year. Property owners exceeding these limits may partially offset these loads by treating existing developed areas that drain to the same stream. There must be no net increase in peak flow leaving the developed site from the predevelopment condition for the 1-year, 24-hour storm.

Under the Tar-Pamlico Stormwater Rule, the City is also required to establish a program to prevent, identify, and remove illegal discharges into the stormwater collection system and to identify sites and opportunities for retrofitting existing development to reduce total nitrogen and phosphorus loads. Finally, the City must develop a locally administered environmental education program for the public and developers in order to address nitrogen and phosphorus loading issues and peak stormwater flow issues. The Program Document describes necessary calculations and methods for meeting these requirements.

The City also prepared a Stormwater Management and Control Ordinance. The ordinance restates the requirements of the Tar-Pamlico Stormwater Rule and provides a means for enforcing these requirements and prohibiting illicit discharges and connections.

In order to limit impervious surfaces for new development, maximum lot coverage regulations are provided in the Greenville Zoning Ordinance for most zones. Typically, the maximum lot coverage for all residential uses is 40 percent.

7.1.7 Floodplain Development Regulations

The legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Parts 3, 5 and 8 of Article 19 of Chapter 106A; and Article 8 of Chapter 160A of the North Carolina General Statutes, delegated the responsibility to local governmental units to adopt regulations designed to promote the public health, safety and general welfare of its citizenry. Flood hazard areas are subject to periodic inundation that may result in loss of life, property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures of flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare. These flood losses are caused by the cumulative effect of obstructions in floodplains causing increases in flood heights and velocities, and by the occupancy in flood hazard areas by uses vulnerable to floods or hazardous to other lands that are inadequately elevated, flood proofed, or otherwise protected from flood damages.

All development that takes place within the floodplain must meet the provisions of the City of Greenville Flood Damage Prevention Ordinance. The City has defined special flood hazard areas as those identified by the Federal Emergency Management Agency (FEMA) or produced under the Cooperating Technical State agreement between the State and FEMA. Also included are lands immediately adjacent to streams or watercourses where locally approved engineering flood studies have identified the limits of the 1 percent flood. In the ordinance, the regulatory flood protection elevation is defined for areas where base flood elevations have been determined as the base flood elevation plus one foot for all structures and other development except manufactured homes, two-family attached dwellings, multi-family dwellings, and single-family dwellings located on lots which have a net area less than 20,000 square feet. For manufactured homes, the regulatory flood elevation is the base flood elevation plus two feet, provided that no portion below the lowest floor is lower than the base flood elevation. For two-family attached, multi-family, or single-family dwellings on lots smaller than 20,000 square feet, the regulatory flood elevation is the base flood elevation plus 1 foot, or the 500-year floodplain elevation, whichever is greater. For areas where the base flood elevation has not been determined, the regulatory flood elevation is at least 2 feet above the highest adjacent grade. Specific provisions for flood hazard reduction provided by the ordinance include:

- All new construction or substantial improvement of any residential structure shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation.
- Non-residential construction shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation. Such structures may be flood proofed in lieu of elevation.
- Manufactured homes shall be elevated so that the reference level is no lower than the regulatory flood protection elevation and be securely anchored to an adequately anchored foundation.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted in any floodway or non-encroachment area unless hydrologic and hydraulic analyses performed in accordance with standard engineering practice demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted within 20 feet from top of bank or five times the width of stream for areas where no base flood elevation has been provided, unless certification by a registered professional engineer demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.
- No encroachment, including fill, new construction, substantial improvements or new development shall be permitted along rivers and streams where based flood elevation is provided but neither floodway nor non-encroachment areas are

identified unless certification by a registered professional engineer demonstrates that the cumulative effect of the proposed development will not increase the water surface elevation the base flood by more than 1 foot.

7.1.8 Water Shortage Response

GUC has implemented a Water Emergency Management Plan in their Utilities Ordinance. The Water Emergency Management Plan was revised to include triggers for implementation of the Stage 1, 2, and 3 conservation measures, effective July 29, 2008. In lieu of river flow, the implementation triggers are based on river level at the raw water intake or the salt wedge location from the raw water intake. Due to the tidal influence, river flow is not an appropriate trigger, since there have been many instances of net negative flow recorded but adequate water over the intake screens (indicating tidally influenced flow). Table 7-2 provides the implementation triggers for water restrictions.

Table 7-2: Greenville Utilities Commission Water Shortage Response Triggers

Stage	River Level at WTP Intake [1]		Salt Wedge Location from WTP Intake
1	– 1.0 feet MSL	Or	10 miles
2	– 1.5 feet MSL	Or	7 miles
3	– 2.0 feet MSL	Or	4 miles

[1] The top elevation of the raw water intake screens are at – 2.5 feet MSL and the mid-point of the screens are at elevation – 3.4 feet MSL. Therefore, when the river level is 1.5 feet above the top of the intake screen, Stage 1 restrictions are applied.

GUC Water Purchase Agreements with Farmville, Winterville, and Greene County stipulate that these systems implement the same water shortage response measures that GUC enacts. All of these communities have adopted GUC's water shortage response measures.

The stages of water conservation are described as follows:

1. Stage 1 – Water Conservation Alert: A Stage 1 water emergency may be declared in the event of an immediate water shortage or when there are three consecutive days when water demand exceeds 80 percent of water production capacity. During a declared Stage 1 water emergency, the following voluntary water conservation practices are encouraged:
    a. Inspect and repair all faulty and defective parts of faucets and toilets.
    b. Use shower for bathing rather than bathtub and limit shower to no more than 5 minutes.

c. Do not leave faucets running while shaving, brushing teeth, rinsing or preparing food.

d. Limit the use of clothes washers and dishwashers and when used, operate fully loaded.

e. Limiting lawn watering to that necessary for plant survival. Water lawns before the peak demand hours of 6 to 10 p.m.

f. Limit vehicle washing.

g. Do not wash down outside areas such as sidewalks, driveways, patios, etc.

h. Installing water-saving showerheads and other devices.

i. Use disposable and biodegradable dishes where possible.

j. Install water-saving devices in toilets such as early closing flappers.

k. Limit hours of water-cooled air conditioners.

l. Do not fill swimming or wading pools.

2. Stage 2 – Water Shortage Warning: A Stage 2 water emergency may be declared in the event of an immediate water shortage or when there are two consecutive days when water demand exceeds 90 percent of the water production capacity. During a declared Stage 2 water emergency, the following activities are prohibited:

   a. Watering lawns, grass, shrubbery, trees, flowers, and vegetable gardens except by hand-held hose, container, or drip irrigation system. A person who regularly sells plants will be permitted to use water on their commercial stock. A golf course may water their greens. State, County and Town licensed landscape contractors may water by hand-held hose or drip irrigation any plants under a written warranty.

   b. Filling swimming or wading pools, either newly constructed or previously drained. Make-up water for pools in operation will be allowed.

   c. Using water-cooled air conditioners or other equipment, in which cooling water is not recycled, unless there are health and safety concerns.

   d. Washing any type of mobile equipment including cars, trucks, trailers, boats, or airplanes. Any persons involved in a business of washing motor vehicles may continue to operate.

   e. Washing outside surfaces such as streets, driveways, service station aprons, parking lots, or patios.

f. Washing the exterior of office buildings, homes, or apartments.

g. Using water for any ornamental fountain, pool, pond, etc.

h. Serving drinking water in food establishments, such as restaurants or cafeterias, unless requested to do so by a customer.

i. Using water from a public or private fire hydrant for any reason other than to suppress a fire or other public emergency or as authorized by the Town Manager or his authorized representative.

j. Using water to control or compact dust.

k. Intentionally wasting water.

l. Commercial and industrial water customers must achieve mandatory reductions in water usage through whatever means are available. A minimum reduction of 20 percent shall be the target; however, a greater target reduction percentage may be required depending on the severity of the water emergency. Compliance with the reduction target shall be determined by the General Manager or his authorized representative. Variances to the target reduction may be granted by the Town Manager or his authorized representative to designated public health facilities.

3. Stage 3 – Water Shortage Danger: A Stage 3 water emergency may be declared in the event of an immediate water shortage or when there is one day when water demand exceeds 100 percent of the water production capacity. During a declared Stage 3 water emergency the following activities are prohibited, in addition to activities prohibited under Stage 2:

   a. Watering lawns, grass, shrubbery, trees, and flowers.

   b. Washing motor vehicles at commercial car wash establishments.

   c. Watering any vegetable garden except by hand-held hose, container, or drip irrigation.

   d. Commercial and industrial water customers must achieve mandatory reductions in water usage through whatever means are available. A minimum reduction of 50 percent shall be the target; however, a greater target reduction percentage may be required depending on the severity of the water emergency. Compliance with the reduction target shall be determined by the General Manager or his authorized representative. Variances to the target reduction may be granted by the General Manager or his authorized representative to designated public health facilities.

e. In the event that the prohibition of the activities listed above is not sufficient to maintain an adequate supply of water for fire protection, all use of water for purposes other than maintenance of public health and safety is prohibited. Residential water use is limited to the amount necessary to sustain life through drinking, food preparation, and personal hygiene.

The General Manager or authorized representative can require that commercial and industrial water customers prepare plans detailing measures to be taken by them to achieve mandatory reductions in daily water usage during Stage 2 and Stage 3 emergencies. Such plans shall be completed within 60 calendar days after receipt of notice to prepare them.

Public or private water systems purchasing water from GUC were required to adopt and enforce this entire article as a condition of water service. These systems are required to enforce the water use restriction for the level of emergency.

Additionally, GUC and its wholesale customers strongly encourage the use of water saving devices. GUC is a licensed member of the national “Water Use it Wisely” campaign. The Energy Services and Public Information Offices incorporate water conservation messages into all communications. This includes preparation of fact sheets, television and radio advertisements, print ads, and billboards to provide local citizens with water conservation tips.

7.2 Pitt County

Pitt County is discussed in this EA to supplement the areas that Farmville or Winterville may serve that are outside the respective ETJs.

7.2.1 Land Use Planning and Environmental Resource Protection Initiatives

7.2.1.1 Land Use Plan

Pitt County finalized an update of its Land Use Plan in early 2002 in anticipation of continued population growth. The original Land Use Plan was adopted in 1990 and a draft update was prepared in 1994. The overall purpose of the Land Use Plan is to, “Protect the public health, safety, and welfare by promoting reasonable, orderly, and efficient growth. Ensure that development includes a variety of land uses, is sensitive to environmental and social concerns, and maintains the County’s character and assets.”

Pitt County adopted the Land Use Plan on April 15, 2002. The plan identifies County goals related to growth and development, land use, transportation, appearance, community services, the natural environment, and plan implementation. Growth within the County has caused concerns over land use and the protection of County resources. Specific objectives and implementation strategies established in order to regulate land use and development include:

- Encourage future development in areas nearest existing municipal corporate limits and other currently developed areas to yield a more compact development pattern and to reduce suburban sprawl.
- Encourage development in areas where the necessary infrastructure – roads, water, sewer, and schools are available, planned, or can most cost efficiently be provided and extended to serve development.
- Develop an effective, jurisdiction-wide land use regulatory program as the best means to implement the goals and objectives of the Comprehensive Land Use Plan update and as a means to maintain control over growth and development in rural areas that are not ready for urbanization.
- Preserve large tracts of prime agricultural land to ensure that farming remains a viable part of the local economy.
- Discourage suburban sprawl by adopting policies that encourage development of mixed land uses, as appropriate, to provide easy access, reduce travel time, and improve convenience among uses near established urban areas.

Additionally, the Land Use Plan identifies six land use classifications within the County. The purpose of the land use classifications is to illustrate a general land development pattern that adheres to and seeks to achieve land use plan goals and objectives.

Approximately 25 percent of the County has been designated Agricultural/Open/Natural Resource. Most of the land in this area is within the 100-year floodplain, and development is minimal. Land use within this classification includes agriculture, forestry, recreational uses, open space, resource conservation, critical natural areas, and very low density residential.

7.2.1.2 Northwest Planning Area Land Use Plan

The Northwest Planning Area Land Use Plan was developed in 1999 to 2000 and was officially adopted by the County on January 8, 2001. The Northwest Planning Area covers approximately 39,000 acres of land in the northwest portion of the County that has experienced rapid residential growth in recent years and was heavily impacted by flooding associated with Hurricane Floyd in 1999. The overall goals of the Northwest Planning Area process were to provide for more orderly growth and development of the area, identify areas suitable for residential and non-residential development, protect investments in public infrastructure, and focus development near the City of Greenville to reduce urban sprawl and minimize conflict with farming operations and other non-urban land uses. Many of the objectives and implementation strategies of the Comprehensive Land Use Plan are found in the Northwest Planning Area Land Use Plan but focus specifically on development in this area. A separate Land Use Map was developed for this Plan.

7.2.1.3 Water Supply Watershed Protection Ordinance

Pitt County has adopted a Water Supply Watershed Protection Ordinance in order to protect the quality of surface water supplies from nonpoint source pollution and minimize stormwater runoff by regulating development densities and the amount of built-upon area within the critical and protected areas of affected watersheds. Critical areas are those areas adjacent to a water supply intake or reservoir where risk associated with pollution is greater than from the remaining portions of the watershed. This includes the land 0.5 miles upstream of the intake located directly in the stream or river or the ridgeline of the watershed, whichever comes first. Protected areas include the land area 10 miles upstream of and draining to a river intake, excluding the critical areas.

Under the Water Supply Watershed Protection Ordinance, developments within the critical area and developments constructed with a curb and gutter street system within the protected area must meet the following development restrictions:

- Subdivision lots and manufactured home park space must have a minimum of 21,780 square feet of land area.
- Multifamily residential developments must have either a built-upon area of 24 percent or less or a minimum of 21,780 square feet of land area for each dwelling unit.
- Non-residential developments may not exceed 24 percent built-upon area.

Developments constructed without a curb and gutter street system within the protected area must meet the following development restrictions:

- Subdivision lots and manufactured home park space must have a minimum of 14,520 square feet of land area.
- Multifamily residential developments must have either a built-upon area of 36 percent or less or a minimum of 14,520 square feet of land area for each dwelling unit.
- Non-residential developments may not exceed 36 percent built-upon area.

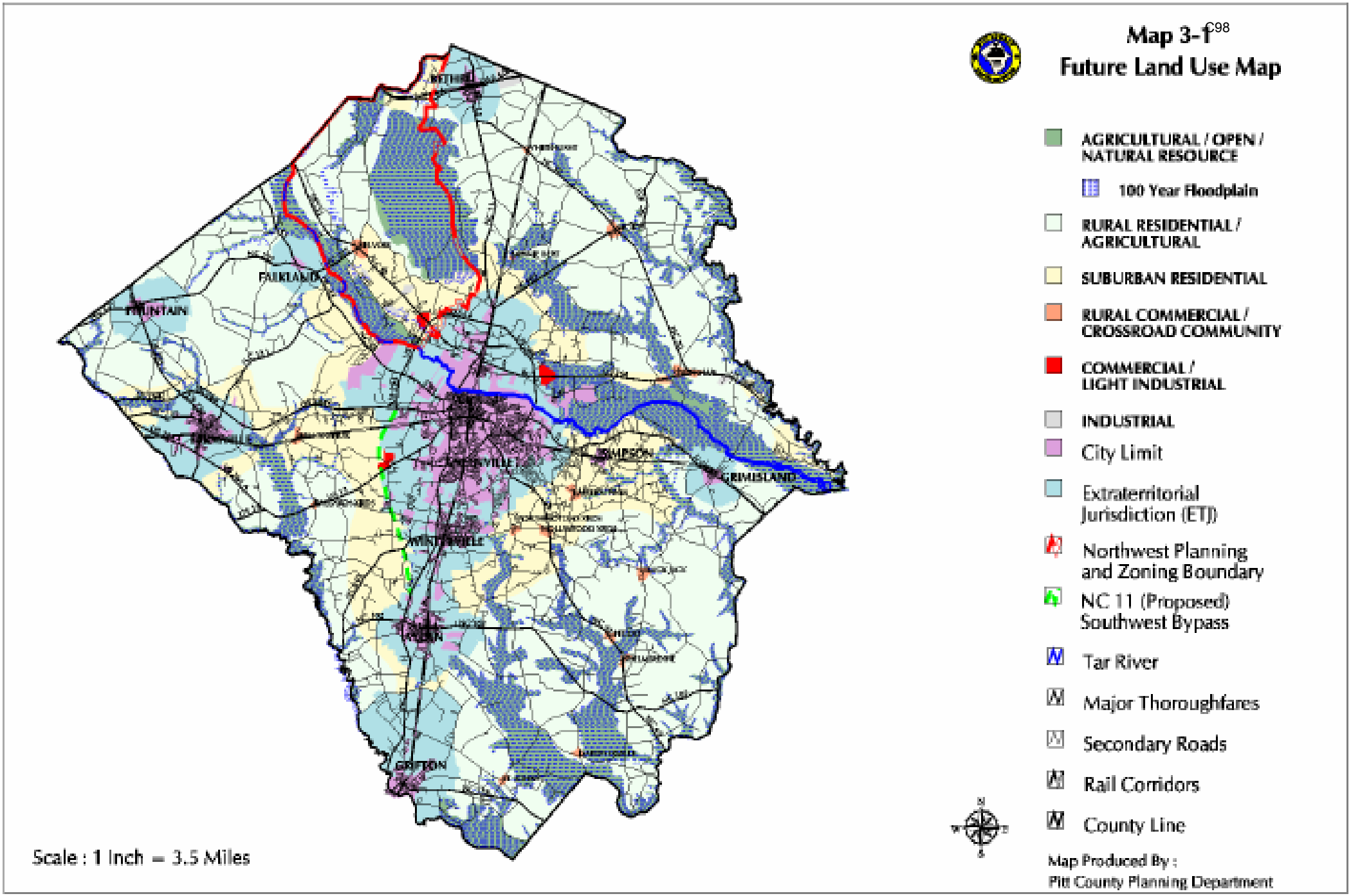

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Figure 7-3: Future Land Use Map for Pitt County

MAP 3-1 FUTURE LAND USE

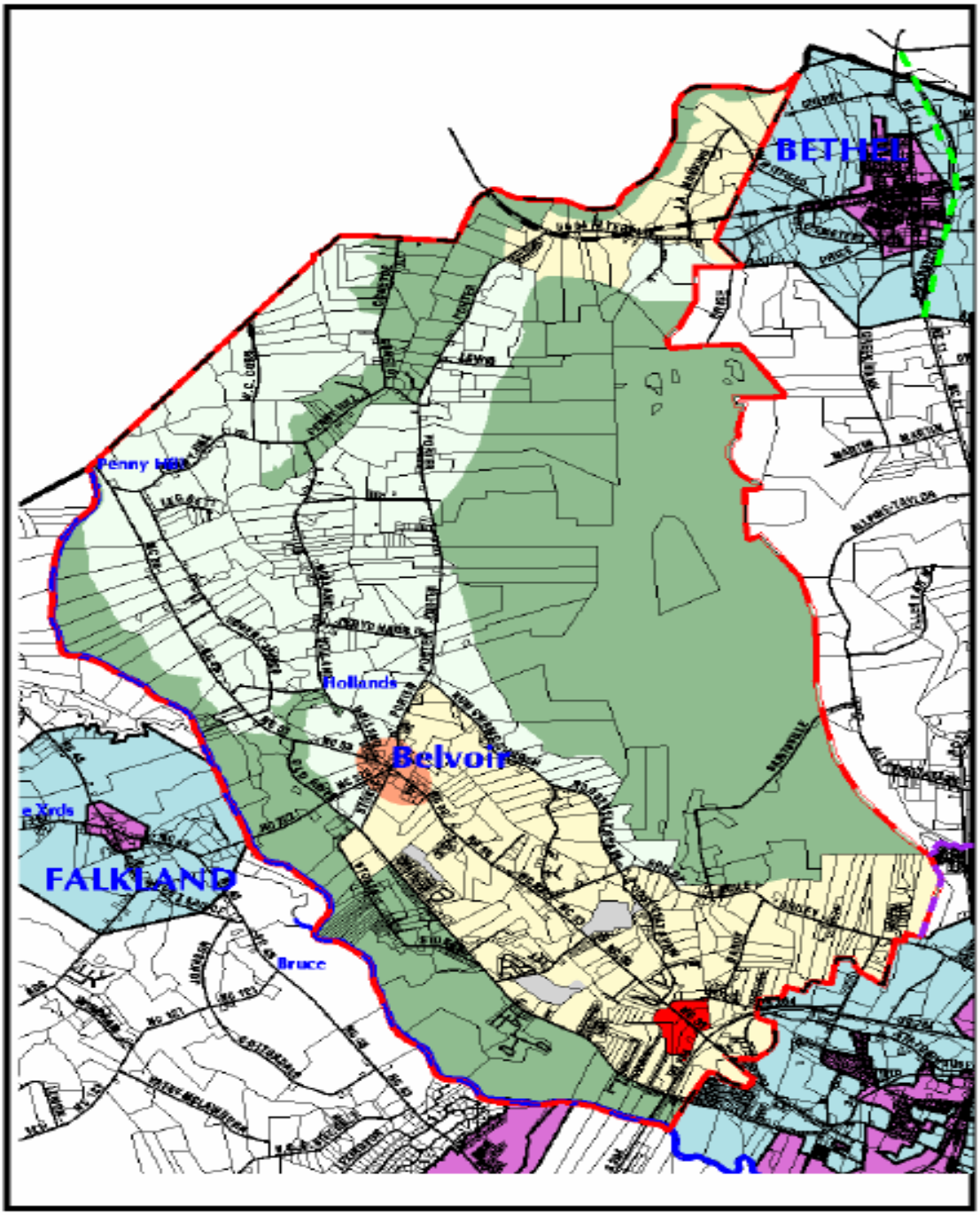
ADOPTED JANUARY 8, 2001

C99

- AGRICULTURAL/OPEN/ NATURAL RESOURCE
- RURAL RESIDENTIAL/ AGRICULTURAL
- SUBURBAN RESIDENTIAL
- RURAL COMMERCIAL/ CROSSROAD COMMUNITY
- COMMERCIAL/LIGHT INDUSTRIAL
- HEAVY INDUSTRIAL
- 100-YEAR FLOODPLAIN
- RAILROAD
- PROPOSED HIGHWAYS
- CITY LIMITS
- EXTRATERRITORIAL JURISDICTION (ETJ)
- PLANNING & ZONING AREA BOUNDARY
- PROPOSED ONE MILE EXTENSION OF GREENVILLE ETJ

SCALE: 1 INCH = 1.25 MILES

MAP PRODUCED BY PITT COUNTY PLANNING DEPARTMENT



MAP 3-1
FUTURE LAND USE
ADOPTED JANUARY 8, 2001

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Figure 7-4: Future Land Use Map for the Northwest Planning Area of Pitt County

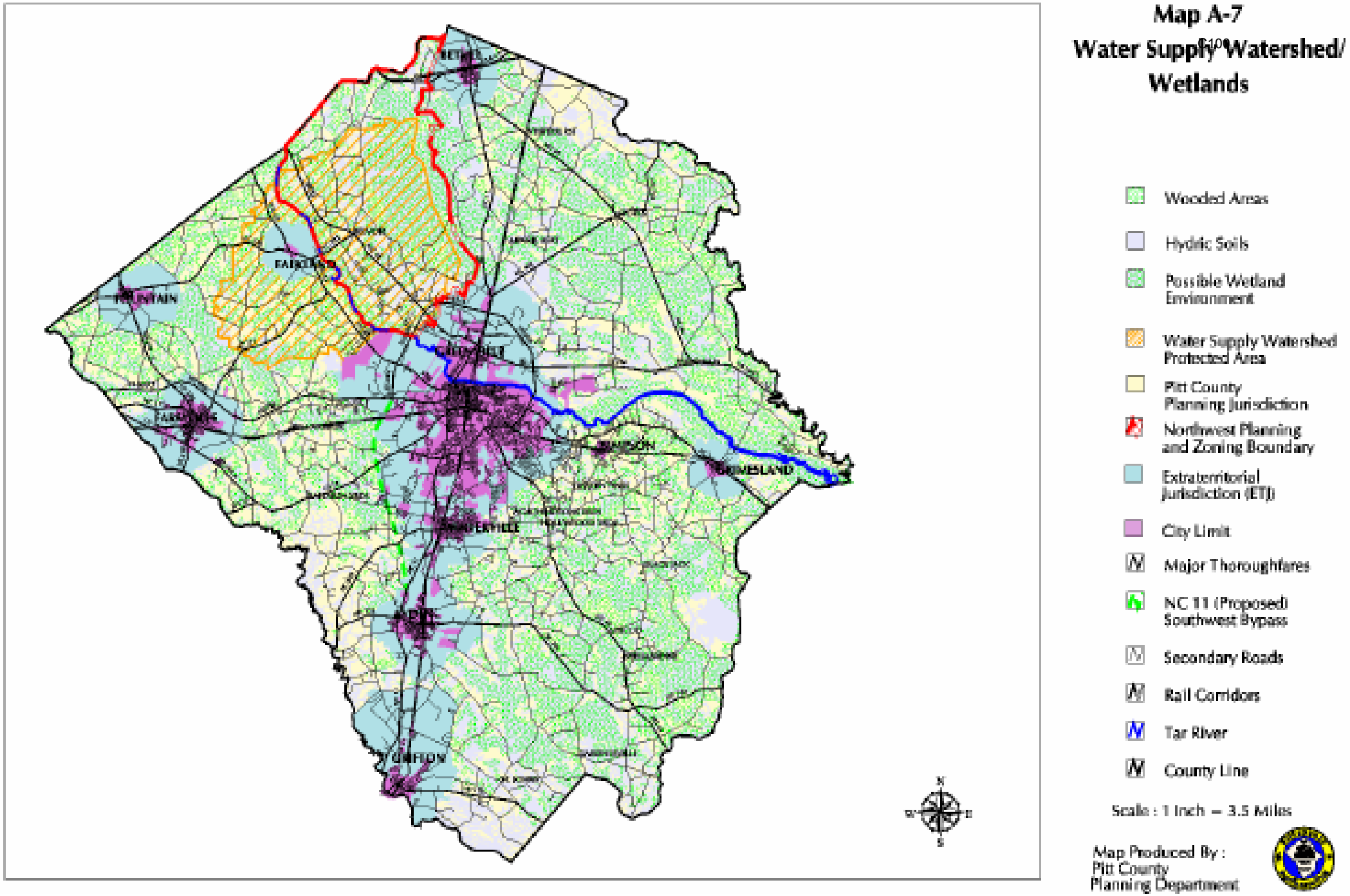

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Figure 7-5: Watershed Protection in Pitt County

7.2.2 Zoning

Zoning requirements and procedures for land within Pitt County are set forth in the Pitt County Zoning Ordinance. This ordinance applies to areas within the County that are located outside the corporate or municipal ETJs of any municipality. The County has been divided into eight zoning districts in the ordinance, and there are an additional four overlay districts. The purpose of these divisions is to provide for the orderly growth and development of the County, minimize land use conflicts, and protect the natural environment and other valuable resources. Density limits and minimum lot sizes have been established for each zoning district and are summarized in Table 7-3.

Five districts have been established for residential uses. The remaining districts are general commercial, light industrial, and general industrial. The rural agricultural district was established to preserve and encourage the continued use of land for agricultural, forestry, and open space purposes; to encourage small-scale and low intensity commercial uses that primarily provide goods and services to residents of the surrounding rural area; to encourage those industries which are agricultural-related; to encourage the concentration of more intensive urban land uses in and around identified growth area; and to discourage any use which would create premature or extraordinary public infrastructure and service demands.

The Water Supply Watershed Overlay was created to protect surface water quality from nonpoint source pollution and minimize stormwater runoff by regulating development densities within the critical and protected areas of affected watersheds. All new development within the overlay requiring a sediment and erosion control plan must comply with the zoning regulations. Two separate overlay districts have been created, the Critical Area Overlay District (WCA) and the Protected Area Overlay District (WPA). Within the WCA district, subdivision lots and manufactured home park spaces must have a minimum area of 21,780 square feet or the minimum required for the zoning district in which it is located. Multi-family residential developments must have a built-upon area of 24 percent or less or a minimum lot size of 21,780 square feet for each dwelling unit. Non-residential development must not exceed 24 percent built-upon area. Within the WPA district for development with a curb and gutter street system, the same requirements apply. Within the WPA district for development without a curb and gutter street system, subdivision lots and manufactured home park spaces must have a minimum area of 14,520 square feet or the minimum required for the zoning district in which it is located. Multi-family residential developments must have a built-upon area of 36 percent or less or a minimum lot size of 14,520 square feet for each dwelling unit. Non-residential development must not exceed 36 percent built-upon area. Vegetative buffer areas are required within this zone to protect water quality, and certain land uses are prohibited.

Table 7-3: Density Limits in Pitt County Zoning Ordinance

Zoning District	Description	Minimum Lot Size
RA	Low density residential, commercial, and agricultural-related industrial	30,000 ft^2
RR	Low density, single-family residential without access to water and sewer infrastructure	Single-family: 25,000 ft^2 Two-family: 37,500 ft^2 Multi-family: 25,000 ft^2 for 1st unit, 12,500 ft^2 for additional units
R40	Low density, single-family residential without access to water and sewer infrastructure	40,000 ft^2
SR	Low density, single-family residential with access to public water and sewer infrastructure	Single-family: 12,500 ft^2 Two-family: 18,750 ft^2 Multi-family: 12,500 ft^2 for 1st, 6,250 ft^2 for 2nd, 4,135 ft^2 each additional
MFR	Moderate density, single and multi-family residential	Single-family: 10,000 ft^2 Two-family: 22,500 ft^2 with septic systems, 15,000 ft^2 with public water and sewer Multi-family: 10,000 ft^2 for 1st, 5,000 ft^2 for 2nd, 2,856 ft^2 each additional
GC	Moderate density, multi-family residential and commercial use	Two-family: 22,500 ft^2 with septic systems, 15,000 ft^2 with public water and sewer Multi-family: 10,000 ft^2 for 1st, 5,000 ft^2 for 2nd, 2,856 ft^2 each additional

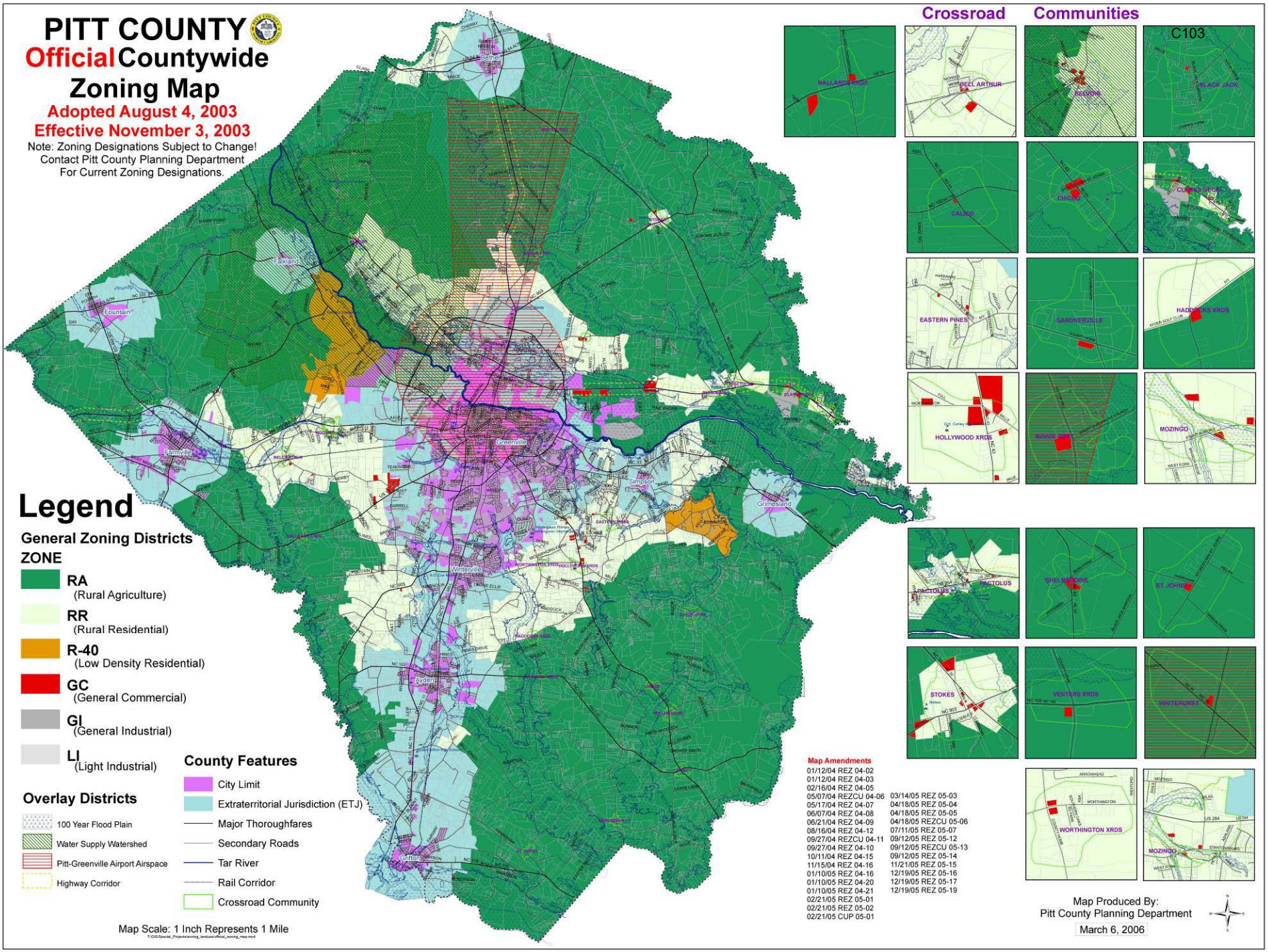

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Figure 7-6: Zoning in Pitt County

7.2.3 Open Space Plans/Initiatives, Greenways, and Riparian Buffers

7.2.3.1 Greenway Plan

The Pitt County Comprehensive Land Use Plan includes a goal for the establishment of greenways in the County. As a result, the County Planning Department and the East Carolina University Planning Program drafted the County's first Greenway Plan. The Pitt County Greenway Plan 2025 was adopted February 20, 2006.

The Greenway Plan lists many goals and objectives for the County's greenway system, including:

- Maintain and enhance the character and identity of Pitt County by the protection of natural areas, open space, and other features that represent the County's heritage, which will improve the long-term sustainability of the County.
- Protect wetlands and floodplain environments from further degradation.
- Preserve and enhance wildlife habitat.
- Encourage protection of agriculture, open space, and green space.

The Greenway Plan recommends the consideration of approximately 215 miles of greenway network, located primarily along some of the major, critical streams and rivers in the County. The proposed greenways consist of approximately 155 miles within the unincorporated areas of the county, 45 miles within the ETJs of municipalities, and 15 miles within limits of County municipalities. Approximately 55 percent would be designated as recreation, 42 percent would be designated for conservation corridors, and 3 percent would consist of sidewalk connectors in urban areas.

7.2.3.2 Riparian Buffers

The Tar-Pamlico Riparian Buffer Protection Rule requires a 50-foot riparian buffer on all sides of intermittent and perennial streams, ponds, lakes, and estuarine waters in the basin. The same requirements apply to the Neuse River Basin, which is also located in Pitt County. On September 14, 2006, the County adopted the Pitt County Riparian Buffer Protection Ordinance, which became effective January 1, 2007. The North Carolina Water Quality Committee (WQC) and the Environmental Management Commission (EMC) voted to grant authority of the Neuse and Tar-Pamlico Buffers to Pitt County.

The Riparian Buffer Protection Ordinance was created for the following objectives:

- Protect and preserve the existing riparian buffers within Pitt County to maintain nutrient controlling function.
- Preserve water quality for the citizens of Pitt County.
- Establish policies through which the local government body may fulfill these objectives.

This ordinance establishes a 50-foot wide riparian buffer adjacent to all surface waters within the County and divides the riparian buffer into two zones. Zone 1 includes the first 30 feet from the edge of the water body and must remain essentially undisturbed vegetation. Zone 2 extends 30 feet beyond Zone 1 and may include managed vegetation. The ordinance also defines land use types that are exempt, allowable, allowable with mitigation, or prohibited within the buffer zones. Exempt uses are allowed if every reasonable effort is made to preserve buffer functions. Allowable uses are allowed within the riparian buffer if there are no practical alternatives, and require written authorization from the County prior to initiation. Uses allowable with mitigation are allowed if there are no practical alternatives and an appropriate mitigation strategy has been approved. Prohibited uses are not allowed without a variance.

7.2.4 Erosion and Sedimentation Control

Pitt County operates a state-delegated Erosion and Sedimentation Control Program that meets or exceeds State erosion control requirements. The County Soil Erosion and Sedimentation Control Ordinance provides for a sediment control officer who is responsible for periodically inspecting sites for enforcement of the ordinance. In 2001, Pitt County's Soil Erosion and Sedimentation Control Program won the Local Soil Erosion and Sedimentation Control Program Award for Outstanding Local Programs, sponsored by the NC Sedimentation Control Commission. This award identifies the County's program as being exemplary in the State. In 2004, Pitt County implemented the Environmental Excellence Award Program, recognizing developers who excel in the installation and maintenance of best management practices (BMPs) while conducting land disturbing activities.

Requirements found in the Pitt County Soil Erosion and Sedimentation Control Ordinance are essentially identical to those of the City of Greenville.

7.2.5 Stormwater Programs and Impervious Surface Limitation

In response to the Tar-Pamlico Stormwater Rule, Pitt County formed the Tar-Pamlico Stormwater Advisory Committee to develop a local stormwater program, provide guidance for implementation, make recommendations, and educate the public on the impacts of the program. On October 12, 2004, the Pitt County Stormwater Ordinance for Nutrient Control became effective. Pitt County also prepared a Program Document for the Pitt County Stormwater Program for Nutrient Control. Both documents were revised May 15, 2006.

The Program Document is almost identical to the Program Document prepared by the City of Greenville, and details the requirements of the Tar-Pamlico Stormwater Rule. The Stormwater Ordinance restates the requirements of the Tar-Pamlico Stormwater Rule and details how they must be achieved in the County.

7.2.6 Floodplain Development Regulations

All development that takes place within the floodplain must meet the provisions of the Pitt County Flood Damage Prevention Ordinance, which was adopted February 21, 2005. The County has defined special flood hazard areas as those identified by FEMA or produced under the Cooperating Technical State agreement between the State and FEMA. In the ordinance, the regulatory flood protection elevation is defined for areas where base flood elevations have been defined as the base flood elevation plus 2 feet. For areas where the base flood elevation is not defined, this elevation is at least 2 feet above the highest adjacent grade. Specific provisions for flood hazard reduction provided by the ordinance include:

- All new construction or substantial improvement of any residential structure shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation.
- Non-residential construction shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation. Structures in the A, AO, AE, and A1-30 zones may be flood proofed in lieu of elevation.
- Manufactured homes shall be elevated so that the reference level is no lower than the regulatory flood protection elevation and be securely anchored to an adequately anchored foundation.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted within 20 feet from top of bank or five times the width of stream for areas where no base flood elevation has been provided, unless certification by a registered professional engineer demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.
- No encroachment, including fill, new construction, substantial improvements or new development shall be permitted along rivers and streams where based flood elevation is provided but neither floodway nor non-encroachment areas are identified unless certification by a registered professional engineer demonstrates that the cumulative effect of the proposed development will not increase the water surface elevation the base flood by more than one foot.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted in any floodway or non-encroachment area unless hydrologic and hydraulic analyses performed in accordance with standard engineering practice demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.

7.2.7 Water Shortage Response

The Towns of Farmville and Winterville have implemented GUC's water shortage response measures. These measures apply to all customers served. Refer to Section 7.1.7 for a detailed explanation.

7.3 Town of Farmville

7.3.1 Land Use Planning

The Town of Farmville is adopted a Revised Land Use Plan on June 3, 2008. The primary purpose of the plan is to prepare for future development, based on the values and needs of Town residents. In preparation of the Plan, the Town of Farmville conducted public meetings and solicited public opinion using community surveys. Based on the information gathered, the Board of Commissioners developed a vision statement for the Town of Farmville, which reads,

> *"Farmville is a good place to raise a family, and/or lead an active retirement life, where citizens have a strong sense of community, are civically involved, and wish to preserve a unique educational environment. Farmville's residents have a mix of cultural and recreational activities for all ages to provide a good quality of life in a community that is clean, neat and aesthetically pleasing. We will grow at a targeted rate of 2 percent per year, while maintaining a community that is residential focused with complete and quality basic services being provided (both public and private), with future economic development focusing on quality industrial and business development. Farmville is a safe community where citizens have confidence and pride in the quality and service of the local government."*

The Board of Commissioners and Town Planning Department also developed specific objectives and implementation strategies related to future land use, economic development, recreation, housing, and infrastructure. Specific objectives that will regulate land use and development include:

- In-fill existing areas with residential development.
  - Examine zoning and subdivision ordinances.
  - Revise zoning standards for multi-family residences in the R-5 and R-8 zones.
- Maintain historic character of town.
  - Continue to educate landowners about the unique historic character of Farmville.
  - Strengthen zoning to include historic district appearance codes.

7.3.2 Zoning

The Town of Farmville Zoning Ordinance establishes 19 zoning districts, including one overlay district, which is different from those of the City of Greenville or Pitt County. The Zoning Ordinance establishes minimum lot size requirements for different land classifications, in order to stabilize established and planned development. Table 7-4 summarizes minimum lot sizes for residential zoning jurisdictions.

Table 7-4: Density Limits in Town of Farmville Zoning Ordinance

Zoning District	Description	Minimum Lot Size
RA-20	Residential-agricultural, rural or near-rural	20,000 ft^2
R-15	Low density, single-family residential neighborhoods	15,000 ft^2
R-12	Medium-density, single-family residential neighborhoods	12,000 ft^2
R-8	Medium to high-density, single-family and multi-family residential neighborhoods	Single-family: 8,000 ft^2 Multi-family: 8 units/acre
R-5	High-density, single-family and multi-family residential neighborhoods	Single-family: 5,000 ft^2 Two-family: 7,500 ft^2 Multi-family: 12 units/acre
R-MH (Manufactured Homes)	High-density, manufactured homes	5,000 ft^2
R-MF	High density, multi-family residential	See footnote 1

[1] *Maximum of 12 one-bedroom units or 17 two-bedroom units per acre.*

7.3.3 Open Space Plans/Initiatives, Greenways, and Riparian Buffers

The Town of Farmville has established a Recreation Department responsible for creating a long-range plan for acquisition and development of recreation areas and facilities. The mission of this department is to provide recreational opportunities, encourage an appreciation for the natural environment, and ensure responsible stewardship of Town resources, parks, and natural areas.

There are two parks within the Farmville town limits. The Oliver Murphrey Park and Walking Trail was built in place of homes lost in the 1999 floods from Hurricane Floyd. The May Museum and Park is dedicated to preserving and interpreting the area history of Farmville.

7.3.3.1 Greenway Plan

The Pitt County Greenway Plan 2025 was adopted by the Farmville Board of Commissioners on January 3, 2006. Approximately 12 miles of greenway are proposed for the Town, including 1.62 miles within the Town limits and 10.38 miles within the Town ETJ.

7.3.3.2 Riparian Buffers

The Town Zoning Ordinance requires 50-foot vegetative buffers along all perennial waters. No new development is allowed in the buffer, except for water dependent structures and public projects where no practical alternative exists.

7.3.4 Erosion and Sedimentation Control

The Town of Farmville enforces its own Sedimentation and Erosion Control Ordinance. This ordinance contains the same requirements discussed previously for the Pitt County Erosion and Sedimentation Control Ordinance.

7.3.5 Stormwater Programs and Impervious Surface Limitation

The Town of Farmville has not been required to comply with the Phase II NPDES Stormwater rules or the Tar-Pamlico Stormwater Rule at this time. The Town of Farmville Zoning Ordinance establishes impervious surface limitations for most zones. An impervious surface limitation of 60 percent has been established for the neighborhood business district. A limit of 65 percent has been established for zones R-12 and R-8. A limit of 75 percent has been established for zones R-5, R-MH, R-MF, and the Highway Business, Rural Business, Industrial, Light Industrial, and Office and Institutional Districts. No limit has been established for Zones RA-20, R-15, R-12 or the Central or General Business Districts.

7.3.6 Floodplain Development Regulations

All development that takes place within the floodplain must meet the provisions of the Town of Farmville Flood Damage Prevention Ordinance. The Town has defined special flood hazard areas as those identified by the Federal Emergency Management Agency (FEMA) or produced under the Cooperating Technical State agreement between the State and FEMA. In the ordinance, the regulatory flood protection elevation is defined for areas where base flood elevations have been defined as the base flood elevation plus four feet. For areas where the base flood elevation is not defined, this elevation is two feet above the highest adjacent grade. Specific provisions for flood hazard reduction provided by the ordinance include:

- All new construction or substantial improvement of any residential structure shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation.
- Non-residential construction shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation. Structures in the A, AO, AE, and A1-30 zones may be flood proofed in lieu of elevation.
- Manufactured homes shall be elevated so that the reference level is no lower than the regulatory flood protection elevation and be securely anchored to an adequately anchored foundation.

- New construction or substantial improvements of elevated buildings that include fully enclosed areas that are below the regulatory flood protection elevation shall not be designed to be used for human habitation, but shall be designed to be used only for parking of vehicles, building access, or limited storage of maintenance equipment. Such areas must also meet specific design criteria.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted within 20 feet from top of bank or 5 times the width of stream for areas where no base flood elevation has been provided, unless certification by a registered professional engineer demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.
- No encroachment, including fill, new construction, substantial improvements or new development shall be permitted along rivers and streams where based flood elevation is provided but neither floodway nor non-encroachment areas are identified unless certification by a registered professional engineer demonstrates that the cumulative effect of the proposed development will not increase the water surface elevation the base flood by more than one foot.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted in any floodway or non-encroachment area unless hydrologic and hydraulic analyses performed in accordance with standard engineering practice demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.

7.3.7 Water Shortage Response

The Town of Farmville has implemented GUC's water shortage response measures. These measures apply to all customers served. Refer to Section 7.1.7 for a detailed explanation.

Additionally, the Town Manager or authorized representative can require that commercial and industrial water customers prepare plans detailing measures to be taken by them to achieve mandatory reductions in daily water usage during Stage 2 and Stage 3 emergencies. Such plans shall be completed within 60 calendar days after receipt of notice to prepare them.

7.4 Town of Winterville

7.4.1 Open Space Plans/Initiatives, Greenways, and Riparian Buffers

7.4.1.1 Greenway Plan

The Pitt County Greenway Plan 2025 was recommended for adoption by the Winterville Board of Aldermen on December 12, 2005. Approximately 14.7 miles of greenway are proposed for the Town, including 7.17 miles within the Town limits and 7.53 miles within the Town ETJ.

7.4.1.2 Riparian Buffers

The Neuse River NSW Management Strategy Buffer Rules require that existing riparian buffer areas be protected and maintained on both sides of surface waters, including both intermittent and perennial streams (15A NCAC 2B.0233). The following represent a few of the Neuse Buffer Rule requirements:

- A 50-foot buffer must be maintained on each side of surface waters.
- All flow entering the buffer must be diffuse flow.
- Non-electric utility crossings in the buffer must be perpendicular to stream flow (unless it is shown “no practical alternative” is available and an appropriate mitigation strategy is provided).
- Underground electric utility crossings may be other than perpendicular only if specified Best Management Practices (BMPs) are used, including all woody vegetation is removed by hand, diffuse flow is maintained at all times, and vegetation removal is minimized (root systems must be left intact).
- Harvesting of dead or infected trees or application of pesticides necessary to prevent or control extensive tree pest and disease infestation is allowed. The Division of Forest Resources must approve the practice for a specific site.

The Town will disapprove any new development activity proposed within this buffer, unless approved by DWQ.

7.4.2 Erosion and Sedimentation Control

The Pitt County Soil Erosion and Sedimentation Control Ordinance is enforced within the Town of Winterville.

7.4.3 Stormwater Programs and Impervious Surface Limitation

The Town of Winterville has not been required to comply with the Phase II NPDES Stormwater rules or the Neuse Stormwater Rules at this time.

7.4.4 Floodplain Development Regulations

The Town of Winterville receives assistance with the enforcement of floodplain regulations from Pitt County. The Pitt County Flood Damage Prevention Ordinance applies within the Town limits.

7.4.5 Water Shortage Response

The Town of Winterville has implemented GUC's water shortage response measures. These measures apply to all customers served. Refer to Section 7.1.7 for a detailed explanation.

7.5 Greene County

Greene County is a very rural county with many small towns and unincorporated areas. Therefore, the County has not enacted zoning regulations for the unincorporated areas or invested in comprehensive land use planning.

7.5.1 Riparian Buffers

Greene County enforces state regulations for riparian buffers. The Greene County Subdivision Regulations require vegetated buffer strips of at least 15 feet along all watercourses, bodies of water, or wetlands.

7.5.2 Erosion and Sediment Control

Greene County enforces state requirements for erosion and sediment control. The Greene County Subdivision Regulations require a sedimentation and erosion control plan for any land disturbing activity where more than one acre is to be uncovered. Persons engaged in land disturbing activities must take all reasonable measures to prevent damage from such activities.

7.5.3 Stormwater Programs and Impervious Surface Limitation

Greene County has not been required to comply with the Phase II NPDES Stormwater rules or the Neuse Stormwater Rules at this time.

7.5.4 Floodplain Development Regulations

Greene County has defined special flood hazard areas as those identified by FEMA in its Flood Insurance Study. In the ordinance, base flood is defined as the flood having a 1 percent chance of being equaled or exceeded in any given year. Specific provisions for flood hazard reduction provided by the ordinance include:

- All new construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated no lower than the base flood elevation.
- Non-residential construction shall have the lowest floor, including basement, elevated no lower than the base flood elevation. Structures in the A zones may be flood proofed in lieu of elevation.
- Manufactured homes shall be elevated so that the lowest floor is no lower than the base flood elevation and be securely anchored to an adequately anchored foundation.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted within the setback established by the Coastal Area Management Act (CAMA) or 20 feet from top of bank for areas where no base flood elevation has been provided, unless certification by a registered professional engineer demonstrates that such encroachment would not result in any increase in the flood levels during the occurrence of the base flood.
- No encroachment, including fill, new construction, substantial improvements, or new development shall be permitted in any floodway unless hydrologic and hydraulic analyses performed in accordance with standard engineering practice demonstrates that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood.

7.5.5 Water Shortage Response

The communities in Greene County purchasing water from GUC have implemented GUC's water shortage response measures. These measures apply to all customers served. Refer to Section 7.1.7 for a detailed explanation.

8. State and Federal Permits Required

- State Environmental Policy Act Environmental Assessment review and concurrence with a Finding of No Significant Impact (FONSI) is required.
- Interbasin Transfer Certificate from the Environmental Management Commission.

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10. Qualifications of Preparers

Mary Sadler, PE, MS Env., of ARCADIS is the technical advisor for the Environmental Assessment portion of this project. She specializes in municipal wastewater treatment processes and modeling, planning and design of wastewater treatment facilities, and environmental permitting. She has been an active participant in over fifiteen Environmental Assessment projects in North Carolina, including the Expanded EA type. Her environmental documents cover a range of projects and issues: new water and wastewater treatment plants, water and wastewater capacity expansions, new NPDES discharges, and impacts to state and federally listed species. A significant environmental permitting achievement includes the Dempsey E. Benton Environmental Assessment and associated Biological Opinion for direct impacts to the federally endangered dwarf wedgemussel.

Linda Diebolt, M.Bio., of ARCADIS is a senior biologist responsible for assisting in the generation of the natural resources sections of the Environmental Assessment. She has over 20 years of experience, and has performed and managed biological assessments, wetland delineations (tidal and non-tidal), permit applications, mitigation site searches, mitigation design and specifications, and preparation of environmental documents. Ms. Diebolt has prepared or assisted in the preparation of more than twenty-five Environmental Assessments throughout the United States.

David S. Briley, PE, of ARCADIS is the project engineer for the Environmental Assessment portion of this project. He specializes in municipal water supply and water treatment processes, planning and design of water treatment facilities, and environmental permitting, including interbasin transfers. He has been an active participant in three Environmental Assessment projects in North Carolina.

Miranda Spencer, PE, of ARCADIS is a project engineer responsible for the mitigative measures portion of this project. She has 2 years of experience in water and wastewater system permitting and design. She has been an active participant in five Environmental Assessment projects in North Carolina.

Hunter Carson, EI, of ARCADIS is a staff engineer responsible for the Interbasin Transfer Management Strategy portion of this project.

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Final Environmental Assessment – Greenville Utilities Commission Interbasin Transfer

Appendix A

Interbasin Transfer Management Strategy for Greenville Utilities Commission, ARCADIS 2008

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Greenville Utilities Commission
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Barrett Lasater
Randy Emory

Copies:
Richard Wyche
Mary Sadler

From:
David S. Briley
Hunter Carson

Date:
January 15, 2008
Revised per DWR Comment September 2008

ARCADIS Project No.:
NC706015.0010

Subject:
Interbasin Transfer Management Strategy
Greenville Utilities Commission

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1. Background

1.1 Central Capacity Use Regulations

In 2001, the North Carolina Environmental Management Commission (EMC) enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules. These regulations were developed as a control measure for groundwater use in the Cretaceous aquifers in response to decreasing groundwater levels and saltwater intrusion. The rules will be implemented over a ten year period with a goal to allow the Cretaceous aquifers to recharge and provide sustainable groundwater supply yields. The CCPCUA Cretaceous aquifer zones are illustrated in Figure 1.

The CCPCUA rules will require groundwater users located in the impacted areas to reduce their consumption in three phases between 2008 and 2018. The required reduction amounts are based on the location of the water use; in the dewatering zone or in the saltwater intrusion zone. The rules specify a percentage reduction in groundwater use from the Cretaceous aquifers from an approved base rate (ABR). The ABR for each groundwater user was determined by the North Carolina Division of Water Resources (DWR) based on historical annual water use from the Cretaceous aquifer system. GUC, Greene County, the Town of Farmville, and the Town of Winterville are located in the “dewatering zone.” The reductions required by the CCPCUA rules for water users in the “dewatering zone” are as follows:

- Phase I (2008) – Permittees in the dewatering zone will be required to reduce annual water use from Cretaceous aquifers by 25 percent from their ABR.

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- Phase II (2013) – Permittees in the dewatering zone will be required to reduce annual water use from Cretaceous aquifers by 50 percent from their ABR.
- Phase III (2018) – Permittees in the dewatering zone will be required to reduce annual water use from Cretaceous aquifers by 75 percent from their ABR.

At the end of each phase, the CCPCUA will be monitored to determine aquifer water level responses to the phased withdrawal reductions.

1.2 Purpose of IBT

The Town of Farmville, Town of Winterville, and Greene County rely on the Cretaceous aquifers for water supply and are affected by the CCPCUA rules. To comply with CCPCUA reductions and meet customer demands, the Town of Farmville, Town of Winterville, and Greene County plan to purchase bulk finished water from GUC. However, GUC relies on the Tar River for its water supply, and the Town of Farmville and the majority of Greene County are located within the Contentnea Creek subbasin. Farmville and Greene County discharge wastewater into the Contentnea Creek subbasin via centralized treatment or on-site septic systems. Therefore, sales of finished water to the Town of Farmville and Greene County constitute an interbasin transfer from the Tar River subbasin to the Contentnea Creek subbasin (Figure 2). The Town of Winterville water system and the southwestern portion of Greene County are located within the Neuse River subbasin. Therefore, sales of finished water to the Town of Winterville and Greene County constitute an interbasin transfer from the Tar River subbasin to the Neuse River subbasin (Figure 2).

To support the Town of Farmville and Greene County's compliance with CCPCUA rules, GUC is requesting an IBT Certificate for the transfer from the Tar River subbasin to the Contentnea Creek subbasin. GUC is requesting an IBT Certificate for the maximum day amount of 8.3 million gallons per day (mgd) to meet customer needs through 2030. GUC also requests an emergency condition IBT of 9.3 mgd.

GUC is also requesting an IBT Certificate for the transfer from the Tar River subbasin to the Neuse River subbasin to support the Town of Winterville's compliance with CCPCUA rules, and to support water use in the portion of the GUC service area within the Neuse River Basin. GUC is requesting an IBT Certificate in the amount of 4.0 mgd to meet Winterville's needs and meet GUC customer demands through 2030. GUC also requests an emergency condition IBT of 4.2 mgd.

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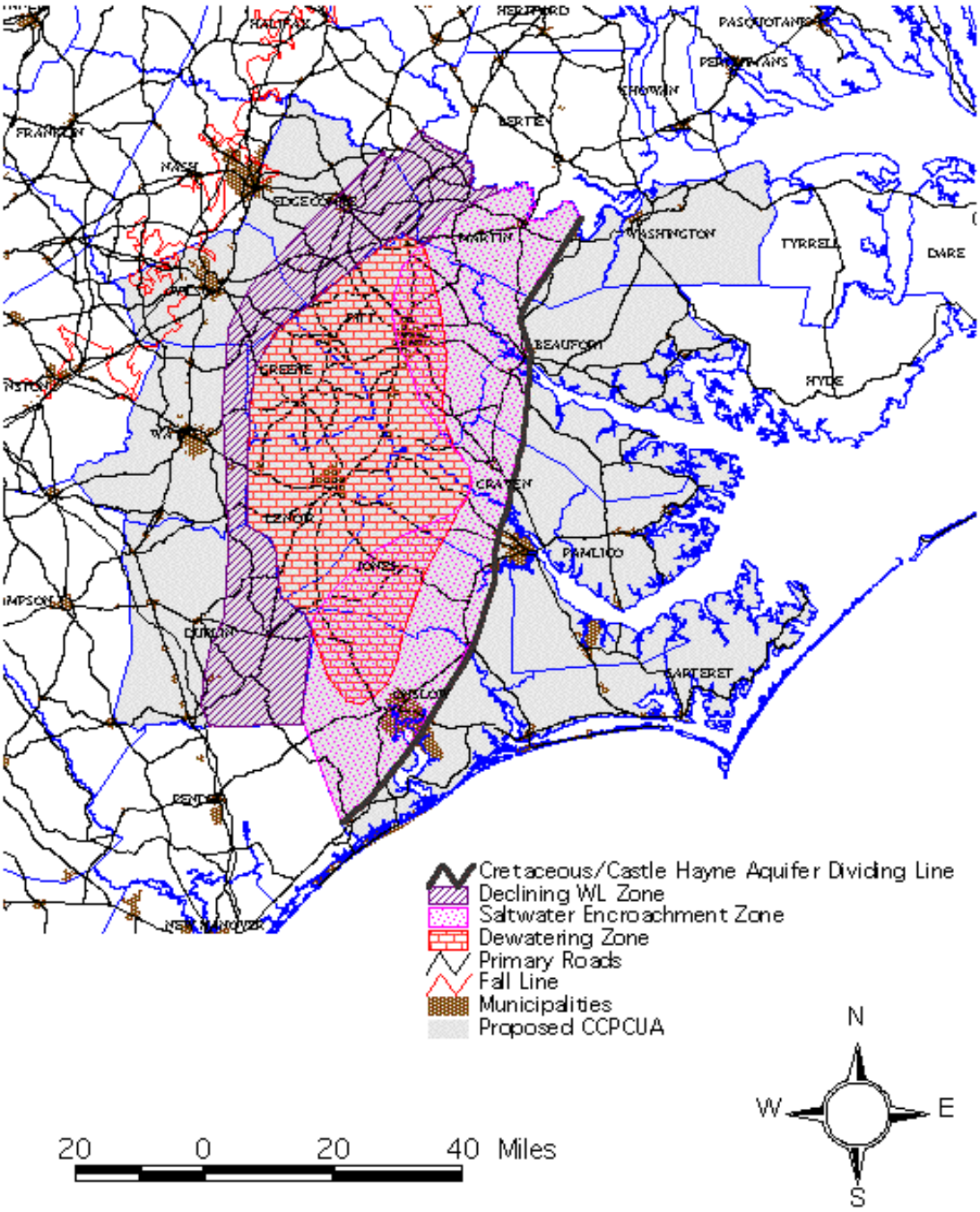
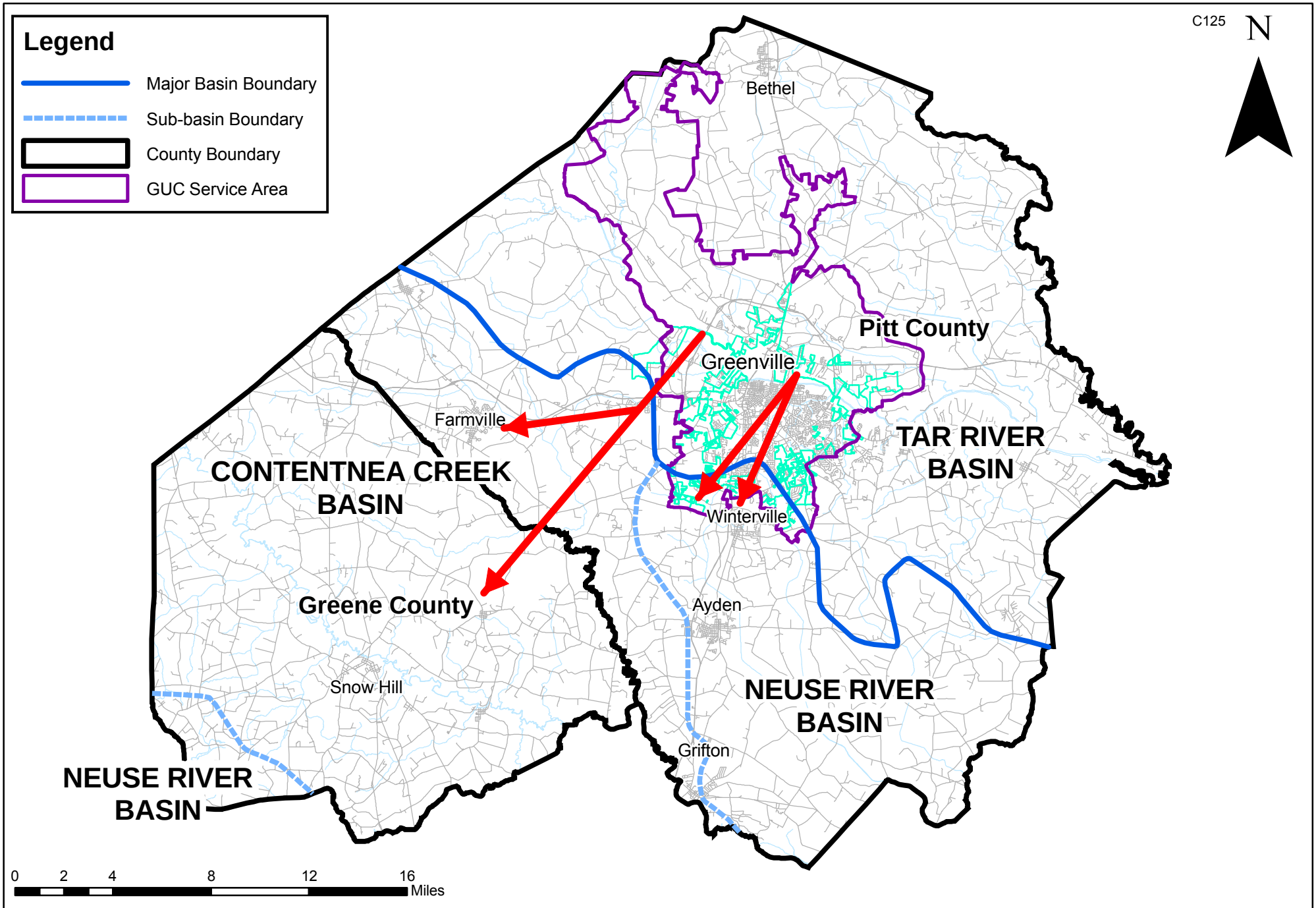
Figure 1: CCPCUA Cretaceous Aquifer





INTERBASIN TRANSFER (IBT) CERTIFICATION SCHEMATIC

Greenville Utilities Commission

9 March 2007

FIGURE 2

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2. Growth and Development

2.1 Population Projections

2.1.1 Greene County

Since 1990, Greene County's population has grown by over 5,000 individuals to 20,466 residents, which is almost a 25 percent increase according to 2006 statistics. Though largely agricultural, the County has a growing industrial community, which will continue to expand as the Global Transpark, a local business park, begins to take shape. According to the North Carolina State Demographics Unit, an annual growth rate of approximately 1 percent is expected in Greene County between 2010 and 2030. This is slightly lower than growth experienced during and in years before 2006. Assuming the estimated growth rate is accurate, the County's population is projected to exceed 27,000 residents by the year 2030 (Table 1).

2.1.2 Town of Farmville

The Town of Farmville has experienced limited growth in the last 15 years: 180 additional residents between 1990 and 2004. The Town does not consistently record yearly census data, nor have they conducted population projections for the near future. The population estimates available are from the Town of Farmville and from the Local Water Supply Plan, published by DWR (Table 1). Based on the observed historical growth percentage (0.28 percent annually between 1990 and 2004), the Town may expect to support a population of approximately 5,000 residents by the year 2030.

2.1.3 Town of Winterville

The Town of Winterville, located to the south of Greenville, has experienced increased growth and development in the past 15 years. The Town's population has more than doubled between 1990 and 2006, and grew by as much as 21.25 percent between 2000 and 2001. Between 2000 and 2006, Winterville's population increased at an average annual rate of 11 percent but it reached 17.1 percent between 2004 and 2005 (Table 1). The Town has commissioned a water system master plan but it has not yet been published. Population projections for Winterville were provided by the Town's master planning consultant. Based on its close proximity to the City of Greenville, growth in Winterville is expected to remain strong in the near future. At an annual growth rate between 4.5 percent and 5.8 percent, Winterville's population in 2025 is expected to reach approximately 21,700 residents (Table 1).

2.1.4 Greenville Utilities Commission

Greenville is the largest municipality in Pitt County, making up 48 percent of the total population in July 2005, according to the N.C. State Demographics Unit. East Carolina University, Pitt Memorial Hospital, and other businesses have attracted many residents to the area, bringing Greenville's population to 68,852 in 2005. The N.C. State Demographics Unit has predicted that Pitt County will grow to 153,411

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by 2010, and 192,493 by the year 2030. Assuming that Greenville continues to make up almost half of the County's population, the City will host approximately 100,000 residents by 2030.

GUC provides utility services to customers in the City of Greenville and some of the surrounding areas. According to 2005 census data from the N.C. State Demographics and projected values from the 2001 GUC Water System Master Plan, approximately 10 percent of the customers served by GUC live outside the City limits. GUC's service population has grown by an average annual rate of 1.91 percent between 2000 and 2005. Assuming an average annual growth rate of approximately 1.8 percent, population for the GUC service area is predicted to increase by approximately 25,000 persons between 2005 and 2020 (Table 1). By 2030, GUC may serve more than 110,000 customers.

Table 1: Historical and Projected Populations and Growth Rates

	Greenville Utilities Commission		Farmville		Greene County		Winterville	
Year	**Population**[1]	**Annual Growth Rate, %**	**Population**	**Annual Growth Rate, %**	**Population**[4]	**Annual Growth Rate, %**	**Population**	**Annual Growth Rate, %**
1990	NA	NA	4,446 [2]	NA	15,384	NA	3,053 [5]	NA
2000	69,507	NA	4,302 [2]	- 0.33	18,974	2.10	3,979 [5]	2.65
2001	NA	NA	NA	NA	19,050	0.40	4,921 [5]	21.25
2002	NA	NA	4,325 [3]	0.27	19,488	2.27	5,101 [5]	3.59
2003	NA	NA	NA	NA	19,860	1.89	5,402 [5]	5.73
2004	NA	NA	4,626 [2]	3.36	19,998	0.69	5,850 [5]	7.97
2005	76,478	1.91 [6]	NA	NA	20,167	0.84	6,942 [5]	17.11
2006	79,025	3.28	NA	NA	20,466	1.47	8,500 [7]	10.34
2010	85,067	1.84	NA	NA	21,567	1.31	NA	NA
2015	NA	NA	NA	NA	22,976	1.27	13,800 [7]	5.8
2020	101,932	1.81	NA	NA	24,485	1.27	NA	NA
2025	NA	NA	NA	NA	25,883	1.11	21,700 [7]	4.5
2030	NA	NA	NA	NA	27,378	1.12	NA	NA

1. *From Greenville Utilities Commission Water System Master Plan (Black and Veatch, not yet published).*
2. *From Town of Farmville.*
3. *From 2002 Town of Farmville Local Water Supply Plan.*
4. *From N.C. Demographics Unit.*
5. *From N.C. Division of Water Resources.*
6. *Average Annual Historical Growth Rate (2000 – 2005).*
7. *Town of Winterville Water and Wastewater System Master Plan (Black & Veatch, not yet published).*

NA = Data Not Available

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2.2 Water Demand Projections

Historical water use data and water demand projections were collected for GUC, Greene County, the Town of Farmville, and the Town of Winterville. These sources have been identified in Table 2. Water demand projections provided by Greene County, the Town of Farmville, and the Town of Winterville were based on average day demands (ADD). Maximum day demand (MDD) projections were developed using historical MDD and ADD peaking factors (Table 3). Water demand projections for each water system are presented in Section 2.2.1 through 2.2.4.

Projected water demands were used in combination with the ABR of each municipality to determine estimated bulk purchases from GUC needed in 2008 and beyond in order for these water systems to comply with the CCPCUA rules.

Greene County, Farmville, and Winterville have each expressed interest in the concept of “water banking” or “banking”. The concept of banking is based on a water system pumping less groundwater than allowed by the CCPCUA rules and off-sets reductions using a supplemental surface water supplier such as GUC. Banking reduces groundwater withdrawals faster than the CCPCUA rules mandate, but allows the water systems to use this banked water at a later time. This approach meets the average reduction requirement over the first two reduction phases, and still maintains a high level of protection for the Cretaceous aquifer system.

DWR has approved the concept of banking, but required that a letter of intent be submitted by each water system interested in pursuing a “Cretaceous water bank account”. Farmville, Winterville and Greene County have all been approved for banking. The letter of approval for Farmville and Greene County is attached to this memorandum. Along with the state’s approval, a set of guidelines were introduced to clarify the banking system. Guidelines that were included in the approval letter received by Farmville and Greene County dated July 6, 2004, included the following provisions:

- Present day through July 31, 2008 – The bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR.
- August 1, 2008 through July 31, 2013 – The bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR less Phase I reduction.
- August 1, 2013 through July 31, 2018 – The bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR less Phase II reduction.

Graphs depicting how the banking concept may be utilized by Farmville, Greene County, and Winterville are included in the following sections.

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Table 2: Water Demand Projections

	Greenville Utilities Commission		Farmville		Greene County		Winterville	
Year	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Average Day Demand (mgd)	Maximum Day Demand (mgd)
1990	8.94 [1]	NA	2.17 [3]	3.20 [3]	NA	NA	NA	NA
1995	9.67 [1]	NA	1.60 [3]	2.38 [3]	NA	NA	NA	NA
2000	10.06 [1]	14.17 [1]	1.57 [3]	2.43 [3]	1.12 [5]	1.83 [5]	0.463 [5]	0.667 [5]
2005	10.03 [1]	14.71 [1]	1.66 [3]	2.74 [3]	1.19 [5]	2.22 [5]	0.706 [5]	1.32 [5]
2006	10.19	15.28	NA	NA	NA	NA	NA	NA
2007	10.34	15.51	NA	NA	NA	NA	0.80 [6]	1.44
2008	10.50	15.75	1.87 [4]	3.18	2.31 [4]	4.04	0.85	1.53
2009	10.65	15.98	1.89 [4]	3.22	2.35 [4]	4.11	0.90	1.62
2010	10.81 [2]	16.21	1.91 [4]	3.25	2.39 [4]	4.18	0.95	1.71
2015	11.19 [2]	16.78	2.01 [4]	3.41	2.60 [4]	4.54	1.20	2.16
2020	11.57 [2]	17.35	2.11 [4]	3.59	2.80 [4]	4.90	1.55	2.79
2025	11.95 [2]	17.92	2.22 [4]	3.77	3.01 [4]	5.27	1.93	3.47
2030	12.33 [2]	18.49	2.33 [4]	3.96	3.22 [4]	5.64	2.00	3.60

[1] *Historical data from Greenville Utilities Commission.*
[2] *ADD demands based on a linear projection of historical demands (1990 – 2005).*
[3] *Town of Farmville Water production data.*
[4] *Water Supply Agreement with Greenville Utilities Commission.*
[5] *Data from Division of Water Resources.*
[6] *Data from the Town of Winterville.*

NA = Data Not Available

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Table 3: Historical Peaking Factors

	Greenville Utilities Commission			Farmville			Greene County			Winterville		
Year	**ADD [1]**	**MDD [1]**	**Peaking Factor (MDD:ADD)**	**ADD [2]**	**MDD [2]**	**Peaking Factor (MDD:ADD)**	**ADD [3]**	**MDD [3]**	**Peaking Factor (MDD:ADD)**	**ADD [3]**	**MDD [3]**	**Peaking Factor (MDD:ADD)**
1999	10.65	16.24	1.52	1.48	2.58	1.74	1.15	1.97	1.71	0.54	1.04	1.93
2000	10.06	14.17	1.41	1.57	2.43	1.55	1.12	1.83	1.63	0.46	0.67	1.44
2001	10.27	13.55	1.32	1.6	2.55	1.59	NA	NA	NA	0.48	0.75	1.58
2002	10.47	15.56	1.49	1.76	3.36	1.91	1.17	2.12	1.81	0.53	0.97	1.83
2003	9.21	12.83	1.39	1.71	2.74	1.60	1.89	2.68	1.42	0.53	1.20	2.25
2004	9.92	16.31	1.64	1.66	2.66	1.60	1.22	2.42	1.98	0.60	0.91	1.51
2005	10.03	14.71	1.47	1.66	2.74	1.65	1.19	2.22	1.87	0.71	1.32	1.87
	MDD:ADD ratio		1.46	MDD:ADD ratio		1.72	MDD:ADD ratio		1.74	MDD:ADD ratio		1.77
	Peaking Ratio Used		1.50	Peaking Ratio Used		1.70	Peaking Ratio Used		1.75	Peaking Ratio Used		1.80

[1] *From Greenville Utilities Commission*
[2] *From Town of Farmville Water Production Data;*
[3] *From N.C. Division of Water Resources;*

NA = Data Not Available

ADD = Average Daily Demand
MDD = Maximum Daily Demand

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2.2.1 Greene County

Greene County is served by ten water systems. Greene County is serving as the lead agency on behalf of these water systems for the purposes of entering into bulk sales agreements with GUC. The water systems in Greene County are:

- Greene County Regional Water System
- Town of Snow Hill
- Town of Hookerton
- Town of Walstonburg
- South Greene Water Corporation
- Maury Sanitary District
- Ormondsville Water Corporation
- Arba Water Corporation
- Lizzie Water Corporation
- Jason-Shine Water Corporation

In 2005, Greene County had an average day demand of 1.19 mgd and a maximum day demand of 2.22 mgd (Table 2). By the year 2030, the County's water demands are projected to increase to 3.22 mgd on an average daily basis and to 5.64 mgd during peak day demands. Peak day demands were projected using a historical peaking factor of 1.75 (Table 3).

The ABR approved for Greene County is 1,079.8 million gallons per year (MGY), which translates to an average annual pumping rate of 2.96 mgd. Greene County will be required to reduce annual withdrawals as required by the CCPCUA rules (Table 4).

Table 4: Annual Withdrawal Rates Required by CCPCUA Rules for Greene County

Year	Total Annual Withdrawal (MGY)	Average Annual Withdrawal (mgd)
ABR	1079.8	2.96
2008	810	2.22
2013	540	1.48
2018	270	0.74

The County intends to bank water by pumping 50 percent of its allowed pumping rate during Phase 1 (2008 through 2013), and 75 percent of its allowed pumping rate during Phase II (2013 through 2018). Proposed banking amounts are included in Table 5 and a graphical interpretation is shown in Figure 3. Water banking will serve as a buffer for the County's water supply during peak demand periods or drought conditions, and will provide flexibility in its well pumping. Between 2008 and 2018, the County will bank approximately 2,700 MG, or 7.4 mgd of pumping capacity, and intends to distribute the capacity equally over the following 20 years (2018 through 2037).

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Table 5: Water Demand Projections and Summary of Greene County Water Operations

Year	Projected System Demand (mgd) [1]	Allowable Well Pumping Rate (mgd) [2]	Supplemental Water			Water to be Banked (mgd) [5, 6]
			Average Day Bulk Sales (mgd) [3]	Maximum Day Bulk Sales (mgd)	Estimated Minimum Purchase (mgd) [4]	
2008	2.31	2.22	1.20	1.82	0.74	1.11
2009	2.35	2.22	1.24	1.89	0.74	1.11
2010	2.39	2.22	1.28	1.96	0.74	1.11
2011	2.43	2.22	1.32	2.04	0.74	1.11
2012	2.47	2.22	1.36	2.11	0.74	1.11
2013	2.51	1.48	1.77	2.92	1.48	0.37
2014	2.56	1.48	1.82	2.99	1.48	0.37
2015	2.60	1.48	1.86	3.06	1.48	0.37
2016	2.64	1.48	1.90	3.13	1.48	0.37
2017	2.68	1.48	1.94	3.21	1.48	0.37
2018	2.72	0.74	2.35	4.02	2.22	0.37
2020	2.80	0.74	2.43	4.16	2.22	- 0.37
2025	3.01	0.74	2.64	4.53	2.22	- 0.37
2030	3.22	0.74	2.85	4.90	2.22	- 0.37
2035	3.43	0.74	3.06	5.26	2.22	- 0.37
2040	3.64	0.74	3.27	5.63	2.22	NA
2045	3.85	0.74	3.48	6.00	2.22	NA
2048	3.98	0.74	3.61	6.22	2.22	NA

[1] *Projected system demands provided by McDavid Associates, Inc.*
[2] *The allowable well pumping rate is based on an approved ABR of 1,079,800,000 gallons or 2,960,000gpd.*
[3] *Average day bulk sales include water to be "banked."*
[4] *Estimated minimum purchase amounts are contractual limits and are equal to the amount of reduction required by CCPCUA rules from the ABR. In the event of curtailment, average daily volume may be adjusted.*
[5] *Distribution of banked water is proposed for 2018 – 2037.*
[6] *Negative banking denotes usage of banked water.*

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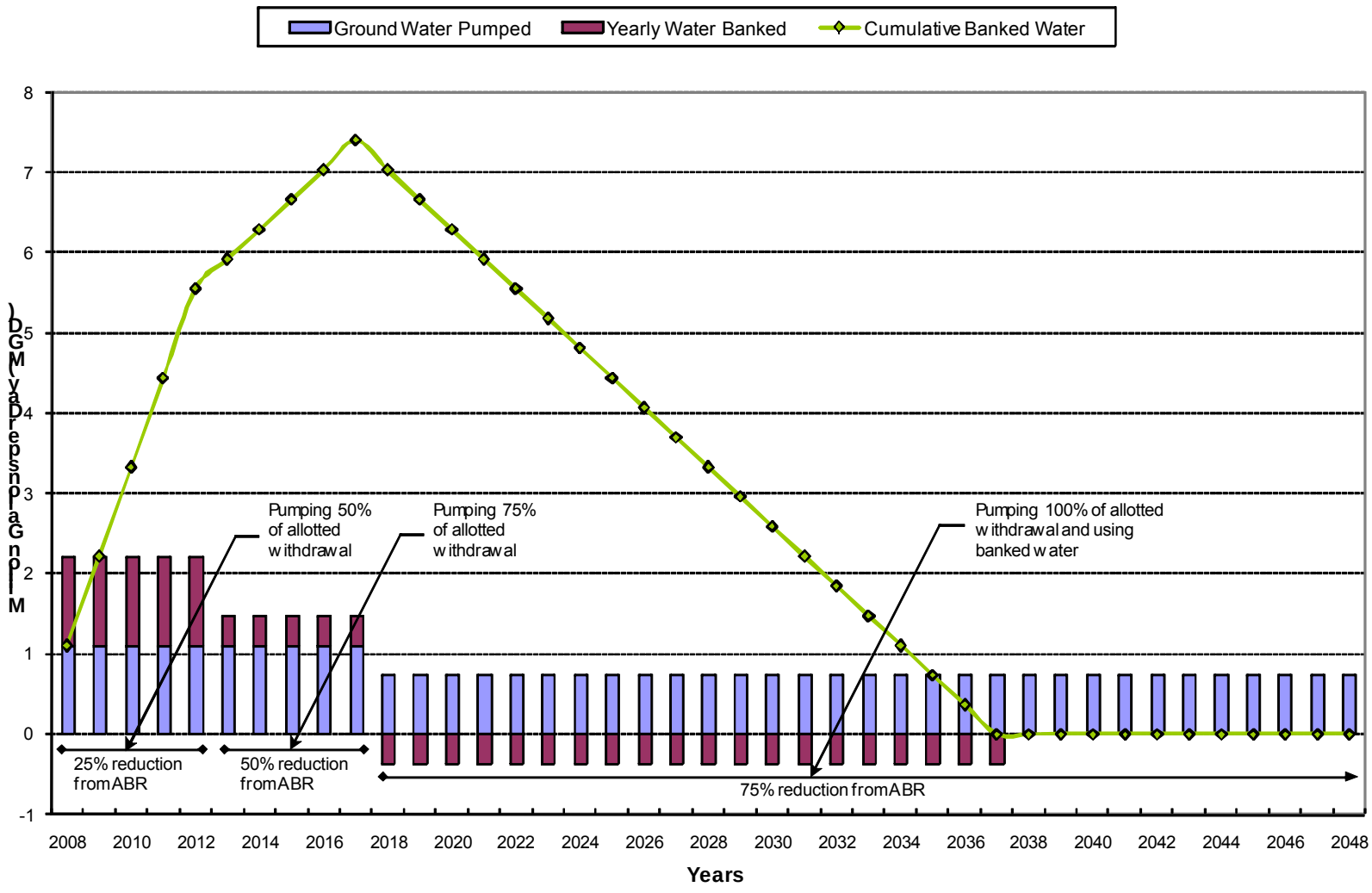
Figure 3: Greene County Banked Water



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2.2.2 Town of Farmville

The Town of Farmville's average day water demand is expected to increase by 25 percent between 2008 and 2030. According to the Water Purchase Agreement with GUC, average daily demands in 2030 will be approximately 2.33 mgd. Based on a peaking factor of 1.70, maximum day demands are projected to be 3.96 mgd in 2030 (Table 3).

The ABR approved for Farmville is 574 MGY, which translates to an average annual pumping rate of 1.572 mgd. Farmville will be required to reduce annual withdrawals as shown in Table 6.

Table 6: Annual Withdrawal Rates Required by CCPCUA Rules for Farmville

Year	Total Annual Withdrawal (MGY)	Average Annual Withdrawal (mgd)
ABR	574	1.572
2008	431	1.179
2013	287	0.786
2018	144	0.393

The Town of Farmville also intends to bank water throughout Phases I and II of the CCPCUA rule, pumping only half of what is permitted during Phase I, and 75 percent of their allotted withdrawal during Phase II. Farmville will bank a total of 1,434 MG between 2008 and 2018. Proposed banking amounts are included in Table 7 and a graphical interpretation is shown in Figure 4. It is unclear at this time whether Farmville intends to utilize its banked water over an extended period similar to Greene County, or maintain its "banked" status for periods of high demand.

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Table 7: Water Demand Projections and Summary of Farmville Water Operations

Year	Projected System Demand (mgd) [1]	Allowable Well Pumping Rate (mgd) [2]	Supplemental Water [3] Average Day Bulk Sales (mgd) [4]	Maximum Day Bulk Sales (mgd)	Estimated Minimum Purchase (mgd) [6]	Water to be Banked (mgd) [5, 7]
2008	1.87	1.18	1.28	2.00	0.39	0.59
2009	1.89	1.18	1.30	2.04	0.39	0.59
2010	1.91	1.18	1.32	2.07	0.39	0.59
2011	1.93	1.18	1.34	2.10	0.39	0.59
2012	1.95	1.18	1.36	2.13	0.39	0.59
2013	1.97	0.78	1.38	2.57	0.79	0.20
2014	1.99	0.78	1.40	2.60	0.79	0.20
2015	2.01	0.78	1.42	2.63	0.79	0.20
2016	2.03	0.78	1.44	2.67	0.79	0.20
2017	2.05	0.78	1.46	2.70	0.79	0.20
2018	2.07	0.39	1.48	3.12	1.18	- 0.20
2020	2.11	0.39	1.52	3.19	1.18	- 0.20
2025	2.22	0.39	1.63	3.38	1.18	- 0.20
2030	2.33	0.39	1.74	3.57	1.18	- 0.20
2035	2.45	0.39	1.86	3.77	1.18	- 0.20
2040	2.58	0.39	1.99	3.98	1.18	NA
2045	2.71	0.39	2.12	4.21	1.18	NA
2048	2.79	0.39	2.20	4.35	1.18	NA

[1] *Projected system demands based on 2002 actual usage and a 1% annual growth rate.*
[2] *Pumped water volumes based on an ABR of 1,572,000 gpd.*
[3] *Supplemental water volumes rounded to nearest thousand gallons.*
[4] *Average day bulk sales include water to be "banked".*
[5] *Distribution of banked water is proposed for 2018 – 2037.*
[6] *Estimated Minimum Purchase amount is equal to required reduction in well pumping to meet CCPCUA rules.*
[7] *Negative banking denotes usage of banked water.*

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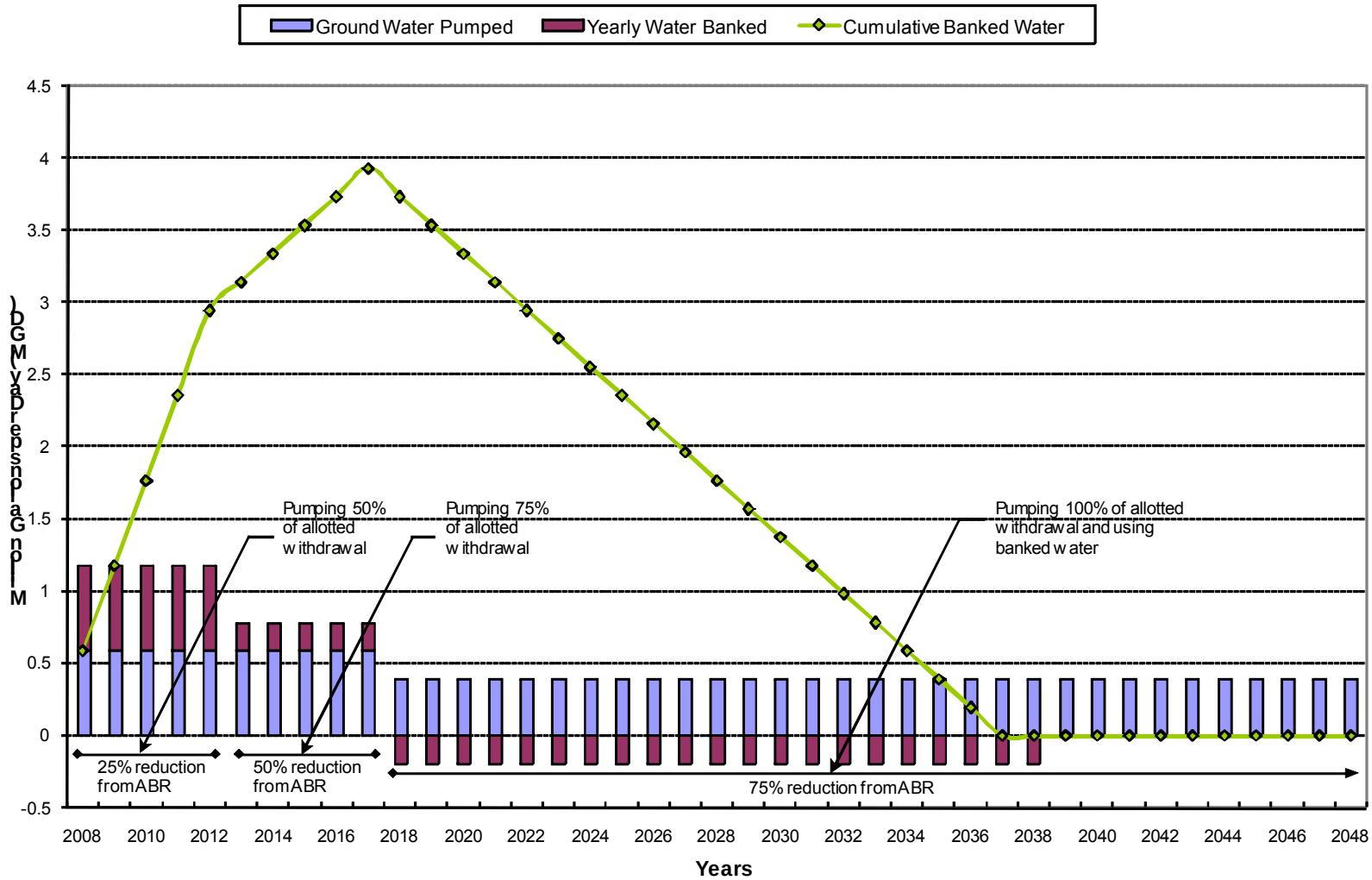
Figure 4: Town of Farmville Banked Water



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2.2.3 Town of Winterville

As Winterville's population increases rapidly, its water demand will grow concurrently. Current water usage is approximately 0.80 mgd. By 2026, it is expected to increase by 135 percent to a build-out capacity of 2.0 mgd for areas not served by Bell Arthur or Eastern Pines Water Corporations. The MDD was projected using a peaking factor of 1.80, and was calculated to approach 3.6 mgd by 2026 (Table 2).

The ABR approved for Winterville is 181 MGY, which translates to an average annual pumping rate of 0.496 mgd. Winterville will be required to reduce annual withdrawals as shown in Table 8.

Table 8: Annual Withdrawal Rates Required by CCPCUA Rules for Winterville

Year	Total Annual Withdrawal (MGY)	Average Annual Withdrawal (mgd)
ABR	181	0.496
2008	136	0.372
2013	91	0.249
2018	45	0.123

Similar to Greene County and the Town of Farmville, Winterville intends to bank water in the same manner throughout Phases I and II of the CCPCUA rule. Winterville submitted a letter of intent to DWR to bank water on August 12, 2008. Winterville has an approved ABR of 0.496 mgd and plans to pump approximately 0.185 mgd, thereby banking up to 449 MG of capacity prior to 2018 (Table 9). Winterville has not expressed how it intends to utilize its banked water. However, Figure 5 depicts a banking strategy where the banked water is used equally over a 20-year period, similar to Greene County and Farmville.

2.2.4 Greenville Utilities Commission

Between 1990 and 2005, GUC water demand increased 1.1 mgd according to historical water use data (Table 2). Based on the GUC Water System Master Plan (Black & Veatch, 2001), the service area will expand to over 100,000 customers by 2020. The projected ADD in 2020 will be approximately 11.6 mgd (Table 2). Peak-day demands were estimated to reach 17.4 mgd in 2020 and 18.5 mgd in 2030.

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Table 9: Water Demand Projections and Summary of Winterville's Water Operations

Year	Projected System Demand (mgd) [1]	Allowable Well Pumping Rate (mgd) [2]	Supplemental Water [3] Average Day Bulk Sales (mgd) [4]	Maximum Day Bulk Sales (mgd)	Estimated Minimum Purchase (mgd) [6]	Water to be Banked (mgd) [5, 7]
2008	0.85	0.37	0.66	1.16	0.12	0.185
2009	0.90	0.37	0.71	1.25	0.12	0.185
2010	0.95	0.37	0.76	1.34	0.12	0.185
2011	1.00	0.37	0.81	1.43	0.12	0.185
2012	1.05	0.37	0.86	1.52	0.12	0.185
2013	1.10	0.25	0.91	1.73	0.25	0.062
2014	1.15	0.25	0.96	1.82	0.25	0.062
2015	1.20	0.25	1.01	1.91	0.25	0.062
2016	1.25	0.25	1.06	2.00	0.25	0.062
2017	1.33	0.25	1.14	2.14	0.25	0.062
2018	1.40	0.12	1.21	2.40	0.37	- 0.062
2020	1.55	0.12	1.36	2.67	0.37	- 0.062
2025	1.93	0.12	1.74	3.34	0.37	- 0.062
2030	2.00	0.12	1.81	3.48	0.37	- 0.062
2035	2.00	0.12	1.81	3.48	0.37	- 0.062
2040	2.00	0.12	1.88	3.48	0.37	NA
2045	2.00	0.12	1.88	3.48	0.37	NA
2048	2.00	0.12	1.88	3.48	0.37	NA

[1] *Projected system demand was linearly interpolated by ARCADIS. The Town of Winterville provided projection values for 2016 and 2026.*
[2] *Pumped water volumes based on an ABR of 180,709,104 gallons.*
[3] *Supplemental water volumes rounded to nearest thousand gallons.*
[4] *Average day bulk sales include a percentage for banked water.*
[5] *Distribution of banked water is proposed for 2018 – 2037.*
[6] *Estimated Minimum Purchase amount is equal to required reduction in well pumping to meet CCPCUA rules.*
[7] *Negative banking denotes usage of banked water.*

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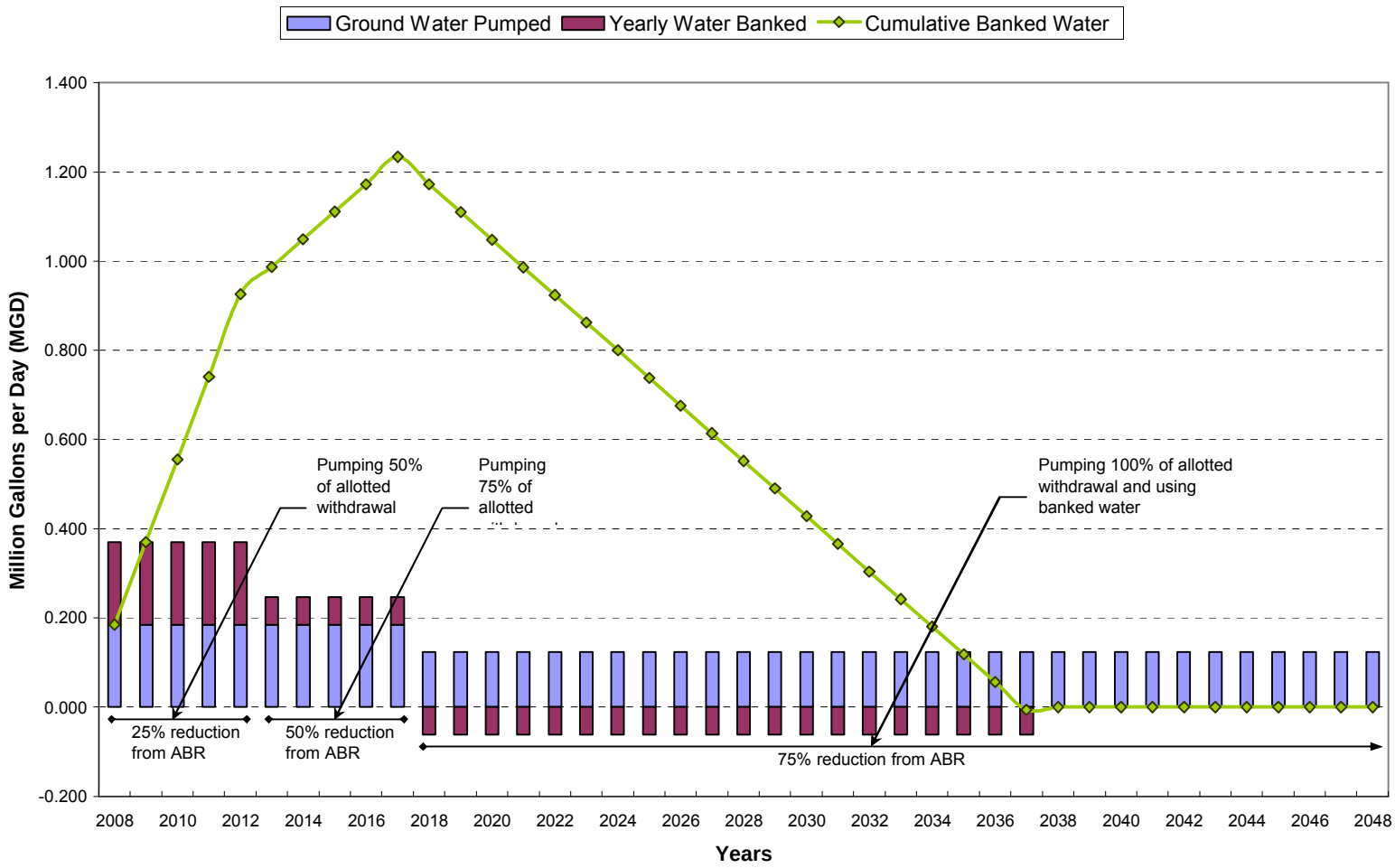
Figure 5: Town of Winterville Banked Water



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3. Water Treatment Plant Capacity

GUC's water treatment plant (WTP) has a permitted capacity of 22.5 mgd. The WTP treats raw water withdrawn from the Tar River and pumped to a 63-million gallon pre-settling impoundment. The WTP utilizes conventional coagulation/sedimentation process, intermediate ozonation (for disinfection), and high-rate, dual-media filters. In 2002, the WTP converted from free chlorine to chloramines for disinfection.

Bulk sales contracts between GUC and its wholesale customers (Farmville, Greene County, and Winterville) stipulate an Estimated Minimum Purchase, which is equal to the required reduction in well pumping to meet CCPCUA rules. Based on the peak demands for the GUC service area and the Estimated Minimum Purchase that GUC is obligated to provide to Farmville, Greene County, and Winterville, the WTP has the capacity to meet the projected needs through 2030 (Table 10). The Estimated Minimum Purchase amount was used since GUC may limit distribution to the wholesale customers when GUC experiences peak demands. Wholesale customers will rely on well pumping to meet demands during those periods, and GUC will provide sufficient water during the remainder of the year to allow its customers meet CCPCUA rules.

Table 11 shows the average annual demands for GUC as well as the projected annual average bulk sales amounts for Farmville, Winterville, and Greene County. This also demonstrates that GUC's existing WTP has sufficient capacity to meet its retail customer's demands as well as the wholesale customers.

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Table 10: Maximum Day GUC Demands with Minimum Bulk Purchases

Year	GUC Demands (mgd) [1]	Estimated Minimum Purchase (mgd)			Total (mgd)
		Winterville	Greene County	Farmville	
2008	15.83	0.12	0.74	0.39	17.09
2013	16.71	0.25	1.48	0.79	19.22
2018	17.28	0.37	2.22	1.18	21.05
2020	17.51	0.37	2.22	1.18	21.27
2025	18.08	0.37	2.22	1.18	21.84
2030	18.65	0.37	2.22	1.18	22.41
2035	19.22	0.37	2.22	1.18	22.98
2040	19.79	0.37	2.22	1.18	23.55

[1] *Demands include minimum bulk sales to Stokes and Bethel.*

Table 11: Average Day GUC Demands with Average Day Bulk Purchases

Year	GUC Demands (mgd) [1]	Estimated Average Day Bulk Sales (mgd)			Total (mgd)
		Winterville	Greene County	Farmville	
2008	10.91	0.66	1.14	1.28	13.99
2013	11.37	0.91	1.69	1.38	15.36
2018	11.80	1.21	2.23	1.48	16.72
2020	11.98	1.36	2.31	1.52	17.17
2025	12.40	1.74	2.51	1.63	18.28
2030	12.83	1.81	2.71	1.74	19.10
2035	13.27	1.81	2.91	1.86	19.85
2040	13.70	1.88	3.11	1.99	20.67

[1] *Demands include annual average bulk sales to Stokes and Bethel.*

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4. IBT Calculations

4.1 Transfer from Tar River Basin to Neuse River Subbasin

IBT calculations for the transfer from the Tar River subbasin (Basin ID 15-1) to the Neuse River subbasin (Basin ID 10-1) are shown in the Water Balance Tables (Tables 12, 13, and 14). Transfers to the Neuse River subbasin are a result of bulk sales to the Town of Winterville and Greene County as well as water use by GUC customers located in the Neuse River Subbasin. IBT calculations are based on the following:

- Peak day demands for GUC are calculated based on a MDD:ADD peaking factor of 1.50, based on historical demand trends.
- Peak day demands for the Town of Winterville are calculated based on a MDD:ADD peaking factor of 1.80, based on historical demand trends.
- Consumptive water use for GUC is 20 percent based on historical operating records.
- Consumptive water use for Winterville and Greene County is assumed to be 30 percent.
- Process water use at the GUC WTP is 8 percent of raw water withdrawal based on operating records.
- The service area for the Town of Winterville is entirely within the Neuse River subbasin.
- The portion of Greene County in the Neuse River subbasin is estimated at 5 percent.
- The portion of GUC's service area in the Neuse River subbasin is estimated at 8 percent based on current water distribution system maps and the number of service connections located in the Neuse River Subbasin.
- All wastewater produced in the GUC service area is returned to the Tar River Basin, with the exception of a limited number of septic tanks in the Neuse River Basin.
- All wastewater produced in the Winterville service area is discharged into the Neuse River subbasin.
- All wastewater produced in Greene County is disposed of by on-site septic systems.

In Table 12, water demands for the Town of Winterville are based on Average Day Bulk Sales as shown in Table 9. This demonstrates the average day IBT amounts that are expected on an annual basis. These demands account for bulk purchases from GUC required for Winterville to meet customer demands, to comply with CCPCUA regulations, and to allow for "banking" of groundwater.

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In Table 13, the Maximum Day Bulk Sales projected for the Town of Winterville are used to determine maximum day IBT amounts. The Maximum Day Bulk Sales represents the total peak day demands for the Winterville service area less the average annual allowable well pumping rate.

In Table 14, the Emergency Bulk Sales projected for the Town of Winterville are used to determine the emergency condition for the IBT. The emergency condition represents the total peak day demand for the Winterville service area. This strategy will allow GUC to provide water to Winterville in the event a catastrophic event was to occur, e.g. aquifer contamination, drought, or major mechanical or electrical failure. GUC requests that the IBT certificate be written such that notification would be required to DWR to trigger the emergency request.

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Table 12: Water Balance Table – Tar River to Neuse River (Average Day)

					Consumptive Use									Wastewater Discharge		WTP Discharge		
					GUC			Winterville			Greene County							
Year	GUC Water Demand	Winterville Estimated Bulk Purchase	Greene County Estimated Bulk Purchase	Withdrawal from Tar River	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	Tar River Basin	Neuse River Basin	Tar River Basin	Total Return to Tar River Basin	Interbasin Transfer
2005	10.03	0.71	0.06	11.66	92	1.85	0.16	0	0.0	0.21	0	0.0	0.06	8.0	0.5	0.9	10.7	0.9
2010	10.81	0.76	0.06	12.57	92	1.99	0.17	0	0.0	0.23	0	0.0	0.06	8.6	0.5	0.9	11.6	1.0
2015	11.19	1.01	0.09	13.28	92	2.06	0.18	0	0.0	0.30	0	0.0	0.09	9.0	0.7	1.0	12.0	1.3
2020	11.57	1.36	0.12	14.10	92	2.13	0.19	0	0.0	0.41	0	0.0	0.12	9.3	1.0	1.0	12.4	1.7
2025	11.95	1.74	0.13	14.93	92	2.20	0.19	0	0.0	0.52	0	0.0	0.13	9.6	1.2	1.1	12.9	2.1
2030	12.33	1.81	0.14	15.43	92	2.27	0.20	0	0.0	0.54	0	0.0	0.14	9.9	1.3	1.1	13.3	2.2
2035	12.71	1.81	0.15	15.85	92	2.34	0.20	0	0.0	0.54	0	0.0	0.15	10.2	1.3	1.2	13.7	2.2
2040	13.09	1.88	0.16	16.34	92	2.41	0.21	0	0.0	0.56	0	0.0	0.16	10.5	1.3	1.2	14.1	2.3

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Table 13: Water Balance Table – Tar River to Neuse River (Maximum Day)

					Consumptive Use								Wastewater Discharge		WTP Discharge		
					GUC		Winterville			Greene County							
Year	GUC Water Demand	Winterville Estimated Bulk Purchase	Greene Estimated Bulk Purchase	Withdrawal from Tar River	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	Tar River Basin	Neuse River Basin	Tar River Basin	Total Return to Tar River Basin	Interbasin Transfer
2005	14.71	1.32	0.11	17.43	92	2.71	0.24	0	0.0	0.40	0	0.0	0.11	11.8	0.9	1.3	15.8	1.7
2010	16.22	1.34	0.10	19.07	92	2.98	0.26	0	0.0	0.40	0	0.0	0.10	13.0	0.9	1.4	17.4	1.7
2015	16.79	1.91	0.16	20.36	92	3.09	0.27	0	0.0	0.57	0	0.0	0.16	13.4	1.3	1.5	18.0	2.3
2020	17.36	2.67	0.21	21.85	92	3.19	0.28	0	0.0	0.80	0	0.0	0.21	13.9	1.9	1.6	18.7	3.2
2025	17.93	3.34	0.23	23.21	92	3.30	0.29	0	0.0	1.00	0	0.0	0.23	14.3	2.3	1.7	19.3	3.9
2030	18.50	3.48	0.25	24.00	92	3.40	0.30	0	0.0	1.04	0	0.0	0.25	14.8	2.4	1.8	20.0	4.0
2035	19.07	3.48	0.26	24.63	92	3.51	0.31	0	0.0	1.04	0	0.0	0.26	15.3	2.4	1.8	20.6	4.0
2040	19.64	3.48	0.28	25.27	92	3.61	0.31	0	0.0	1.04	0	0.0	0.28	15.7	2.4	1.8	21.2	4.1

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Table 14: Water Balance Table – Tar River to Neuse River (Emergency Condition)

					Consumptive Use									Wastewater Discharge		WTP Discharge		
					GUC			Winterville			Greene County							
Year	GUC Water Demand	Winterville Estimated Bulk Purchase	Greene County Estimated Bulk Purchase	Withdrawal from Tar River	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	% Tar River	Tar River Basin	Neuse River Basin	Tar River Basin	Neuse River Basin	Tar River Basin	Total Return to Tar River Basin	Interbasin Transfer
2005	14.71	1.32	0.11	17.43	92	2.71	0.24	0	0.0	0.40	0	0.0	0.11	11.8	0.9	1.3	15.8	1.7
2010	16.22	1.71	0.21	19.58	92	2.98	0.26	0	0.0	0.51	0	0.0	0.21	13.0	1.2	1.4	17.4	2.2
2015	16.79	2.16	0.23	20.71	92	3.09	0.27	0	0.0	0.65	0	0.0	0.23	13.4	1.5	1.5	18.1	2.7
2020	17.36	2.79	0.25	22.02	92	3.19	0.28	0	0.0	0.84	0	0.0	0.25	13.9	2.0	1.6	18.7	3.3
2025	17.93	3.47	0.26	23.39	92	3.30	0.29	0	0.0	1.04	0	0.0	0.26	14.3	2.4	1.7	19.4	4.0
2030	18.50	3.60	0.28	24.17	92	3.40	0.30	0	0.0	1.08	0	0.0	0.28	14.8	2.5	1.8	20.0	4.2
2035	19.07	3.60	0.30	24.80	92	3.51	0.31	0	0.0	1.08	0	0.0	0.30	15.3	2.5	1.8	20.6	4.2
2040	19.64	3.60	0.32	25.44	92	3.61	0.31	0	0.0	1.08	0	0.0	0.32	15.7	2.5	1.9	21.2	4.2

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4.2 Transfer from Tar River Basin to Contentnea Creek Subbasin

IBT calculations for the transfer from the Tar River subbasin (Basin ID 15-1) to the Contentnea Creek subbasin (Basin ID 10-2) are shown in the Water Balance Tables (Tables 15, 16, and 17). Transfers to the Contentnea Creek subbasin are a result of bulk sales to the Town of Farmville and Greene County.

- Peak day demands for the Town of Farmville are calculated based on a MDD:ADD peaking factor of 1.70, based on historical demand trends.
- Peak day demands for Greene County are calculated based on a MDD:ADD peaking factor of 1.75, based on historical demand trends.
- Consumptive water use for Farmville and Greene County is assumed to be 30 percent.
- Process water use at the GUC WTP is 8 percent of raw water withdrawal based on operating records.
- The service area for the Town of Farmville is entirely within the Contentnea Creek subbasin.
- The portion of Greene County in the Contentnea Creek subbasin is estimated at 95 percent.
- No wastewater produced in the Town of Farmville and Greene County service areas is returned to the Tar River subbasin.

In Table 15, water demands for the Town of Farmville and Greene County are based on Average Day Bulk Sales as shown in Tables 5 and 7, respectively. This demonstrates the average day IBT amounts that are expected on an annual basis. These demands account for bulk purchases from GUC required for Farmville and Greene County to meet customer their demands, to comply with CCPCUA rules, and to allow for “banking” of groundwater.

In Table 16, the maximum day IBT amount was determined using the maximum day bulk sales projected for Greene County and the Town of Farmville. The maximum day bulk sales represent the total peak day demands for Greene County and Farmville less the average annual allowable well pumping rate.

In Table 17, the emergency bulk sales projected for Greene County and Farmville are used to determine the emergency condition for the IBT. The emergency condition represents the total peak day demand. This strategy will allow GUC to provide water to Greene County and Farmville in the event a catastrophic event was to occur, e.g. aquifer contamination, drought, or major mechanical or electrical failure. GUC requests that the IBT certificate be written such that notification would be required to DWR to trigger the emergency request.

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Table 15: Water Balance Table – Tar River to Contentnea Creek (Average Day)

Year	Farmville Estimated Bulk Purchase	Greene County Estimated Bulk Purchase	Total Bulk Sales to Contentnea Basin	Withdrawal from Tar Basin (associated with bulk sales only)	Consumptive Use			Wastewater Discharge		WTP Discharge	Total Return to Tar River Basin	Interbasin Transfer
					% Tar River	Tar River Basin	Content-nea Creek Basin	Tar River Basin	Content-nea Creek Basin	Tar River Basin		
2005	1.66	1.19	2.85	3.08	0	0.0	0.9	0.0	2.0	0.2	0.2	2.9
2010	1.32	1.22	2.54	2.74	0	0.0	0.8	0.0	1.8	0.2	0.2	2.5
2015	1.42	1.76	3.18	3.43	0	0.0	1.0	0.0	2.2	0.3	0.3	3.2
2020	1.52	2.31	3.83	4.14	0	0.0	1.1	0.0	2.7	0.3	0.3	3.8
2025	1.63	2.51	4.14	4.47	0	0.0	1.2	0.0	2.9	0.3	0.3	4.1
2030	1.74	2.71	4.45	4.81	0	0.0	1.3	0.0	3.1	0.4	0.4	4.5
2035	1.86	2.91	4.77	5.15	0	0.0	1.4	0.0	3.3	0.4	0.4	4.8
2040	1.99	3.11	5.10	5.51	0	0.0	1.5	0.0	3.6	0.4	0.4	5.1

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Table 16: Water Balance Table – Tar River to Contentnea Creek (Maximum Day)

Year	Farmville Estimated Bulk Purchase	Greene County Estimated Bulk Purchase	Total Bulk Sales to Contentnea Basin	Withdrawal from Tar Basin (associated with bulk sales only)	Consumptive Use			Wastewater Discharge		WTP Discharge	Total Return to Tar River Basin	Interbasin Transfer
					% Tar River	Tar River Basin	Content-nea Creek Basin	Tar River Basin	Content-nea Creek Basin	Tar River Basin		
2005	1.66	2.08	3.74	4.04	0	0.0	1.1	0.0	2.6	0.3	0.3	3.7
2010	2.07	1.87	3.93	4.25	0	0.0	1.2	0.0	2.8	0.3	0.3	3.9
2015	2.63	2.91	5.54	5.99	0	0.0	1.7	0.0	3.9	0.4	0.4	5.5
2020	3.19	3.95	7.15	7.72	0	0.0	2.1	0.0	5.0	0.6	0.6	7.1
2025	3.38	4.30	7.68	8.29	0	0.0	2.3	0.0	5.4	0.6	0.6	7.7
2030	3.57	4.65	8.22	8.88	0	0.0	2.5	0.0	5.8	0.7	0.7	8.3
2035	3.77	5.00	8.77	9.47	0	0.0	2.6	0.0	6.1	0.7	0.7	8.8
2040	3.98	5.35	9.33	10.08	0	0.0	2.8	0.0	6.5	0.7	0.7	9.3

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Table 17: Water Balance Table – Tar River to Contentnea Creek (Emergency Condition)

Year	Farmville Estimated Bulk Purchase	Greene County Estimated Bulk Purchase	Total Bulk Sales to Contentnea Basin	Withdrawal from Tar Basin (associated with bulk sales only)	Consumptive Use			Wastewater Discharge		WTP Discharge	Total Return to Tar River Basin	Interbasin Transfer
					% Tar River	Tar River Basin	Content-nea Creek Basin	Tar River Basin	Content-nea Creek Basin	Tar River Basin		
2005	1.66	3.64	5.30	5.73	0	0.0	1.6	0.0	3.7	0.4	0.4	5.3
2010	3.25	3.98	7.22	7.80	0	0.0	2.2	0.0	5.1	0.6	0.6	7.2
2015	3.41	4.32	7.73	8.35	0	0.0	2.3	0.0	5.4	0.6	0.6	7.7
2020	3.59	4.66	8.24	8.90	0	0.0	2.5	0.0	5.8	0.7	0.7	8.2
2025	3.77	5.01	8.78	9.48	0	0.0	2.6	0.0	6.1	0.7	0.7	8.8
2030	3.96	5.35	9.32	10.06	0	0.0	2.8	0.0	6.5	0.7	0.7	9.3
2035	4.17	5.70	9.87	10.66	0	0.0	3.0	0.0	6.9	0.8	0.8	9.9
2040	4.38	6.05	10.43	11.27	0	0.0	3.1	0.0	7.3	0.8	0.8	10.4

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5. IBT Management Strategy

Greene County, the Town of Farmville, and the Town of Winterville have each entered into Water Purchase Agreements with GUC in response to the CCPCUA rules. Key provisions that are similar to each contract are as follows:

- Contract terms are valid for 40 years, beginning August 1, 2008.
- The minimum daily amount that GUC is committed to provide is equal to water supply reductions required by CCPCUA rules for each customer.
- Interruption or curtailment of water supply will occur no more than 10 percent of the time (36 days per year). GUC will provide at least a 24-hour notice prior to interruption or curtailment of water service.

GUC currently has system interconnections with the Town of Winterville. GUC has constructed a 24-inch transmission main to the end of its water system for the purposes of interconnecting to the Farmville and Greene County water systems. Greene County and the Town of Farmville are currently constructing a booster pumping station and 10 miles of 24-inch transmission mains to complete the system interconnection with GUC.

The projected average daily bulk purchases for Greene County, the Town of Farmville and the Town of Winterville are shown in Tables 5, 7, and 9. These tables illustrate the typical amount of water that GUC will sell to these water systems on an annual average daily basis. These estimated purchase amounts include “banking” from 2008 through 2018.

GUC will sell additional potable water to help its customers meet their peak demands if water supply is available. The maximum day IBT calculations are based on GUC selling water to meet wholesale customers’ peak day demands less the allowable well pumping rate (Tables 13 and 16).

The emergency condition represents the total peak day demand for each of the wholesale customers. This strategy will allow GUC to provide water to Greene County, Farmville, and Winterville in the event a catastrophic event was to occur, e.g. aquifer contamination, drought, or major mechanical or electrical failure. The intent is for the IBT Certificate to allow this flexibility for GUC to meet the needs of its wholesale customers during an emergency even if it occurs during a peak demand period. GUC also intends to help its wholesale customers meet peak demands if supply is available.

When GUC experiences peak demands, GUC may limit distribution to the wholesale customers as necessary. However, GUC will supply the wholesale customers with the Estimated Minimum Purchase. Wholesale customers will rely on well pumping to meet their customer’s demands during those periods and GUC will provide sufficient water during the remainder of the year to allow its customers to meet CCPCUA rules. In the event that GUC experiences a mechanical failure, pipeline break, unusually high demand or other situation in its water system, the Water Purchase Agreements include a provision that allows GUC to curtail or interrupt service.

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GUC and its wholesale customers will be required to balance requirements of two regulations: CCPCUA rules and requirements of the IBT Certificate. CCPCUA rules limit the amount of well pumping from the Cretaceous aquifer system over an **annual period** (e.g. total annual volume). The IBT Certificate will limit the transfer amount on a **maximum day basis**. This IBT management strategy was developed to meet the requirements of two sets of rules with different criteria. GUC and its wholesale customers will develop more detailed standard operating procedures to guide bulk sales and purchases to ensure compliance with both rules and to ensure that the needs of each water system are met.

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6. ATTACHMENTS

EXHIBIT "B"

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Water Resources

Michael F. Easley, Governor

William G. Ross Jr., Secretary
John Morris, Director

July 6, 2004

Albert V. Lewis, Jr.
McDavid Associates, Inc.
120 N. Main Street
Farmville, NC 27828

Dear Mr. Lewis:

This letter is in response to your June 28, 2004 "Banking Request" inquiry for the City of Farmville and for Greene County water systems. We have previously approved the concept of "banking" Cretaceous aquifer withdrawals. In this letter we formally approve your plan to use this banking concept and set out guidelines to participate in that process.

At the outset, users of this banking concept should understand that the Environmental Management Commission and the Division of Water Resources strongly believe, based on the hydrologic information available to us, that the three phases of water withdrawal reduction will be necessary to bring withdrawals from the Cretaceous aquifer system in balance with recharge. Positive water level responses made in the short term as a result of banking credits must be weighed carefully during the Central Coastal Plain Capacity Use Area reviews conducted in 2008, 2013, and 2018 against the effects on water levels of the future withdrawal of this banked water.

CCPCUA permit holders or applicants who have implemented alternative sources of water may establish accounts of banked Cretaceous aquifer water by prior agreement with the Division of Water Resources. Water bank years will be based on the anniversary of the effective date of the rule (August 1, 2002), so a banking year will start on August 1 and run through July 31. Credits to a Cretaceous water bank account may be made in any year prior to August 1, 2018. During the period extending from the present day through July 31, 2008, the bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the Approved Base Rate (ABR). During the August 1, 2008 through July 31, 2013 time period, the bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR less Phase I reduction. During the August 1, 2013 through July 31, 2018 time period, the bank may be credited with the positive volume of water calculated by subtracting the actual annual use from the ABR less Phase II reduction.

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CCPCUA permit holders or applicants must submit a letter of intent to establish a Cretaceous water bank, which will be subject to review and approval by the Division of Water Resources. This document will be added to their permit file. They also must sign an annual water withdrawal summary provided to them by the Division of Water Resources within 60 days after August 1 of each year. That summary will contain the previous year's withdrawal, their ABR less any phased reduction amount as applicable, the Cretaceous water bank credit, the Cretaceous water bank debit, and their Cretaceous water bank balance.

Debits from a Cretaceous water bank may occur after July 31, 2010 only. Future permits may have stipulations about how debits may occur. For example, there may be annual limits on the amount of debits from the Cretaceous water bank as needed to protect the Cretaceous aquifers.

As far as the Town of Farmville and Greene County (and the CCPCUA permit holders and applicants it represents) are concerned, your June 28, 2004 letter with attachments is sufficient information to add to these respective permit files signifying their intent to participate in Cretaceous banking. The Division of Water Resources approves the banking proposal described in these documents.

We appreciate the thoughtful approach that Farmville and Greene County have taken to meet their water supply needs. Your Cretaceous banking idea and alternative water supply purchase agreements with the Greenville Utility Commission are excellent examples of creative and farsighted action to assure that your communities have water supplies to support a sound economy.

Please let me or Nat Wilson know if you have any questions. I can be reached at 919-715-5422 and Nat can be reached at 919-715-5445.

Sincerely,

John N. Morris

John N. Morris

cc: Mr. Bennie Heath
Mr. Lee Worsley
Mr. Richard Hicks
Mr. Randy Emory
Dr. Richard Spruill

Received
SEP 22 2003

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Water Resources

Michael F. Easley, Governor

William G. Ross Jr., Secretary
John N. Morris, Director

September 17, 2003

Mr. Randall D. Emory
Greenville Utilities Commission
PO Box 1847
Greenville, NC 27835-1847

Dear Mr. Emory:

I am responding to your letter of August 20, 2003, which followed up on our meeting on July 17 when we discussed the concept developed by Greenville Utilities to provide for "banking" of allowed withdrawals under Central Coastal Plain Capacity Use Area permits.

As we discussed at the meeting, the goal of the Central Coastal Plain Capacity Use Area is to provide a fair and predictable schedule for reducing unsustainable withdrawals from the Cretaceous aquifer system and to make the transition to sustainable water sources that can support a healthy economy. Our goal is to interpret this rule in a flexible manner that will help local governments solve this critical water supply problem. In our interpretation of the rule we are guided by the necessity to be fair to all water users in the region and to assure that we make steady progress in protecting the aquifer, which is a critical resource for the region's future.

Under your proposal, a local government water system would reduce water withdrawals faster than required by the rule and "bank" the difference between the system's permitted withdrawal and their actual withdrawal. Later, this banked water would be drawn upon in a way that would allow higher withdrawals later in the process but still meet the average reduction requirement over the first two reduction phases. This banking concept appears to be fair, in that the average rate of reductions is met. The proposal has the benefit of achieving significant earlier reductions above what would be required.

We support this banking concept in principle. The Division of Water Resources does not have the authority to approve a specific permit involving this banking concept until a permit is applied for and acted upon after the required public notice period. During the review of a permit application, we would carefully review the details of the proposal to make sure that our standards of fairness and aquifer protection are achieved.

Your example of the application of the banking concept extends only through the second water use reduction phase and does not explain what would happen in the third reduction phase. A permit applicant will need to have a practical plan to deal with this third phase to make sure that a satisfactory water supply is available after the banked water is exhausted. We would not want

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to put a water system at risk by allowing the higher withdrawals later in the process unless the water system has a satisfactory plan to cover the whole sixteen-year transition process.

We appreciate the efforts made by Greenville Utilities to work toward creative and workable solutions to assure adequate future water supplies to support the economy of this region. We will look forward to continuing to work with you toward these goals.

Sincerely,

John N. Morris

John N. Morris

JM/km

cc: Mr. Nat Wilson

Greenville Utilities

August 20, 2003

Mr. John N. Morris, Director
Division of Water Resources
NCDENR
1611 Mail Service Center
Raleigh, NC 27699-1611

Subject: Central Coastal Plain Capacity Use Area Rules
Inter System Banking Concept

Dear John:

At our meeting with you and your staff on July 17, 2003, we presented information on a concept that, if implemented, could result in significant voluntary reductions in withdrawals from the Cretaceous aquifer system prior to the mandatory reductions which begin in 2008 during Phase II of the Central Coastal Plain Capacity Use Area (CCPCUA) rules. We referred to this concept as "Inter-System Trading/Banking Credits", hereinafter referred to simply as, "Banking".

Under the Banking concept; a water system subject to the CCPCUA rules could immediately begin reducing the quantity of water they withdraw from the aquifer, off-setting those reductions using supplemental water purchased from a surface water system such as Greenville Utilities. The quantities of water **not pumped** from the aquifer would be aggregated and set aside (i.e., "banked") for later withdrawal from the aquifer during Phase III of the rules, beginning in 2013.

In the example we presented to you during the presentation, the affected system would reduce their withdrawals from the aquifer during Phase I by 876 million gallons or approximately 44% of the total quantity they would otherwise have pumped from the aquifer. During Phase II of the rule, they would continue their reduced withdrawals at the required reduction rate (25%). During Phase III (50% reduction phase), they would continue reduced withdrawals at the 25% level, thus effectively using the previously "banked" water to account for the other 25% of the required reduction.

We believe that "Banking" is an environmentally sound concept that is consistent with the intent of the Central Coastal Plain Capacity Use Area rule and one that could have a measurable, positive effect on the aquifer system.

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At this time, two of the Pitt County systems that have expressed interest in purchasing supplemental water from Greenville Utilities have asked us whether Banking has been approved by the State. The purpose of this letter is to formally request your approval of the Banking concept. If possible, we would appreciate a response by September 5, 2003.

In the meantime, if you should have any questions or need any additional information regarding this matter, please do not hesitate to let us know.

Sincerely,

Randall D. Emory, PE
Director of Water Resources

RDE/jhb

cc: Mr. Malcolm A. Green, PE, General Manager/CEO
Mr. Ronald D. Elks, Assistant General Manager
Mr. J. Steven Porter, PE, W/S Systems Engineer
Mr. Barrett L. Lasater, Plants Manager
Dr. Richard Spruill

ARCADIS

Final Environmental Assessment – Greenville Utilities Commission Interbasin Transfer

Appendix B

Analysis of Greenville Utility Commission's Proposed Interbasin Transfer Withdrawals on Tar River Flows at Greenville, North Carolina (ENTRIX, revised April 2008)

Analysis of Greenville Utility Commission's Proposed Interbasin Transfer Withdrawals on Tar River Flows at Greenville, North Carolina

Prepared by

ENTRIX
ENVIRONMENTAL CONSULTANTS

October 2007
Revised January 2008 and April 2008

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Introduction

A hydrologic model was developed for the lower Tar River to predict river flows under current and future water usage scenarios. The model was designed to evaluate the effect of Greenville Utility Commission's (GUC) proposed interbasin transfer (IBT) withdrawals on current and future flows at Greenville. The model was based on available United States Geological Survey (USGS) flow records from the Tar River at Tarboro (Gage No. 02083500) and the Tar River at Greenville (Gage No. 02084000) (USGS, NWIS). The flow record at the Tar River at Tarboro gage provides not only a long-term record (1931 to 2007) of hydrologic conditions in the river, representing the majority of the entire drainage area of the basin, but also the best available basis for predicting downstream flows at Greenville, where only a short period of record is available (1997 to 2007). The drainage area of the Tar River gage at Tarboro is 2,186 square miles. The drainage area of the Tar River at Greenville is 2,660 square miles.

The relationship between available flow records for the Tar River at Greenville and the Tar River at Tarboro was estimated using hydrologic and statistical methods. This relationship was used to generate a long-term flow record at Greenville, which was then used in a spreadsheet model to estimate future flows at Greenville with and without the proposed interbasin transfers (IBT). The model quantifies the relative differences in flow associated with current and projected water usage and discharges. Tidal influences are not simulated in this model. Days may occur when the tidal influence creates a net downstream flow of zero or a net upstream flow ("negative" flow).

The model was used to evaluate resulting flow in the river at two locations. The first location was the USGS gage at Greenville, which is downstream of GUC's water treatment plant intake and water treatment plant discharge, but is upstream of GUC's wastewater treatment plant (WWTP) discharge (Figure 1). This 7.7-mile portion of the Tar River is the reach that will have the lowest flows as a result of all upstream withdrawals, and therefore, may be considered the reach of the Tar River most affected by the proposed IBT. The second location where flows were evaluated is the Tar River downstream of the GUC WWTP discharge (Figure 1). This reach downstream of the Greenville WWTP will also be affected by the proposed IBT, but less so because the flows in that reach include the discharge from the WWTP. The flow in this reach goes to the Pamlico River and Pamlico Sound. Both reaches are tidally influenced, especially at low flows, and the effects analysis presented herein must be interpreted in light of the fact that daily tidal fluctuations at Greenville can be much greater than the net downstream flow of the Tar River arriving at Greenville. Figure 2 provides a schematic representation of the lower Tar River and the modeled withdrawals, discharges, and output locations.

Greenville Model Nodes

Figure 1. Schematic diagram of the Tar River in the vicinity of Greenville, NC showing the relative locations and approximate distances between withdrawal and discharge locations, USGS gage location, and hydrologic model output points

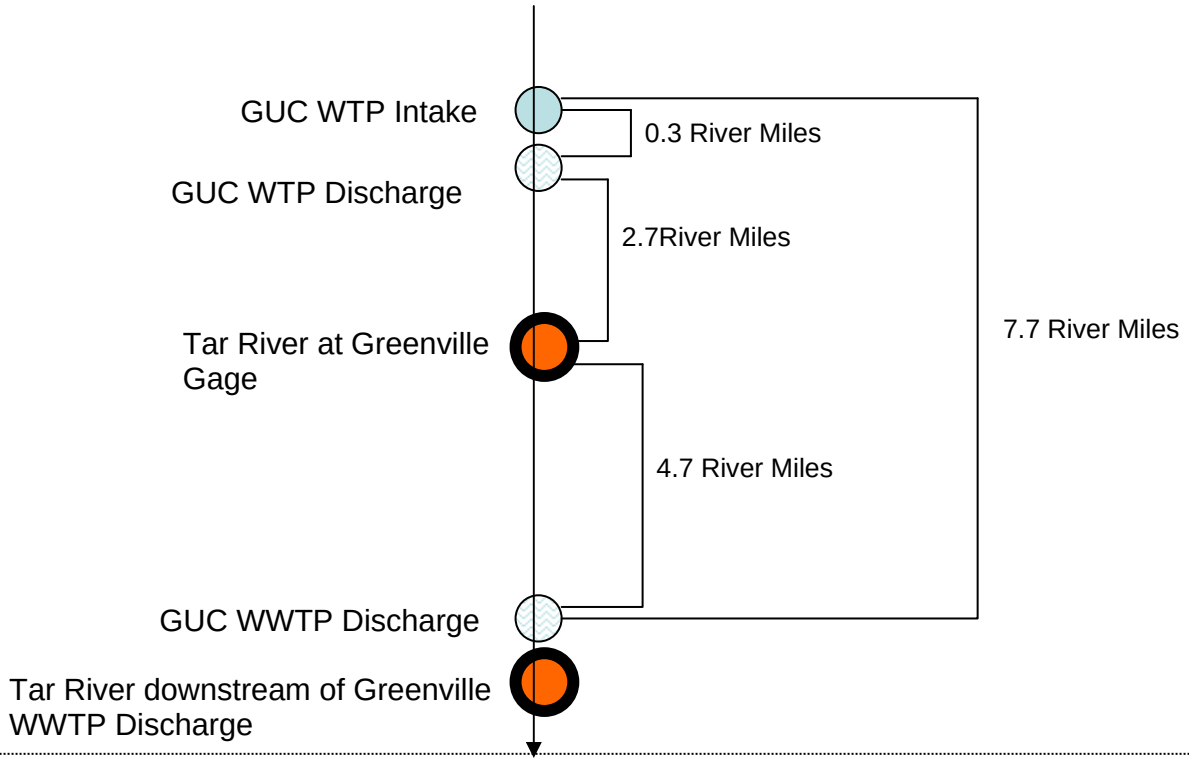
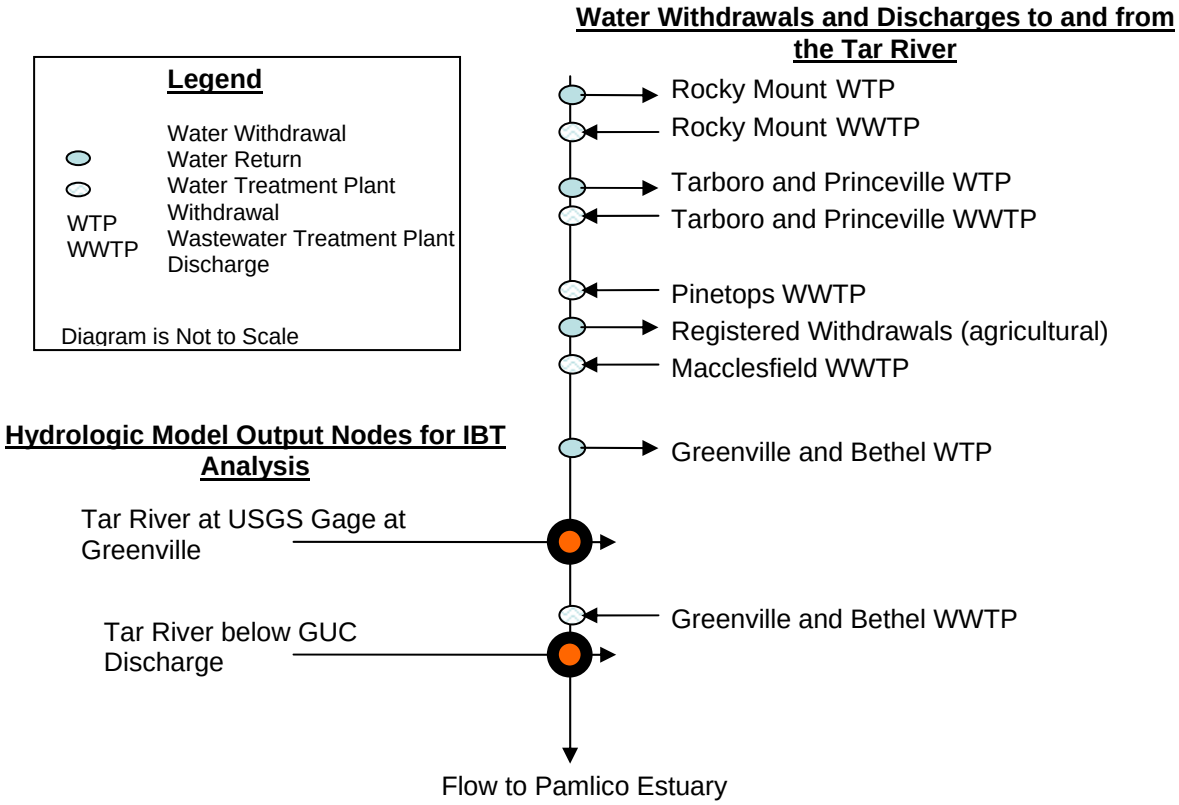


Figure 2. Schematic diagram of the lower Tar River showing the withdrawals and discharges of water accounted for in the hydrologic analysis of Greenville Utility Commission's (GUC) proposed interbasin transfer



The following scenarios were evaluated in the model at both locations:

1. Current flows with No IBT
2. Current flows with 2030 Average Day IBT
3. Current flows with 2030 Maximum Withdrawal IBT
4. Predicted 2030 flows with No IBT
5. Predicted 2030 flows with 2030 Average Day IBT
6. Predicted 2030 flows with 2030 Maximum Withdrawal IBT

Flow statistics for the Tar River were generated for each scenario at both river locations. In order to evaluate the seasonal flow fluctuations, the statistics were based on daily average flow by month. A range of flow statistics and comparisons were developed for each scenario in order to quantify and demonstrate the effect of the proposed IBT withdrawals on current and future conditions at both Tar River locations. The impact of projected growth and different IBT scenarios were evaluated by examining changes in these statistics. Finally, a discussion of the importance of the influence of tidal fluctuations on the Tar River at Greenville are provided to help the reader understand the potentially ameliorating effect of tides at Greenville on the influence on river flow estimated for GUC's proposed IBT.

Development of a Long-Term Flow Record for the Tar River at Greenville

Tar River flows recorded at the Tarboro gage were used to predict Tar River flows downstream at Greenville. Hydrologic and statistical analyses were performed to develop a predictive relationship between the two locations. First, a tidal filter was applied to the Greenville USGS gage data to reduce the influence of tidal fluctuations on the estimates of daily average flow. In order to improve the strength of the relationship between Greenville and Tarboro gage flows, statistical analyses were performed to determine the best way to fit the Tarboro-Greenville flow relationship and to reduce the effects of data outliers. Finally, once the statistical fit between flows at Tarboro and Greenville was best adjusted to the data, that model was used to generate a long-term flow record for the Tar River gage at Greenville.

Tidal Filtering

Tidal filtering was applied to the available data for the Greenville gage (collected at 15-minute intervals), which were available from USGS from April 1997 to September 2007. The tidal filtering was performed using the "Godin filter" approach, as described by Gabriel Godin in his book The Analysis of Tides (Godin 1972). The filtering was performed first using Microsoft Excel® spreadsheets to apply a 23-25-27 Godin filter (these numbers refer to the number of days in each "bin" of the running filter), which was the approach recommended by Godin for the tidal influence in the shallow water of near-coastal rivers.

The results of this filtering did show decreased tidal influence; however, the correlation between the discharge measurements at Tarboro (upstream) and Greenville (downstream) was not significantly improved (relative to results without the filtering). To improve the data correlation, a Godin filter was again applied to the real-time data using the USGS "Gr" software, which was obtained from the USGS National Water Information System (NWIS) website at http://ca.water.usgs.gov/program/sfbay/gr/ (USGS, CA). The filtered data did appear to exhibit less

tidal influence, but the correlation between the Tarboro and Greenville gages was not improved. As a result, the filtered data were not used in the final data correlation for development of the extended period of record for the hydrologic model for the Greenville gage. Instead, the recorded daily average discharge data downloaded from the USGS NWIS website for the Tarboro and Greenville gages for the period of April 1997 to the end of September 2007 were used to model the relationship between these two stations (details provided in the next section). That modeled relationship was then used to develop an extended period of record for the Greenville gage, from October 1931 through September 2007 (76 years of data).

Statistical Relationship between Tar River Flows at Tarboro and Greenville – Regression Analysis

The relationship between river flow at Tarboro and Greenville for the overlapping period of USGS flow records (April 1997 through September 2007) was examined using graphical and statistical tools and using a number of possible transformations. A strong linear correlation was observed between the downstream and upstream flows, and the correlation was strengthened by comparing the downstream flow with the upstream flow measurement of the previous day (one-day lag). The correlation in some cases was slightly improved with the logarithm transformation. However, the improvement was not significant; therefore, the transformation was not used in the final regression model.

A limited number of outliers were removed from the data set. Figure 3 presents a plot of the upstream (Tarboro) discharge versus the downstream (Greenville) discharge, identifying the data associated with Hurricane Floyd (September 15 through October 2, 1999). This severe storm event created flow rates which were much higher than any other measurements obtained during the entire period of record for either of the two gage stations. These measurements were considered to be outliers for the purposes of creating a normal-condition flow relationship and were excluded from the analysis, because the focus is on low-flow conditions when the proposed IBT amount could have the largest impact on instream flow levels.

Figure 4 presents a plot of the remaining discharge data showing a number of high outliers and a few low outliers. In the figure, the high outliers are identified as those associated with a downstream flow/upstream flow ratio of 1.9 (the 97.5th percentile for that ratio) or higher. The low outliers were selected as those with negative values (upstream flow) at the Greenville gage. It was hypothesized that the high outliers might be caused by unusually large local rainfall events that considerably increased the downstream flow over that predicted from the upstream flow. Rainfall data were available for the Greenville gage only from October 17, 2003 to September 30, (approximately three years). Comparison of the precipitation data to the discharge data indicated that the high and low outliers were associated with high rainfall events where the

Figure 3. Downstream vs. Upstream Discharge, Identifying Data Associated with Hurricane Floyd (September 15 - October 2, 1999)

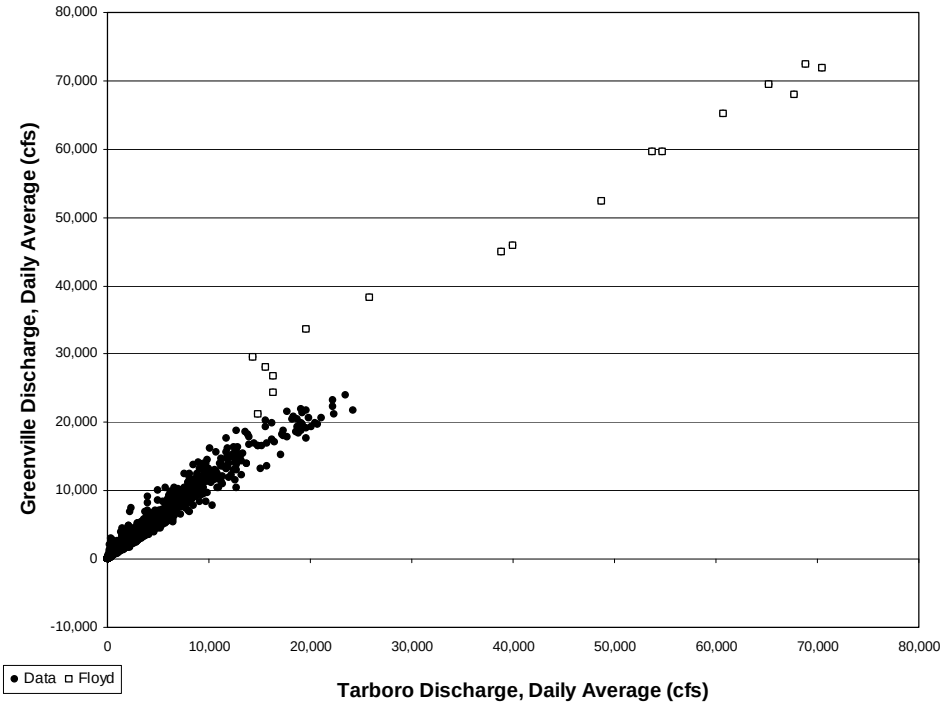
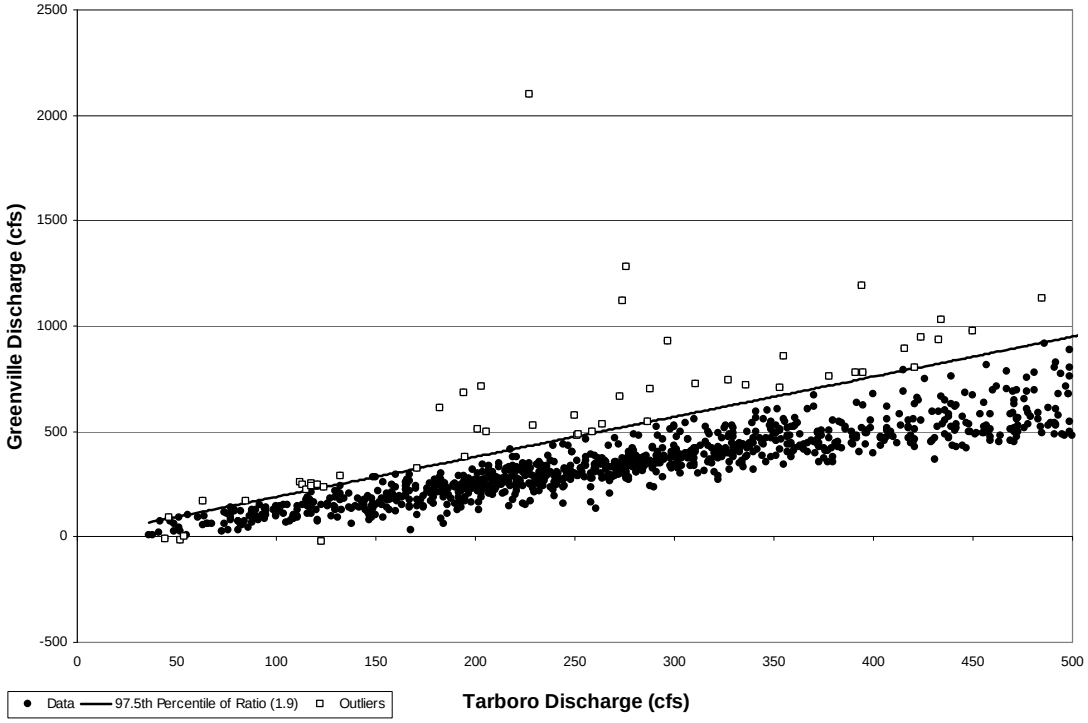


Figure 4. Flow vs. Flow, Identifying Outliers Excluded from Further Analysis



precipitation data were available. Based on these observations, these high and low outliers likely were not contributing to a best fit of the underlying dominant flow relationship between the upstream and downstream gages, and those measurements were excluded from further analysis in the flow model.

Examination of plots of downstream (Greenville) flow versus upstream (Tarboro) flow indicated that separate linear regression analyses should be performed for different flow ranges because the slopes of the regression lines were different for different flow ranges. The data were separated into five separate flow ranges, and separate linear regression analyses were applied to each range. Figure 5 presents a Tarboro flow versus Greenville flow plot for the remaining data illustrating the "best fit" linear regression lines. The linear relationships obtained for the five flow ranges were as follows (all flows are in cubic feet per second [cfs]):

- Greenville Flow (cfs) = (1.116 × Tarboro Flow (cfs)); Tarboro Flow (cfs) < 118 cfs; R^2 = 0.93 (254 data points)
- Greenville Flow (cfs) = (-31.778) + (1.383 × Tarboro Flow (cfs)); Tarboro Flow (cfs) >119 and < 398 cfs; R^2 = 0.80 (444 data points)
- Greenville Flow (cfs) = (88.454) + (1.080 × Tarboro Flow (cfs)); Tarboro Flow (cfs) = 398 to 2,833 cfs; R^2 = 0.55 (638 data points)
- Greenville Flow (cfs) = (-259.794) + (1.203 × Tarboro Flow (cfs)); Tarboro Flow (cfs) = 2,834 to 12,572 cfs; R^2 = 0.83 (377 data points)
- Greenville Flow (cfs) = (5767.346) + (0.723 × Tarboro Flow (cfs)); Tarboro Flow (cfs) > 12,572 cfs; R^2 = 0.51 (40 data points)

Figure 6 presents the same Tarboro flow versus Greenville flow plot but focuses on the lower flow region to provide greater detail of that data and the results of the modeling.

The resulting flow model was used to construct an extended Greenville data set for the time period from October 1931 to September 2007 based on discharge data for the Tarboro gage for that period of record. Thus, the flow model for the Greenville gage is based on this extended period of record, from October 1931 to September 2007.

Synthesized Historical Tar River Flow at Greenville Gage

Figure 7 presents the average annual flow at the Greenville gage for each full year of synthesized data (1932-2006). Figure 8 and Table 1 present the monthly average flows for the synthesized data. Table 1 presents the monthly average flows in tabular format for the results presented in Figure 8 (current conditions with no IBT) and for seven other IBT scenarios analyzed as part of this study. Table 2 presents the monthly averages calculated for the same eight scenarios but at the location downstream of the GUC WWTP. The flow data associated with Hurricane Floyd in the month of September 1999 were removed from the data set for the IBT- impact analyses, but Figure 8 shows the average September flows with and without Hurricane Floyd data.

Figure 5. Results of Modeling for the Flow vs. Flow Relationship

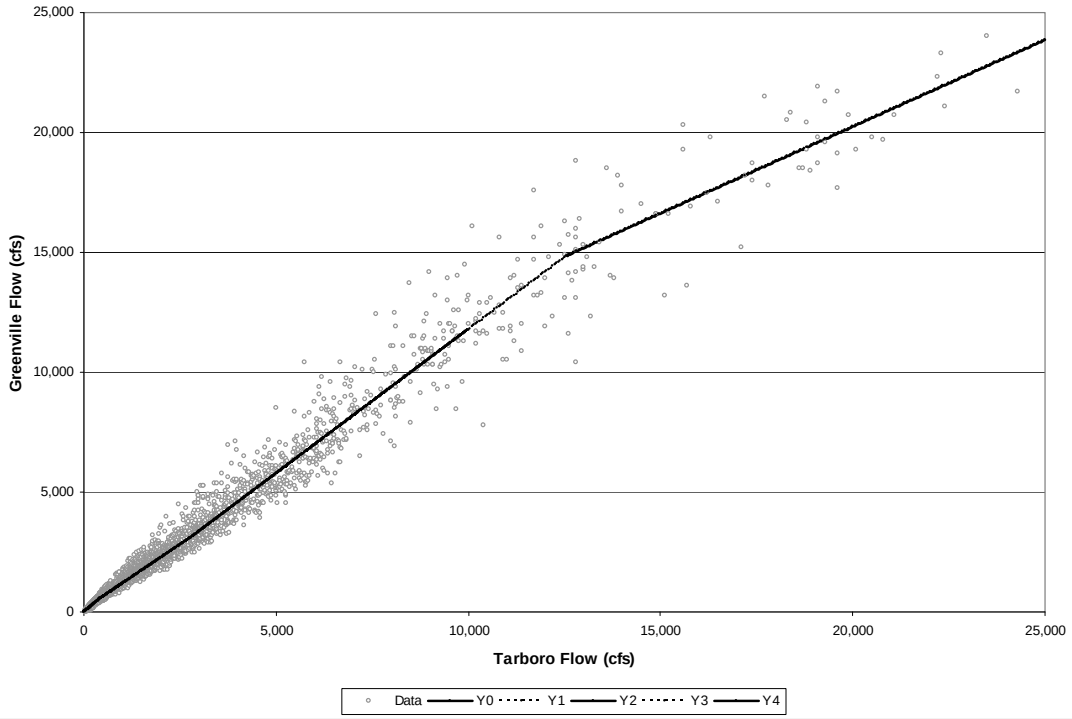
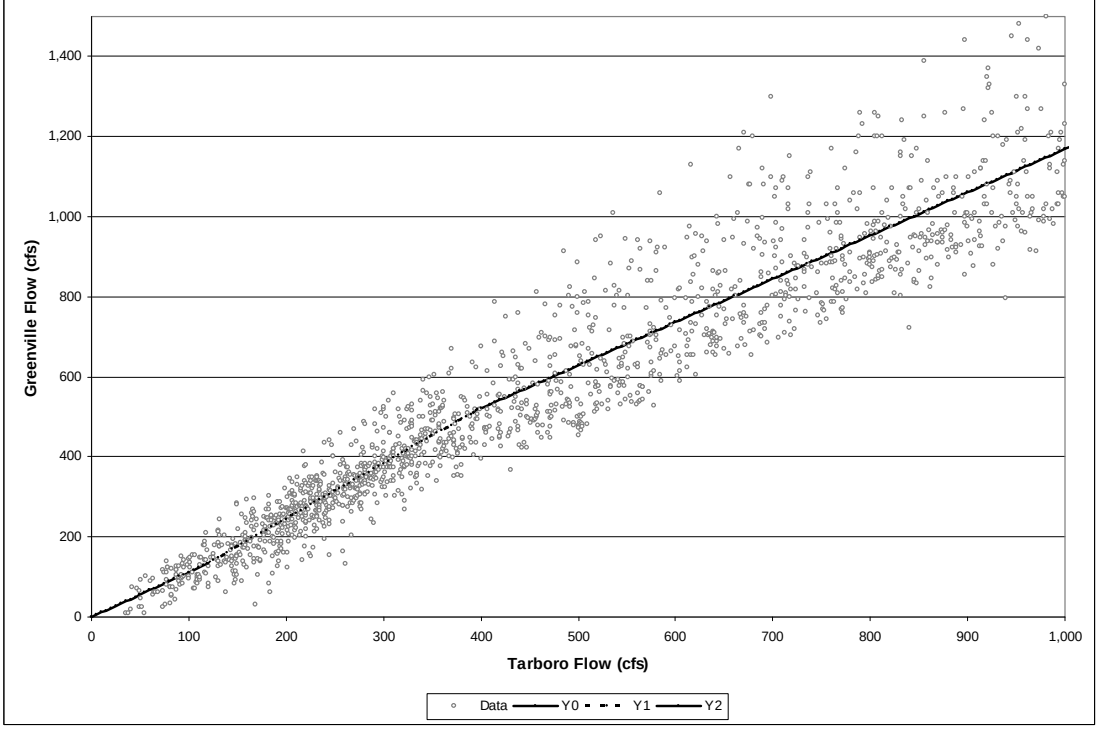


Figure 6. Results of Modeling for the Flow vs. Flow Relationship (Low-Flow Region Detail)



Long-Term Flow Record for the Tar River at Greenville

Figure 7. Average Annual Flow at Tar River Gage (1932-2006)

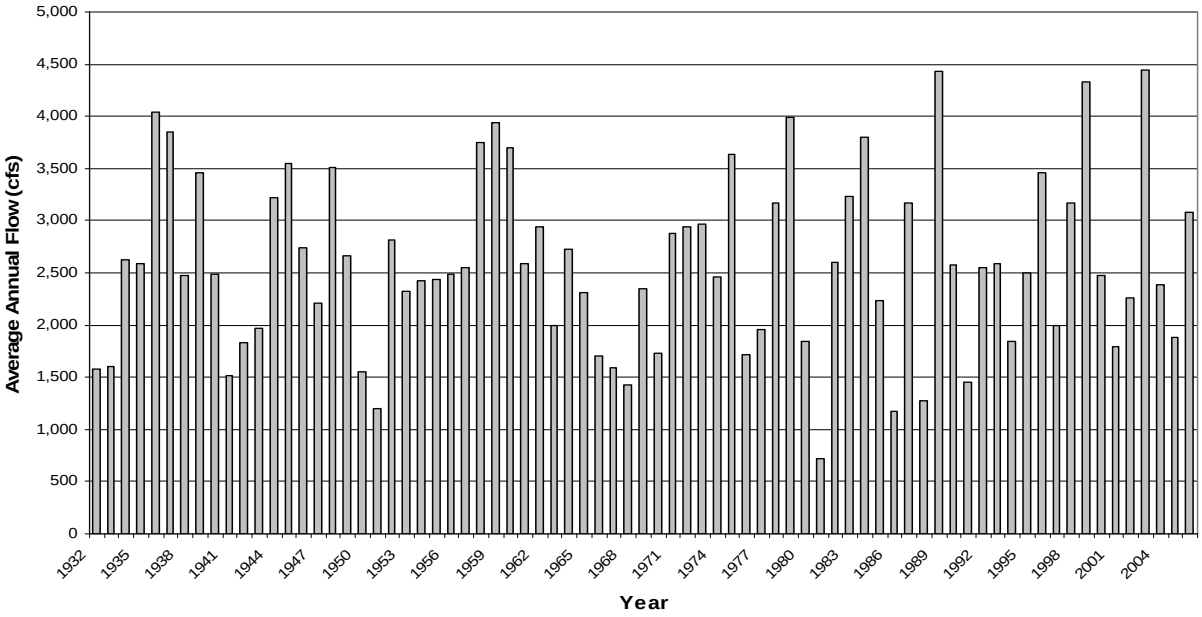
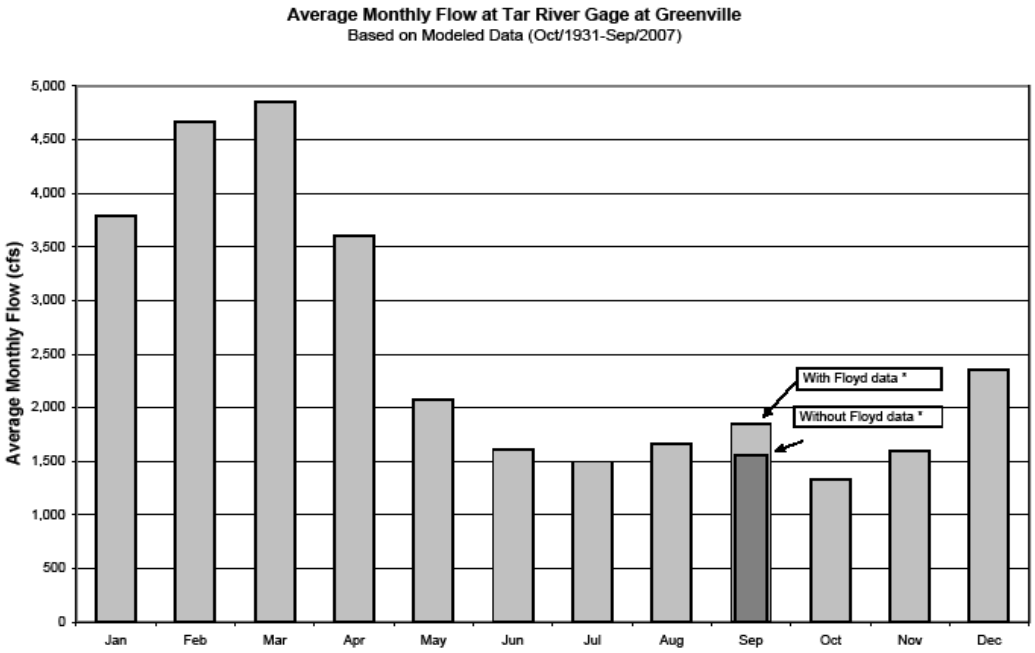


Figure 8. Average Monthly Flow at Tar River Gage based on Modeled Data

(October 1931 – September 2007)



cfs - Cubic feet per second.
* Monthly averages with and without the flow data from September 1999, when Hurricane Floyd passed through the Greenville, NC area.

Table 1. Annual and Monthly Average Tar River Flows at Greenville[1,2,3]

	Current			Future (2030)		
All flows in cfs	No IBT	Avg IBT	Max. Withdrawal IBT*	No IBT	Avg IBT	Max. Withdrawal IBT
All Data	2,524	2,513	2,505	2,525	2,513	2,505
January	3,776	3,766	3,756	3,777	3,768	3,758
February	4,649	4,638	4,628	4,651	4,641	4,630
March	4,840	4,831	4,820	4,844	4,834	4,823
April	3,589	3,579	3,571	3,592	3,582	3,575
May	2,058	2,047	2,042	2,063	2,053	2,047
June	1,596	1,583	1,578	1,598	1,585	1,579
July	1,481	1,468	1,461	1,486	1,473	1,466
August	1,641	1,630	1,624	1,647	1,635	1,629
September	1,536	1,523	1,516	1,534	1,521	1,515
October	1,320	1,307	1,299	1,315	1,302	1,295
November	1,578	1,565	1,556	1,570	1,558	1,549
December	2,345	2,334	2,323	2,342	2,327	2,317

[1] Based on long-term flow record of Tar River at Tarboro (1931-2007; USGS Gage No.02083500; Tar River at Tarboro, NC; drainage area 2,183 mi^2) extrapolated downstream per methods described in ENTRIX 2007.
[2] Flow at Greenville, North Carolina, downstream of Greenville Utilities Commission water supply intake, but upstream of Greenville wastewater discharge (location of USGS Gage No. 02084000; drainage area 2,660 mi^2)
[3] These results are based on the modeled period of record from 1931 to 2007
* Max. Withdrawal IBT = Maximum Withdrawal IBT

Table 2. Annual and Monthly Average Tar River Flows downstream of GUC WWTP Discharge[1,2,3]

	Current			2030		
All flows in cfs	No IBT	Avg IBT	Max. IBT	No IBT	Avg IBT	Max. IBT
All Data	2,537	2,526	2,518	2,529	2,518	2,509
January	3,789	3,779	3,769	3,780	3,770	3,761
February	4,662	4,652	4,642	4,656	4,645	4,635
March	4,854	4,844	4,833	4,850	4,840	4,829
April	3,603	3,593	3,585	3,596	3,587	3,579
May	2,069	2,059	2,054	2,068	2,057	2,052
June	1,607	1,594	1,589	1,604	1,591	1,586
July	1,492	1,480	1,472	1,488	1,476	1,468
August	1,653	1,641	1,635	1,650	1,638	1,633
September	1,549	1,536	1,529	1,539	1,527	1,520
October	1,333	1,321	1,313	1,313	1,300	1,292
November	1,593	1,581	1,572	1,578	1,566	1,557
December	2,360	2,348	2,338	2,345	2,330	2,320

[1] Based on long-term flow record of Tar River at Tarboro (1931-2007; USGS Gage No.02083500; Tar River at Tarboro, NC; drainage area 2,183 mi^2) extrapolated downstream per methods described in ENTRIX 2007
[2] Flow at Greenville, North Carolina, downstream of Greenville Utilities Commission water supply intake, but upstream of Greenville wastewater discharge (location of USGS Gage No. 02084000; drainage area 2,660 mi^2)

[3] These results are based on the modeled period of record from 1931 to 2007

Develop Flow Accounting Model for Lower Tar River

ENTRIX developed a spreadsheet-based flow model for the lower Tar River that accounts for all documented current and expected future withdrawals from and discharges to the Tar River at selected nodes downstream of the Rocky Mount Reservoir. Withdrawals and discharges for the following communities were included:

- City of Rocky Mount
- Town of Tarboro
- Town of Princeville
- Town of Pinetops
- Town of Macclesfield
- Town of Bethel
- City of Greenville

Figure 2 provides a schematic representation of the lower Tar River and the modeled withdrawals, discharges, and output locations.

These withdrawals and discharges were included to predict the effects on flows in the Tar River at the Greenville Gaging station and in the Tar River downstream of the GUC WWTP discharge. Current water usage and discharges are reflected in the long-term flow record at Greenville described above. Average daily flows by month are presented in Tables 1 and 2. Tables 3 through 10 summarize the current and 2030 estimated total withdrawals and discharges associated with municipalities and registered users without any IBT quantities. The withdrawal and discharge numbers are provided in millions of gallons per day (MGD) and cfs. The monthly 2030 projected flows were created by adding to the current flow record the monthly incremental change in water withdrawals and wastewater discharges from 2002 to 2030. The annual 2030 water withdrawal and wastewater discharge projections were converted to monthly averages using monthly adjustment factors based on the past variability associated with water withdrawals and discharges for each municipality.

Water Withdrawals

Water usage for current and 2030 conditions was obtained for each municipality from their 2002 Local Water Supply Management Plans posted on the Division of Water Resources (DWR) website (DWR 2007a). GUC water use projections were obtained from ARCADIS. In addition, a list of registered non-municipal water users was obtained from Wayne Howard with DWR on September 12, 2007 (DWR 2007b). The amount of water consumed by registered water users was estimated and added to the model. Any organization that utilizes more than 100,000 gallons of surface water per day is required to register their water usage with the DWR. The DWR website was then reviewed for each registered water user to determine the estimated amount of water used in 2002. The water use data available on the DWR web site included average daily water withdrawals and pump capacity, but the number of days water was obtained was almost never reported. Conversations with Pitt County Soil and Water Conservation District and Natural Resources Conservation staff in September 2007 indicated that the DWR registered water withdrawals database is the only source of agricultural water usage data for the basin.

Only registered non-municipal water users that appeared to be agricultural operations were included in the water withdrawal totals. All other registered water users were hydropower or mining/quarry organizations. The hydro power organization and many of the quarries reported a water discharge rate that matched their water withdrawal rate. Other quarries reported that their water sources were "ponds" and "stormwater". Since the Tar River or a Tar River tributary was not the source for the water withdrawals, these water withdrawals were not included in the water withdrawal totals.

In order to estimate the amount of water used each year by the registered agricultural operations the following assumptions were made:

- No flow returns to the Tar River or its tributaries (consumptive use).
- 2030 usage will be the same as 2002 usage. (No net increase in water withdrawals associated with these registered users is expected for 2030.)
- Based on a conversation with Pitt County Soil and Water Conservation District and Natural Resource Conservation Service staff, it was determined that these agricultural withdrawals are most likely to be utilized in May, June, July, and August. Withdrawals are not expected to occur every day within this irrigation period.
- Conservative water usage estimates were included in the model based on daily water withdrawals over the entire May through August period. (Daily average withdrawal multiplied by the number of days in the month.)

Current municipal water withdrawals for the Towns of Macclesfield, Bethel, and Pinetops were assumed to be zero because their water source is currently groundwater. It was assumed that these communities will still be obtaining their water from groundwater in 2030. The GUC provides wastewater treatment services and part of the water needs for the Town of Bethel (since 2003). The Town of Princeville obtains its drinking water and wastewater treatment from the Town of Tarboro. Tables 3 and 4 summarize all municipal and registered water withdrawals for 2002 (representing current use), and Tables 5 and 6 document 2030 withdrawals without any IBT quantities.

Water Returns and Wastewater Discharges

Wastewater discharges for 2030 were developed by ARCADIS based on current discharge monitoring report (DMR) data submitted to the Division of Water Quality in accordance with existing National Pollutant Discharge Elimination System (NPDES) permits. ARCADIS obtained past and current discharge monitoring reports for Rocky Mount, Tarboro, Macclesfield, Pinetops, and GUC. These data were used to develop wastewater projections and monthly adjustment factors for each community's WWTP. Tables 7 and 8 summarize all municipal discharges for 2002 (representing current use), and Tables 9 and 10 document 2030 discharges without any IBT quantities.

Current (2002) and Projected 2030 Municipal and Registered Withdrawals

Table 3. 2002 Average Daily Withdrawals in MGD

Month	Rocky Mount 2002	Tarboro and Princeville 2002	Registered Agricultural Withdrawals	Pinetops 2002	Macclesfield 2002	Bethel 2002	Greenville and Bethel 2002 No IBT
January	11.42	2.10	0.00	Ground-water	Ground-water	Ground-water and water from GUC	11.28
February	11.07	2.05	0.00				10.43
March	10.99	2.12	0.00				10.51
April	12.13	2.30	0.00				12.69
May	14.50	2.66	4.69				13.68
June	16.67	2.92	4.69				11.77
July	12.93	2.54	4.69				10.47
August	12.76	2.57	4.69				12.36
September	12.48	2.30	0.00				11.17
October	14.22	2.33	0.00				10.55
November	11.24	2.23	0.00				9.99
December	10.46	2.37	0.00				9.47

Water withdrawal data from 2002 Local Water Supply Plans. Greenville data from ARCADIS. Registered agricultural withdrawal data from DWR.

Table 4. 2002 Average Daily Withdrawals in cfs

Month	Rocky Mount 2002	Tarboro and Princeville 2002	Registered Agricultural Withdrawals	Pinetops 2002	Macclesfield 2002	Bethel 2002	Greenville and Bethel 2002 No IBT
January	17.68	3.25	0.00	Ground-water	Ground-water	Ground-water and water from GUC	17.44
February	17.13	3.18	0.00				16.14
March	17.00	3.27	0.00				16.27
April	18.77	3.56	0.00				19.64
May	22.43	4.12	7.26				21.17
June	25.79	4.51	7.26				18.21
July	20.01	3.93	7.26				16.20
August	19.75	3.98	7.26				19.12
September	19.31	3.56	0.00				17.28
October	22.01	3.60	0.00				16.32
November	17.39	3.45	0.00				15.45
December	16.19	3.67	0.00				14.66

Water withdrawal data from 2002 Local Water Supply Plans. Greenville data from ARCADIS. Registered agricultural withdrawal data from DWR.

Table 5. Projected 2030 Average Daily Withdrawals in MGD No IBT

Month	Rocky Mount 2030	Tarboro and Princeville 2030	Registered Agricultural Withdrawals	Pinetops 2030	Macclesfield 2030	Greenville and Bethel 2030 No IBT
January	18.30	2.79	0.00	Assume	Assume	12.14
February	17.74	2.73	0.00	still using	still using	11.87
March	17.60	2.81	0.00	groundwater	groundwater	11.56
April	19.43	3.06	0.00			12.93
May	23.23	3.54	4.69			14.12
June	26.71	3.88	4.69			14.01
July	20.72	3.38	4.69			12.98
August	20.45	3.42	4.69			13.81
September	20.00	3.06	0.00			13.33
October	22.79	3.10	0.00			12.97
November	18.01	2.96	0.00			12.42
December	16.76	3.15	0.00			11.82

Water withdrawal data from 2002 Local Water Supply Plans. Greenville data from ARCADIS. Registered agricultural withdrawal data from DWR.

Table 6. 2030 Average Daily Withdrawals in cfs No IBT

Month	Rocky Mount 2030	Tarboro and Princeville 2030	Registered Agricultural Withdrawals	Pinetops 2030	Macclesfield 2030	Greenville and Bethel 2030 No IBT
January	28.32	4.32	0.00	Assume	Assume	18.78
February	27.45	4.23	0.00	still using	still using	18.37
March	27.23	4.35	0.00	groundwater	groundwater	17.89
April	30.07	4.74	0.00			20.00
May	35.94	5.47	7.26			21.84
June	41.33	6.00	7.26			21.68
July	32.05	5.22	7.26			20.08
August	31.64	5.29	7.26			21.36
September	30.95	4.74	0.00			20.63
October	35.26	4.79	0.00			20.06
November	27.87	4.58	0.00			19.22
December	25.94	4.88	0.00			18.29

Water withdrawal data from 2002 Local Water Supply Plans. Greenville data from ARCADIS. Registered agricultural withdrawal data from DWR.

Current (2002) and Projected 2030 Municipal Discharges

Table 7. 2002 Average Daily Discharge in MGD No IBT

Month	Rocky Mount 2002	Tarboro 2002	Macclesfield 2002	Pinetops 2002	Greenville and Bethel WWTP 2002 No IBT	Greenville WTP 2002 No IBT
January	12.37	2.139	0.066	0.223	8.50	0.691
February	11.97	2.173	0.067	0.231	8.59	0.648
March	11.70	2.060	0.074	0.227	8.48	0.648
April	11.98	2.069	0.060	0.237	8.99	0.648
May	8.85	1.779	0.042	0.177	7.60	0.648
June	8.05	1.766	0.038	0.142	6.99	0.648
July	8.24	1.788	0.042	0.127	7.20	0.648
August	9.11	1.842	0.054	0.139	7.33	0.648
September	12.93	2.267	0.051	0.218	8.23	0.648
October	13.38	2.363	0.049	0.240	8.84	0.708
November	11.43*	2.041*	0.079	0.285*	10.13	0.648
December	14.56*	2.851*	0.076	0.380*	9.62	0.648

*****2003 DMR data since 2002 November and December data was much higher than usual

Discharge projection data is from ARCADIS and is based on NPDES discharge monitoring reports

Table 8. 2002 Average Daily Discharge in cfs No IBT

Month	Rocky Mount 2002	Tarboro 2002	Macclesfield 2002	Pinetops 2002	Greenville and Bethel WWTP 2002 No IBT	Greenville WTP 2002 No IBT
January	19.14	3.310	0.103	0.345	13.15	1.069
February	18.52	3.362	0.103	0.357	13.29	1.003
March	18.10	3.187	0.114	0.351	13.12	1.003
April	18.54	3.201	0.093	0.367	13.91	1.003
May	13.69	2.753	0.065	0.274	11.76	1.003
June	12.46	2.732	0.058	0.220	10.81	1.003
July	12.75	2.766	0.065	0.196	11.14	1.003
August	14.10	2.850	0.083	0.215	11.34	1.003
September	20.01	3.508	0.079	0.337	12.73	1.003
October	20.70	3.656	0.076	0.371	13.68	1.095
November	17.68*	3.158*	0.123	0.441*	15.67	1.003
December	22.53*	4.411*	0.118	0.588*	14.88	1.003

*****2003 DMR data since 2002 November and December data was much higher than usual

Discharge projection data is from ARCADIS and is based on NPDES discharge monitoring reports

Table 9. 2030 Average Daily Discharge in MGD No IBT

Month	Rocky Mount 2030	Tarboro 2030	Macclesfield 2030	Pinetops 2030	Greenville WWTP 2030 No IBT	Greenville WTP 2030 No IBT
January	19.45	3.752	0.160	0.423	10.86	0.691
February	19.90	3.628	0.183	0.439	12.09	0.648
March	20.51	3.735	0.174	0.429	12.04	0.648
April	20.10	3.754	0.162	0.398	11.89	0.872
May	19.88	3.823	0.150	0.400	10.82	0.648
June	20.37	4.087	0.135	0.356	10.39	0.648
July	18.81	3.571	0.145	0.346	10.30	0.648
August	18.54	3.461	0.160	0.340	11.63	0.648
September	20.16	3.759	0.156	0.405	11.96	0.735
October	16.93	3.474	0.147	0.330	11.26	0.841
November	18.80	3.912	0.161	0.403	10.82	0.819
December	19.36	3.944	0.175	0.421	10.84	0.648

Discharge projection data is from ARCADIS and is based on NPDES discharge monitoring reports.

Table 10. 2030 Average Daily Discharge in cfs No IBT

Month	Rocky Mount 2030	Tarboro 2030	Macclesfield 2030	Pinetops 2030	Greenville WWTP 2030 No IBT	Greenville WTP 2030 No IBT
January	30.10	5.805	0.247	0.655	16.80	1.069
February	30.79	5.614	0.284	0.679	18.70	1.003
March	31.74	5.779	0.269	0.660	18.62	1.003
April	31.10	5.808	0.250	0.616	18.40	1.349
May	30.77	5.914	0.233	0.620	16.75	1.003
June	31.52	6.324	0.209	0.550	16.08	1.003
July	29.10	5.525	0.224	0.535	15.93	1.003
August	28.69	5.354	0.248	0.527	17.99	1.003
September	31.19	5.815	0.242	0.626	18.51	1.137
October	26.20	5.374	0.228	0.510	17.43	1.301
November	29.10	6.052	0.249	0.623	16.74	1.267
December	29.96	6.102	0.271	0.652	16.77	1.003

Discharge projection data is from ARCADIS and is based on NPDES discharge monitoring reports.

Analysis of Proposed IBT Scenarios and Resulting Tar River Flows at Greenville

The long-term flow record developed for the Tar River at Greenville was used as the base model upon which all simulations were built and represents the current withdrawal and discharge conditions at the location of the gaging station. Simulations were analyzed for six different scenarios described including current and 2030 conditions with and without the proposed IBT. The difference between current and proposed 2030 municipal, industrial, and agricultural withdrawals and discharges was incorporated into the current flow record to generate predicted monthly flows for the 2030 simulations. In order to produce the analyses required by the IBT statute (DWR and USGS Communication September 2007), the model evaluated the influence of the proposed IBT withdrawals on current and future 2030 flow conditions.

In March 2008, the DWR requested that additional conservatism be built into the hydrologic analysis for the proposed IBT by making two specific changes to the model input data. The first change requested by the DWR was to subtract the 2002 GUC water withdrawals from the Tar River at Greenville flow record established for current conditions and 2030 conditions. This double counts GUC water withdrawals for a number of years. The second change was to set up the model with the GUC wastewater discharge reduced by the amount of the maximum IBT. The results of these scenarios will be particularly conservative because the total volume of the GUC wastewater discharge will be removed from the Tar River in the 2002 scenario and for most months in the 2030 scenario. In reality GUC would continue to treat wastewater from within the Tar portion of its service area even under the maximum IBT scenarios. Table 11 describes the model simulations that were conducted. Tables 12 and 13 document the GUC withdrawals associated with proposed average IBT and maximum withdrawal IBT used in both the current and 2030 modeled IBT scenarios.

Modeled Scenarios

Table 11. Description of hydrologic modeling locations and scenarios used in the evaluation of the effects of Greenville Utilities Commission proposed interbasin transfers.

Locations	Description
Greenville at USGS Gage	Tar River at Greenville Gage, located approximately 3.0 miles downstream of Greenville Utilities Commission's (GUC) raw water supply withdrawal intake, but upstream of the GUC WWTP discharge
Greenville Downstream of WWTP Discharge	Tar River Downstream of GUC WWTP Discharge, located approximately 4.7 miles downstream of Greenville USGS Gage
Scenarios	
Current	Flows for the 76-year period of record representing conditions that would be expected to occur in the Tar River accounting for current municipal, industrial and agricultural withdrawals and flow returns in the basin downstream of the Rocky Mount reservoir
Current Flows Average (Avg.) IBT	Flows for the 76-year period of record representing conditions that would be expected to occur in the Tar River accounting for current municipal, industrial and agricultural withdrawals and flow returns in the basin, plus GUC's proposed average daily interbasin transfer (IBT)
Current Flows Maximum Withdrawal (Max.) IBT	Flows for the 76-year period of record representing conditions that would be expected to occur in the Tar River accounting for current municipal, industrial and agricultural withdrawals and flow returns in the basin, plus GUC's proposed daily maximum withdrawal (Max.) IBT
2030 Flows No IBT	Flows for the 76-year period of record representing conditions expected to occur in the Tar River in the future accounting for projected 2030 levels of municipal, industrial and agricultural withdrawals and flow returns in the basin downstream of the Rocky Mount reservoir
2030 Flows Average (Avg.) IBT	Flows for 76-year period of record representing conditions expected to occur in the Tar River in the future accounting for projected 2030 levels of municipal, industrial and agricultural withdrawals and flow returns in the basin, plus GUC's proposed average daily GUC IBT
2030 Flows Maximum Withdrawal (Max.) IBT	Flows for 76-year period of record representing conditions expected to occur in the Tar River in the future accounting for projected 2030 levels of municipal, industrial and agricultural withdrawals and flow returns in the basin, plus GUC's proposed average daily maximum withdrawal IBT

Table 12. Explanation of Modeling Scenarios Used in the Tar River Water Balance

	GUC Water Demand (mgd)	Neuse River Subbasin IBT (mgd)	Contentnea Subbasin IBT (mgd)	Total Water Use (mgd) [2]	WTP Capacity (mgd) [3]	Comment
Current Conditions [1]						
No IBT	10.91	0	0	10.91	23.76	modeling scenario
Average Day IBT	12.83	2.0	3.9	18.73	23.76	modeling scenario
Maximum Withdrawal IBT	18.65	3.9	9.6	32.15	23.76	modeling scenario
2030 Conditions [1]						
No IBT	12.83	0	0	12.83	23.76	modeling scenario
Average Day IBT	12.83	2.0	3.9	18.73	23.76	modeling scenario
Max Day IBT	18.65	3.8	8.5	30.95	23.76	[4]
Maximum Withdrawal IBT	18.65	3.9	9.6	32.15	23.76	modeling scenario

[1] The daily water withdrawal data used for each model scenario have been underlined. The model runs evaluated the influence of 2030 average day IBT and 2030 maximum withdrawal IBT on both current flows and projected 2030 flow.

[2] The total withdrawal indicated in this column represents a yearly average. Total withdrawals were modeled by month using a composite monthly factor. The composite monthly factor was determined using six years of daily water withdrawal data from the GUC.

[3] The water treatment plant capacity of 22 mgd plus 8 percent process water.

[4] The maximum day IBT scenario was not modeled in the water balance. In the 2030 condition, both the maximum day IBT and maximum withdrawal IBT scenarios exceed the water treatment plant capacity. Therefore, the water treatment plant capacity (plus process water) was used as the worst-case (maximum withdrawal) condition. There are three reasons to support this assumption: 1) the maximum day for the Neuse River subbasin, the Contentnea subbasin, and GUC are not expected to occur on the same day, 2) GUC's water purchase agreement contracts stipulate that GUC reserves the right to curtail water to Farmville, Winterville, and Greene County given the appropriate notice, and 3) Farmville, Winterville, and Greene County expect to use their banked water during periods of high water demand.

Table 13. 2030 Monthly Water Withdrawals associated with each Proposed Interbasin Transfer Scenario in Million Gallons per Day (MGD)

Month	Average Day IBT Greenville With 2030 bulk sales	Maximum Withdrawal IBT Greenville 2030*
January	17.56	23.76
February	17.17	23.76
March	16.73	23.76
April	18.70	23.76
May	20.42	23.76
June	20.27	23.76
July	18.77	23.76
August	19.97	23.76
September	19.29	23.76
October	18.76	23.76
November	17.97	23.76
December	17.10	23.76

*****Maximum Water Treatment Plant Capacity plus Process Water

Influence of Rocky River Reservoir on Projected Tar River Flows at Greenville

The permit to begin constructing or filling the Rocky Mount Reservoir was issued in May 1969 and the Dam became operational in 1971. According to Jim Mead with DWR, the Rocky Mount Reservoir has always had a minimum release requirement of 80 cfs. Lower flow releases have been allowed under specific drought conditions. The following Rocky Mount reservoir operating conditions were made permanent in 2002:

- Stage I (when the City of Wilson is purchasing water from the City of Rocky Mount) conditions involve a reduction in the minimum release from 80 to 75 cfs.
- Stage II conditions (when the reservoir elevation is at or below 120 ft) allow a reduction from 75 to 70 cfs.
- Stage III conditions (the reservoir operations model indicates for two consecutive weeks that the reservoir elevation will decrease to 115 ft or lower) allow a reduction from 70 to 60 cfs. Different water conservation measures are associated with each Stage and become more restrictive as the stage increases. Stage III requires Rocky Mount to impose mandatory water conservation measures.
- In addition to the minimum flow release requirements the reservoir level must be managed so that it does not fluctuate by more than 1 vertical foot between April 15 and May 15 of each year. This management measure was put in place to protect favorable fish spawning conditions.
- Winter reservoir drawdowns are allowed under current management conditions. The normal and low flow releases from the Rocky Mount reservoir are reflected in the historical gage data.

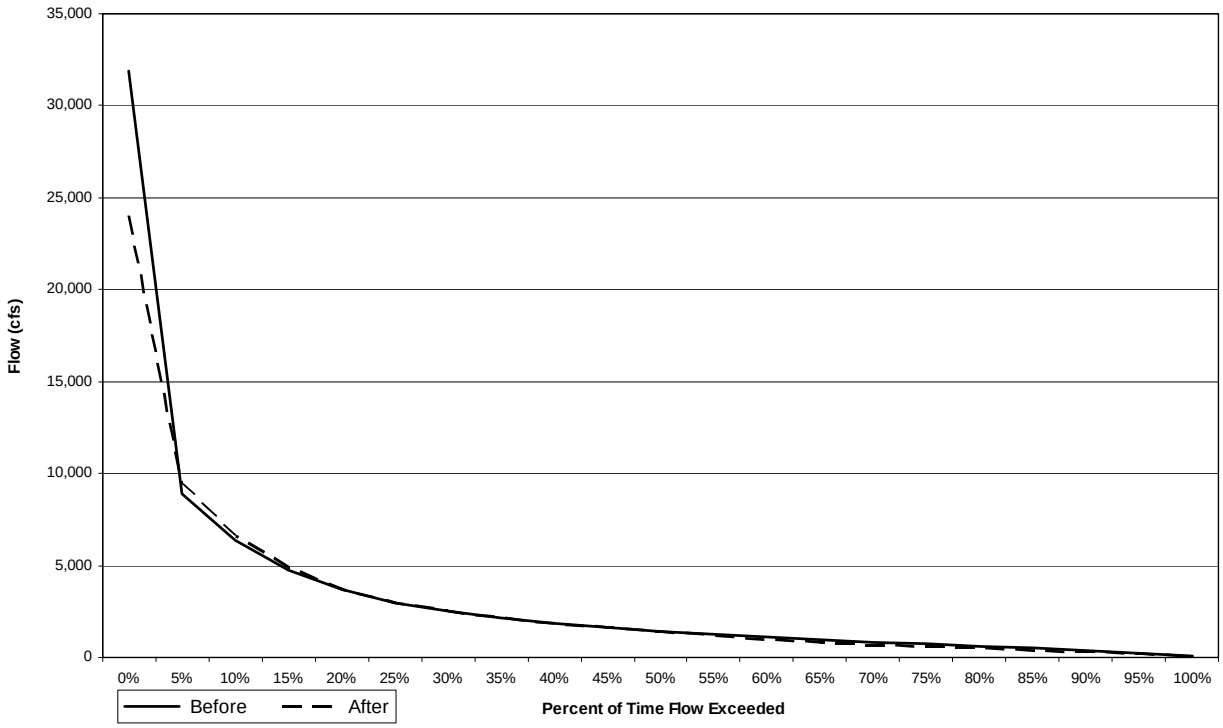
In 1993 permission was given to allow the minimum release to go to 65 cfs and in 1995 the minimum release requirement returned to 80 cfs. In 1999 Rocky Mount Reservoir was allowed to cut back releases to 60 cfs; and a 2002 letter from the Division of Land Resources reaffirmed the operating Stages (reservoir management Stages I through III) approved in 1999. Due to drought

conditions later in 2002, Rocky Mount was allowed to adopt a minimum release of 50 cfs at the reservoir, but had to maintain 60 cfs at the WWTP discharge location downstream of Rocky Mount Mills dam. The Rocky Mount WWTP discharge requirements are based on a minimum river flow of 60 cfs. In 2007 Rocky Mount was allowed to reduce reservoir releases so that river flows at the WWTP discharge point were as low as 40 cfs. Later in the fall of 2007 Tar River flows at the Rocky Mount WWTP discharge went down to 20 cfs.

The Rocky Mount operating rules were considered in the hydrologic analysis and modeling. The years examined by the hydrologic modeling included 1931-2007. The hydrologic analysis was based on actual flows at Tarboro, which reflect about 40 years of conditions prior to the existence of the Rocky Mount reservoir and 36 years of data since the reservoir began operating. The hydrologic model reflects the impacts of the Rocky Mount operating rules and minimum flows that have been in place over the past 36 years.

Reservoirs such as Rocky Mount's often augment low flows in rivers because they store water from higher flow periods and release it over extended lower flow periods. Flow duration curves for the pre-reservoir period of record and post-reservoir period of record were developed and evaluated to determine if this effect was present in the Tar River at Greenville flow record (Figure 9). In this case, this trend is not observed. It appears from Figure 9 that the opposite is true, however the difference in pre-reservoir low flows and post-reservoir low flows should be considered negligible. This small difference may be attributed to climatic or other natural differences between the two time periods and may be within the error of the regression model used to estimate much of the period of record for the Greenville gage. The hydrologic analysis and modeling results should be considered adequate to account for the minor effects of the reservoir on the flow regime of the river.

Figure 9. Flow Duration Curves Based on Average Annual Flow at Greenville Gage. Comparison of Generated Flow Record Prior to (1932-1968) and After (1972-2006) Operation of the Rocky Mount Reservoir



Results and Discussion

Model results have been tabulated and graphed for each scenario in order to quantify and demonstrate the influence of the proposed IBT withdrawals on current and future flow conditions at both Tar River locations. The impact of projected growth and different IBT scenarios can be evaluated by examining changes in the model output data. Monthly flow duration curves were developed for each model location for both current and future scenarios and are included at the end of this document. In addition, the following tables were generated for each modeled location and IBT scenario:

- Minimum, maximum, mean, the 95th, 50th (median), and 5th percentiles for flow
- Flow that is equaled or exceeded for a specific percent of time (0% through 100%)
- Low Flow Details (25 to 16,000 cfs): Percent of time and average number of days flow is below a specific range
- Percent of time on an annual basis that daily flows go below the 7Q10 flow and below 80% of the 7Q10 flow for the period of record (7Q10 value confirmed with USGS via email, J. Curtis Weaver Oct 12, 2007)
- Average number of days per year that daily flows go below the 7Q10 flow and below 80% of the 7Q10 flow

Flow statistics are summarized in Table 14 for both locations. As expected, the lowest Tar River flow conditions are observed at the Greenville gage, the location downstream of the GUC water intake but upstream of the WWTP discharge. The effects of the proposed IBT appear to be negligible for both locations at average flow levels and above. They only become significant at the minimum recorded flows of record where under maximum IBT scenarios for 2030 conditions the stream flow becomes negative. For this tidally influenced system, negative flows represent movement of water upstream caused by tailwater conditions.

Table 15 summarizes the percent of time and number of days (annually) that flows would be below the summer 7Q10 and below 80 percent of the 7Q10 (87.2 cfs). For the Greenville Gaging Station location, flows would be expected to drop below the 7Q10 1.3% of the time each year (0.9% of the time flows would drop below 80% of 7Q10) for current conditions and 1.4% of the time (0.9% of time for 80% of 7Q10) for 2030 conditions. With an average IBT withdrawal, flows are predicted to drop below the 7Q10 1.6% of the time (1.1% of the time flows would drop below 80% of 7Q10) for current and 2030 conditions. This percentage increases to 1.8% for the maximum expected IBT withdrawal. At the location downstream of the WWTP, flows would drop below the 7Q10 1.0% of the time currently (0.7% of the time flows would drop below 80% of 7Q10) and are predicted to drop below 1.3% of the time for 2030 conditions. (0.8% of the time for 80% of 7Q10). Considering the average IBT withdrawal, flows would be expected to drop below the 7Q10 1.3% of the time for the current conditions (0.9% of time flows would drop below 80% of 7Q10) and 1.6% for 2030 conditions (1.1% of the time below 80% of 7Q10). These percentages increase to 1.5% (current) and 1.7% (2030) of the time below the 7Q10 for the maximum IBT (1.0% for current conditions and 1.3% in 2030 below 80% of the 7Q10). At the downstream location under the most conservative scenario where wastewater withdrawals are reduced by the amount of the IBT, current flows would be below the 7Q10 1.8% of the time (1.2% below 80% of 7Q10) and 2.1% of the time in 2030 (1.6% below 80% of 7Q10). The similarity in percentages between “No IBT”, average, maximum, and two times the maximum IBT scenarios indicate that the projected IBT quantities appear to have very little impact on flows in the Tar River at Greenville.

At the gage location, under current conditions the total number of days per year (on average) that flows would go below the 7Q10 are: 4.7 days with no IBT, 5.8 days with average IBT, and 6.4 days with maximum withdrawal IBT. In 2030 the total number of days per year (on average) that flows would go below the 7Q10 are: 5.0 days with no IBT, 5.9 days with average IBT, and 6.5 days with maximum withdrawal IBT (Table 15). At the downstream location in 2002: the total number of days per year (on average) that flows would go below the 7Q10 are: 3.7 days with no IBT, 4.6 days with average IBT, 5.4 days with maximum withdrawal IBT, and 6.4 days with reduced wastewater returns. In 2030 the total number of days per year (on average) that flows would go below the 7Q10 are: 4.7 days with no IBT, 5.7 days with average IBT, 6.3 days with maximum withdrawal IBT, and 7.7 days with reduced wastewater returns (Table 15).

Table 16 shows the flow that is met or exceeded a given percent of each year and Table 17 shows the percentage of each year that flow would be above a given level. Table 18 presents the average number of days that flows would be below given flows in the low flow range (25 to 16,000 cfs) at the Greenville gage and at the location downstream of the GUC WWTP. As shown in these tables, there are only minor changes in flows regimes predicted between current conditions and average and maximum IBT conditions at both locations.

Table 18 shows that on average under 2030 conditions at the Greenville gage 0.2 days per year flows are below 25 cfs with no IBT and 1.2 days per year are below 25 cfs with maximum withdrawal IBT. Downstream of the GUC WWTP in 2030 with no IBT 0.2 days per year flows fall below 25 cfs and 1.1 days with the maximum withdrawal IBT, and 1.9 days with the wastewater flows reduced (two times the maximum IBT).

These minor differences in in-stream flows related to the IBT scenarios are also illustrated on the flow duration curves at the end of this document. Flow duration curves identify the percent of the time a specific flow is exceeded for each IBT scenario (highest flows are exceeded 0% of the time and lowest flows 100% of the time). The figures were created on a monthly basis, so that differing flow conditions can be evaluated for different months of the year. Low flow conditions are also presented separately to provide more detail of the critical flow periods. The lowest flows on the Tar River have historically occurred during the months of September and October.

Tidal Influence

The estimated effects on Tar River flows associated with GUC's proposed IBT are based on projected flows estimated from the best available hydrologic data from the USGS for the lower Tar River. The flow data from the USGS gage at Tarboro were used to develop the long-term flow record for the Tar River at Greenville. The Tarboro gage receives flow from 82% of the total Tar River drainage area. Since the synthesized long-term flow record developed for Greenville (based on 77 years of flow records) was based on regression analyses, the predicted flows are more accurate on a weekly, monthly or annual basis than for individual days. The projected flows are likely to accurately predict flow conditions over time and the distribution of flows over time. Therefore the estimates of weekly, monthly, and annual flows are much more likely than daily flows to be in close agreement with the actual Tar River at Greenville flows that have occurred or may occur. The flow estimates provided throughout this report should be interpreted as net freshwater flows delivered by the Tar River to the tidally-influenced section of the lower Tar River near Greenville.

It is challenging to fully understand and quantify the low-flow characteristics for the Tar River at Greenville, or for that matter for any tidally influenced section of river. Current USGS techniques for low-flow analyses do not provide a means for accounting for the effects of tides. J. Curtis Weaver with the USGS North Carolina Water Science Center noted in regards to the 7Q10 flow at Greenville:

> "Based on recently collected data, it has become more challenging to understand and quantify the low-flow characteristics for the Tar River at Greenville…. This is due to recognition of astronomical and wind tides affecting the flows…. The techniques used for determining low-flow estimates do not account for the complex flow dynamics that can occur because of tides." (October 12, 2007 email)

The lower Tar River is influenced by tides to a point just upstream of the USGS gage at Greenville. The amount of tidal influence is variable and depends on weather, tidal phase, and river flow (USGS 2007; GMA 2003). The presence of tides in the Tar River at Greenville is more pronounced during low-flow periods. Monitoring conducted by GUC in 2002 and 2007 has demonstrated that the salt wedge moves further upstream during low flow conditions than during high flow conditions. Wind also appears to play an important role along with downstream flow volume in determining the location of the salt wedge.

Under some of the conditions where we have estimated that withdrawals and interbasin transfers have a small effect on net downstream river flow, tidal influences may be greater than the net amount of flow being delivered from upstream. The tidal influence during critically low periods may substantially ameliorate the impacts of IBT withdrawals. The tidal influence at Greenville was cited by GMA (2003) as one factor that provides downstream aquatic habitat protection during low flows in the vicinity of Greenville. Tidal influence is greatest during lower flow conditions (GMA 2003). The potential effects of GUC's proposed IBT should be interpreted in this context.

Table 14. Summary of Statistics for Flow - Based on Generated Flow Record (All Data)[1]

Statistics for Flow (cfs)	Location - Greenville Gage Station[2]						Location - Downstream of Greenville WWTP[3]							
	Current Scenarios			Future (2030) Scenarios			Current Scenarios				Future (2030) Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
Maximum	31,866	31,855	31,849	31,872	31,860	31,854	31,878	31,866	31,860	31,849	31,875	31,863	31,858	31,840
Minimum	24	11	4	20	7	-1	38	25	17	4	17	5	-3	-15
Average	2,524	2,513	2,505	2,525	2,513	2,505	2,537	2,526	2,518	2,506	2,529	2,518	2,509	2,492
Percentiles														
95th	9,033	9,023	9,014	9,035	9,025	9,016	9,046	9,036	9,027	9,014	9,038	9,028	9,018	9,001
50th (Median)	1,398	1,387	1,381	1,397	1,384	1,375	1,410	1,398	1,393	1,381	1,403	1,390	1,380	1,365
5th	229	216	210	228	215	208	242	229	222	210	231	219	211	194

cfs = Cubic feet per second.

GUC = Greenville Utilities Commission.

WWTP = Waste water treatment plant.

[1] Based on long-term flow record of the Tar River at Tarboro (USGS Gage 02083500; 1931-2007; drainage area of 2,183 mi^2) extrapolated downstream as described in the text.

[2] Flow at Greenville NC, downstream of GUC water supply intake and upstream of Greenville wastewater discharge (USGS Gage 02084000; drainage area of 2,660 mi^2).

[3] Flow at Greenville NC, downstream of Greenville wastewater discharge.

* This scenario increases the Greenville withdrawal by the Max IBT amount (as in the 'Max IBT' scenario) and also decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the discharge was entered as zero (0).

Table 15. Percent of Time (Annually) and Average Number of Days (Annually) Daily Flow is Below 7Q10[1]

Stream Flow (cfs)	Location - Greenville Gage Station[2]						Location - Downstream of Greenville WWTP[3]							
	Current Scenarios			Future (2030) Scenarios			Current Scenarios				Future (2030) Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
	Percent of Time (per Year)													
7Q10 Flow: 109	1.3%	1.6%	1.8%	1.4%	1.6%	1.8%	1.0%	1.3%	1.5%	1.8%	1.3%	1.6%	1.7%	2.1%
7Q10 × 80%: 87.2	0.9%	1.1%	1.2%	0.9%	1.1%	1.3%	0.7%	0.9%	1.0%	1.2%	0.8%	1.1%	1.3%	1.6%
	Average Number of Days (per Year)													
7Q10 Flow: 109	4.7	5.8	6.4	5.0	5.9	6.5	3.7	4.6	5.4	6.4	4.7	5.7	6.3	7.7
7Q10 × 80%: 87.2	3.3	3.9	4.5	3.3	4.1	4.9	2.5	3.2	3.6	4.5	3.1	3.9	4.6	5.8

cfs = Cubic feet per second.

GUC = Greenville Utilities Commission.

WWTP = Waste water treatment plant.

[1] Based on long-term flow record of the Tar River at Tarboro (USGS Gage 02083500; 1931-2007; drainage area of 2,183 mi^2) extrapolated downstream as described in the text.

[2] Flow at Greenville NC, downstream of GUC water supply intake and upstream of Greenville wastewater discharge (USGS Gage 02084000; drainage area of 2,660 mi^2).

[3] Flow at Greenville NC, downstream of Greenville wastewater discharge.

* This scenario increases the Greenville withdrawal by the Max IBT amount (as in the 'Max IBT' scenario) and also decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the discharge was entered as zero (0).

Table 16. Flow Level that is Met or Exceeded a Given Percent of Time (per Year)[1]

Percent of Time Flow is Met or Exceeded	Stream Flow (cfs)													
	Location - Greenville Gage Station[2]						Location - Downstream of Greenville WWTP[3]							
	Current Scenarios			Future (2030) Scenarios			Current Scenarios				Future (2030) Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
0% (max flow)	31,866	31,855	31,849	31,872	31,860	31,854	31,878	31,866	31,860	31,849	31,875	31,863	31,858	31,840
5%	9,033	9,023	9,014	9,035	9,025	9,016	9,046	9,036	9,027	9,014	9,038	9,028	9,018	9,001
10%	6,448	6,438	6,428	6,450	6,440	6,430	6,462	6,451	6,441	6,428	6,455	6,445	6,436	6,417
15%	4,776	4,766	4,756	4,779	4,769	4,759	4,789	4,780	4,769	4,756	4,785	4,774	4,765	4,744
20%	3,670	3,660	3,650	3,671	3,661	3,652	3,683	3,674	3,663	3,650	3,675	3,663	3,656	3,637
25%	2,942	2,932	2,925	2,939	2,928	2,918	2,956	2,944	2,937	2,925	2,943	2,932	2,923	2,908
30%	2,483	2,472	2,461	2,484	2,474	2,464	2,498	2,486	2,475	2,472	2,490	2,480	2,470	2,451
35%	2,134	2,123	2,115	2,136	2,126	2,117	2,147	2,136	2,128	2,115	2,139	2,129	2,122	2,102
40%	1,851	1,839	1,834	1,850	1,838	1,829	1,862	1,851	1,845	1,834	1,855	1,844	1,834	1,818
45%	1,606	1,595	1,586	1,607	1,597	1,589	1,620	1,609	1,600	1,586	1,612	1,601	1,593	1,576
50%	1,398	1,387	1,381	1,397	1,384	1,375	1,410	1,398	1,393	1,381	1,403	1,390	1,380	1,365
55%	1,205	1,194	1,186	1,207	1,197	1,189	1,218	1,207	1,199	1,186	1,211	1,200	1,193	1,176
60%	1,031	1,020	1,014	1,032	1,020	1,013	1,044	1,033	1,026	1,014	1,036	1,024	1,016	1,000
65%	882	871	862	883	871	863	897	885	876	863	887	875	868	851
70%	748	736	730	749	736	729	760	748	741	731	752	740	733	717
75%	636	624	618	638	624	617	649	637	630	618	642	629	622	605
80%	538	526	519	540	527	520	551	539	532	520	544	531	524	507
85%	429	417	411	430	417	410	442	429	422	411	433	421	413	397
90%	332	320	311	329	317	309	345	332	325	313	333	321	313	297
95%	229	216	210	228	215	208	242	229	222	210	231	219	211	194
100% (min flow)	24	11	4	20	7	-1	38	25	17	4	17	5	-3	-15

[1] Based on long-term flow record of the Tar River at Tarboro (USGS Gage 02083500; 1931-2007; drainage area of 2,183 mi^2) extrapolated downstream as described in the text.

[2] Flow at Greenville NC, downstream of GUC water supply intake and upstream of Greenville wastewater discharge (USGS Gage 02084000; drainage area of 2,660 mi^2).

[3] Flow at Greenville NC, downstream of Greenville wastewater discharge.

* This scenario increases the Greenville withdrawal by the Max IBT amount (as in the 'Max IBT' scenario) and also decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the discharge was entered as zero (0).

Table 17. Percent of Time (per Year) Flow is At or Above the Given Flow Levels

Stream Flow (cfs)	Location - Greenville Gage Station						Location - Downstream of Greenville WWTP							
	Current Scenarios			2030 Scenarios			Current Scenarios				2030) Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
25	100.0%	99.8%	99.7%	99.9%	99.8%	99.7%	100.0%	100.0%	99.9%	99.7%	99.9%	99.8%	99.7%	99.5%
50	99.7%	99.5%	99.4%	99.6%	99.4%	99.4%	99.8%	99.7%	99.6%	99.4%	99.6%	99.5%	99.4%	99.2%
75	99.3%	99.1%	99.0%	99.3%	99.1%	99.0%	99.5%	99.3%	99.2%	99.0%	99.3%	99.1%	99.0%	98.7%
§ 87.2	**99.1%**	**98.9%**	**98.8%**	**99.1%**	**98.9%**	**98.7%**	**99.3%**	**99.1%**	**99.0%**	**98.8%**	**99.2%**	**98.9%**	**98.7%**	**98.4%**
100	98.9%	98.6%	98.4%	98.9%	98.6%	98.4%	99.1%	98.9%	98.8%	98.4%	98.9%	98.6%	98.5%	98.1%
§ 109	**98.7%**	**98.4%**	**98.2%**	**98.6%**	**98.4%**	**98.2%**	**99.0%**	**98.7%**	**98.5%**	**98.2%**	**98.7%**	**98.4%**	**98.3%**	**97.9%**
150	97.7%	97.3%	97.2%	97.7%	97.3%	97.1%	98.0%	97.7%	97.5%	97.2%	97.8%	97.5%	97.2%	96.7%
200	96.1%	95.6%	95.4%	96.1%	95.6%	95.3%	96.5%	96.1%	95.8%	95.4%	96.2%	95.8%	95.4%	94.8%
400	86.4%	85.7%	85.4%	86.3%	85.7%	85.4%	87.0%	86.3%	85.9%	85.4%	86.5%	85.9%	85.6%	84.8%
600	76.8%	76.2%	75.8%	76.8%	76.2%	75.9%	77.4%	76.8%	76.5%	75.9%	77.1%	76.4%	76.0%	75.2%
800	67.9%	67.5%	67.2%	67.9%	67.5%	67.3%	68.5%	67.9%	67.7%	67.2%	68.2%	67.7%	67.5%	66.9%
1,000	61.0%	60.6%	60.3%	61.0%	60.6%	60.3%	61.3%	61.0%	60.8%	60.4%	61.0%	60.8%	60.5%	60.0%
1,200	55.1%	54.9%	54.5%	55.1%	54.8%	54.7%	55.4%	55.1%	54.9%	54.6%	55.2%	55.0%	54.8%	54.2%
1,400	50.0%	49.7%	49.6%	50.0%	49.7%	49.5%	50.3%	50.0%	49.8%	49.6%	50.0%	49.8%	49.6%	49.2%
1,600	45.2%	44.9%	44.7%	45.2%	44.9%	44.7%	45.3%	45.2%	45.0%	44.7%	45.3%	45.0%	44.8%	44.5%
1,800	40.9%	40.7%	40.7%	41.0%	40.8%	40.6%	41.3%	41.0%	40.8%	40.7%	41.1%	40.8%	40.7%	40.3%
2,000	37.3%	37.1%	36.9%	37.3%	37.1%	36.9%	37.5%	37.3%	37.2%	36.9%	37.4%	37.2%	37.1%	36.7%
2,500	29.8%	29.7%	29.6%	29.8%	29.6%	29.6%	30.0%	29.8%	29.7%	29.6%	29.8%	29.7%	29.6%	29.5%
3,000	24.5%	24.5%	24.5%	24.5%	24.5%	24.4%	24.7%	24.6%	24.5%	24.5%	24.6%	24.5%	24.5%	24.4%
3,500	21.1%	21.0%	21.0%	21.2%	21.0%	21.0%	21.2%	21.2%	21.0%	21.0%	21.2%	21.1%	21.0%	20.9%
5,000	14.2%	14.2%	14.1%	14.2%	14.2%	14.1%	14.3%	14.2%	14.2%	14.1%	14.2%	14.2%	14.2%	14.1%
6,000	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.1%
8,000	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.6%	6.5%
9,000	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.1%	5.0%	5.0%	5.0%	5.1%	5.0%	5.0%	5.0%
10,000	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
12,000	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
14,000	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
16,000	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%

* This scenario increases the Greenville withdrawal by the Max IBT amount (as in the 'Max IBT' scenario) and also decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the discharge was entered as zero (0). § 109 cfs is the 7Q10 flow level (summer), and 87.2 cfs is 80% of the 7Q10

Table 18. Average Number of Days (per Year) Flow is Below the Given Flow Levels

Stream Flow (cfs)	Location - Greenville Gage Station						Location - Downstream of Greenville WWTP							
	Current Scenarios			2030 Scenarios			Current Scenarios				2030 Scenarios			
	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	No IBT	Avg IBT	Max IBT	2xMax IBT *	No IBT	Avg IBT	Max IBT	2xMax IBT *
25	0.0	0.7	1.1	0.2	0.9	1.2	0.0	0.0	0.4	1.1	0.2	0.7	1.1	1.9
50	1.2	1.9	2.3	1.4	2.1	2.3	0.7	1.2	1.6	2.3	1.4	1.9	2.2	3.0
75	2.5	3.3	3.6	2.5	3.3	3.7	1.9	2.5	2.9	3.6	2.5	3.1	3.6	4.9
87.2	3.3	3.9	4.5	3.3	4.1	4.9	2.5	3.2	3.6	4.5	3.1	3.9	4.6	5.8
100	3.9	5.1	5.7	4.1	5.3	5.7	3.3	3.9	4.5	5.7	3.9	5.0	5.6	6.9
109	4.7	5.8	6.4	5.0	5.9	6.5	3.7	4.6	5.4	6.4	4.7	5.7	6.3	7.7
150	8.2	9.7	10.3	8.4	9.7	10.5	7.1	8.2	9.0	10.3	8.1	9.2	10.2	12.2
200	14.1	15.9	16.8	14.1	16.0	17.2	12.7	14.1	15.2	16.8	13.8	15.5	16.6	19.2
400	49.8	52.1	53.3	50.1	52.2	53.3	47.4	49.9	51.3	53.2	49.2	51.6	52.7	55.4
600	84.6	87.0	88.2	84.6	87.0	88.2	82.6	84.7	86.0	88.1	83.8	86.3	87.6	90.5
800	117.4	118.6	119.9	117.2	118.7	119.4	115.2	117.1	117.9	119.8	116.2	118.1	118.9	121.0
1,000	142.6	143.9	144.9	142.6	143.8	144.9	141.3	142.5	143.2	144.6	142.3	143.4	144.2	146.1
1,200	163.9	164.7	166.0	164.0	164.9	165.6	162.9	163.8	164.5	165.9	163.6	164.3	165.0	167.4
1,400	182.8	183.8	184.1	182.8	183.8	184.4	181.6	182.7	183.4	184.0	182.5	183.5	184.1	185.5
1,600	200.1	201.2	202.1	200.1	201.4	201.9	199.6	200.1	201.0	202.0	200.0	200.7	201.5	202.8
1,800	215.7	216.4	216.6	215.5	216.3	216.8	214.3	215.6	216.1	216.5	215.3	216.2	216.7	217.9
2,000	229.0	229.6	230.6	229.1	229.8	230.5	228.3	229.0	229.4	230.5	228.8	229.4	229.8	231.2
2,500	256.4	256.9	257.1	256.4	257.0	257.2	255.8	256.3	256.9	257.0	256.2	256.9	257.0	257.4
3,000	275.7	275.9	275.9	275.7	275.8	276.0	275.0	275.5	275.7	275.9	275.5	275.7	275.9	276.2
3,500	288.0	288.4	288.6	287.9	288.4	288.6	287.7	288.0	288.4	288.6	287.8	288.4	288.5	288.9
5,000	313.3	313.5	313.6	313.3	313.5	313.6	313.0	313.3	313.5	313.6	313.3	313.5	313.6	313.7
6,000	324.3	324.4	324.4	324.3	324.4	324.5	324.2	324.3	324.4	324.4	324.3	324.4	324.4	324.6
8,000	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.3	341.4
9,000	346.8	346.9	346.9	346.8	346.9	346.9	346.8	346.8	346.8	346.9	346.8	346.9	346.9	347.0
10,000	351.2	351.3	351.3	351.2	351.3	351.3	351.2	351.2	351.3	351.3	351.2	351.2	351.3	351.4
12,000	356.5	356.5	356.5	356.5	356.5	356.5	356.2	356.5	356.5	356.5	356.4	356.5	356.5	356.5
14,000	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5
16,000	361.9	361.9	361.9	361.9	361.9	361.9	361.9	361.9	361.9	361.9	361.9	361.9	361.9	362.0

* This scenario increases the Greenville withdrawal by the Max IBT amount (as in the 'Max IBT' scenario) and also decreases the Greenville WWTP discharge (not adjusted for the other IBT scenarios) by the Max IBT amount (effectively removing 2x the Max IBT amount from the Tar River flow). If the calculated discharge was below zero, the discharge was entered as zero (0).

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Flow Duration Curves

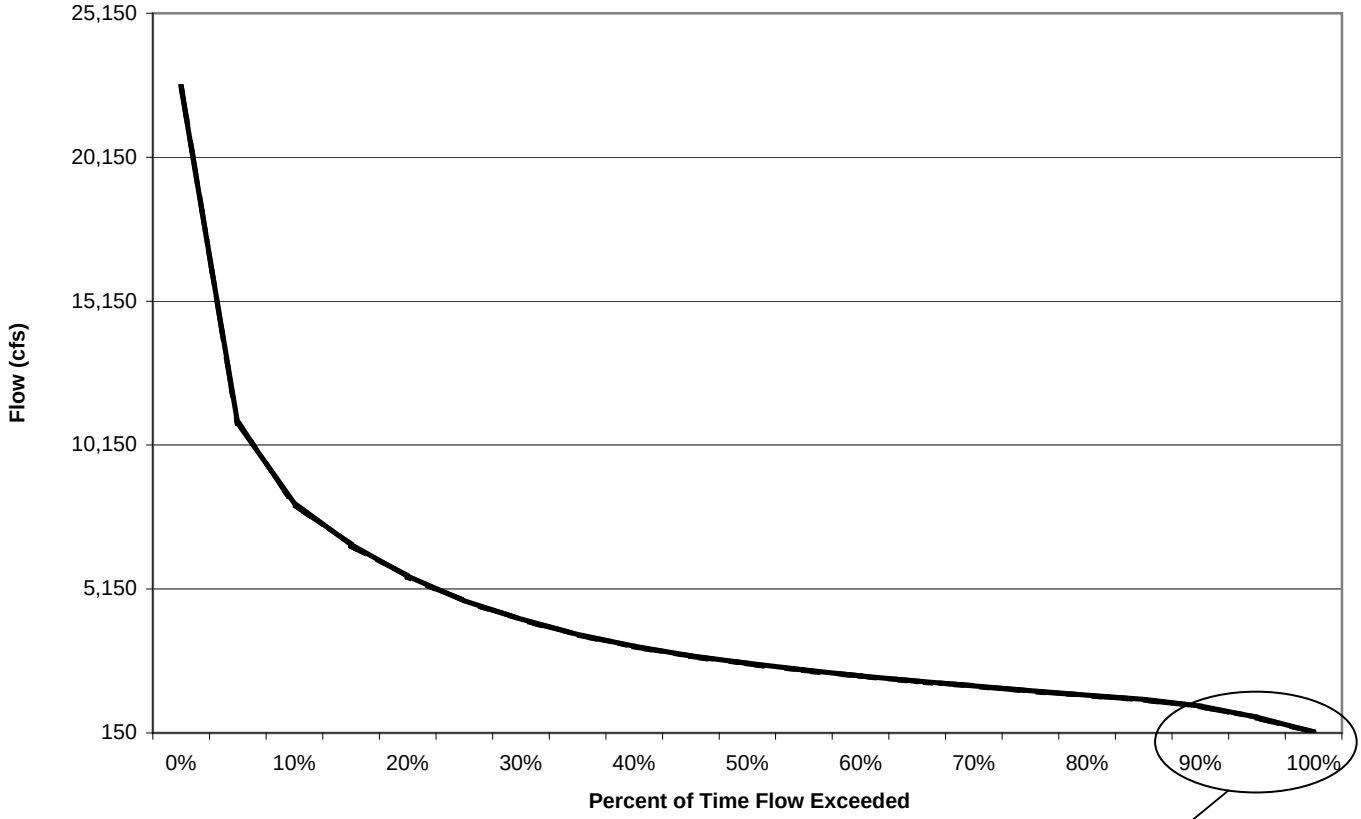
Figures Presenting Flow Duration Based on Average Number of Days

- Low Flow Detail, by Month

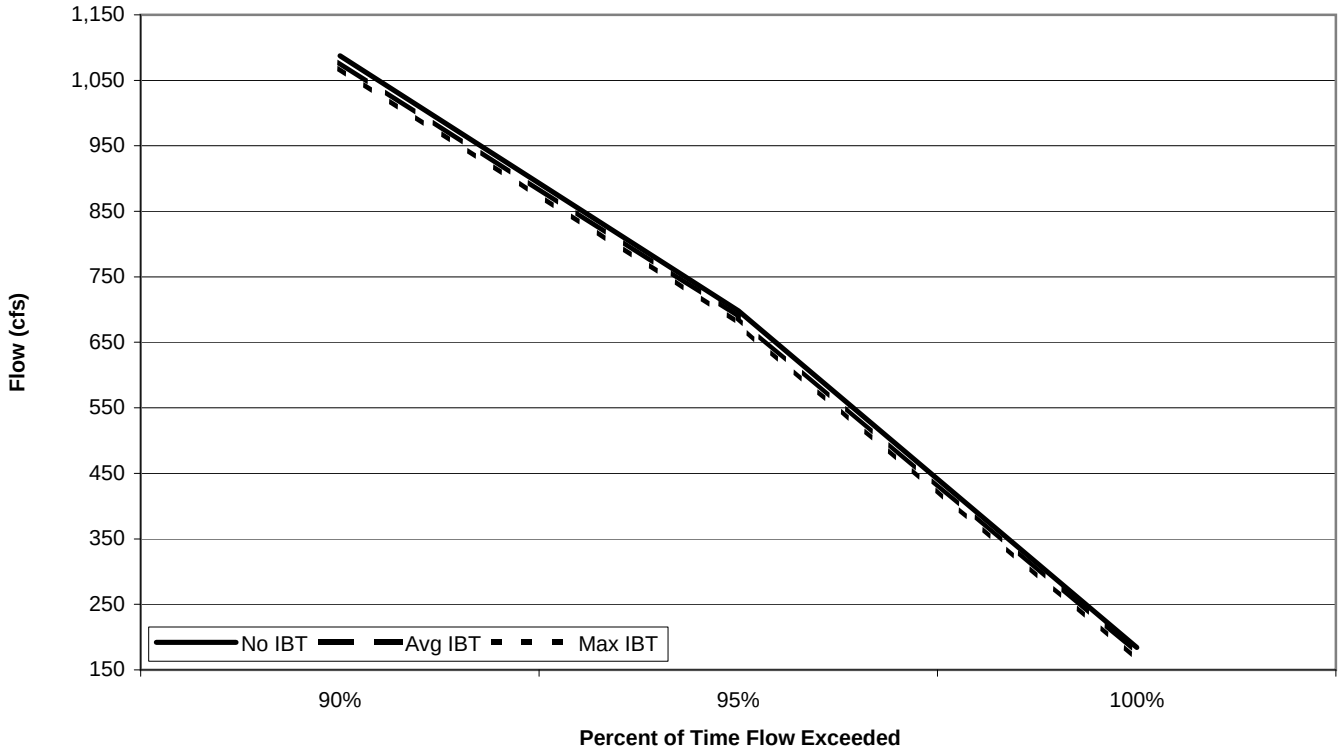
Flow Duration Curves

Greenville Gage Station - Current Scenarios

January



Low-Flow Detail

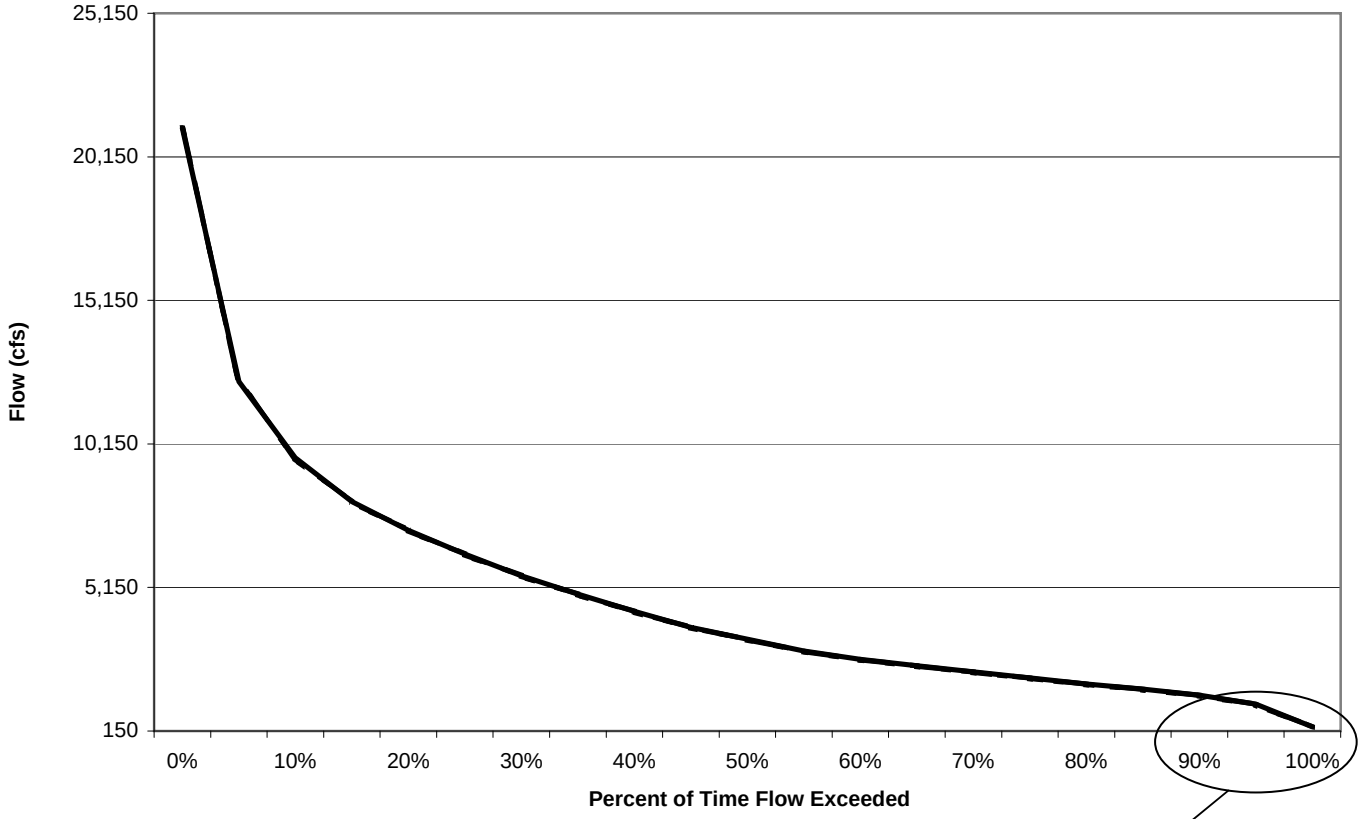


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Current Scenarios

February



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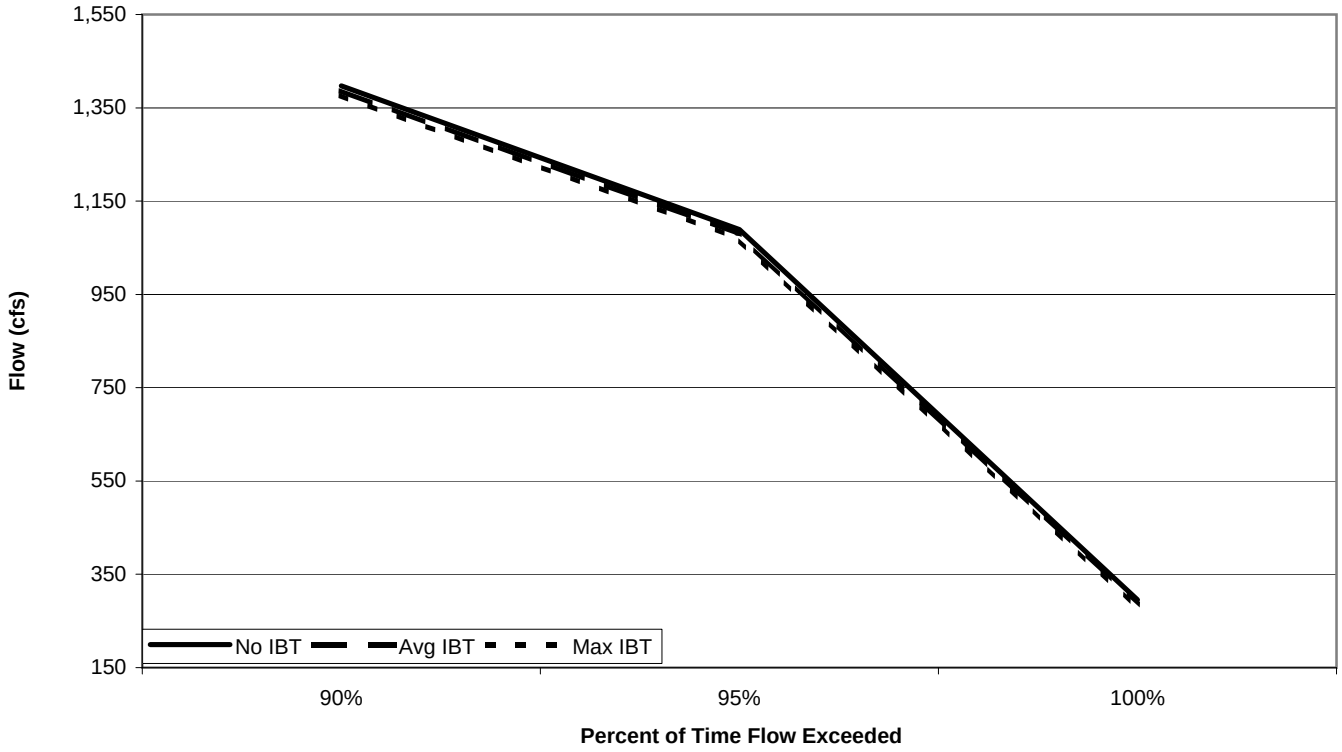
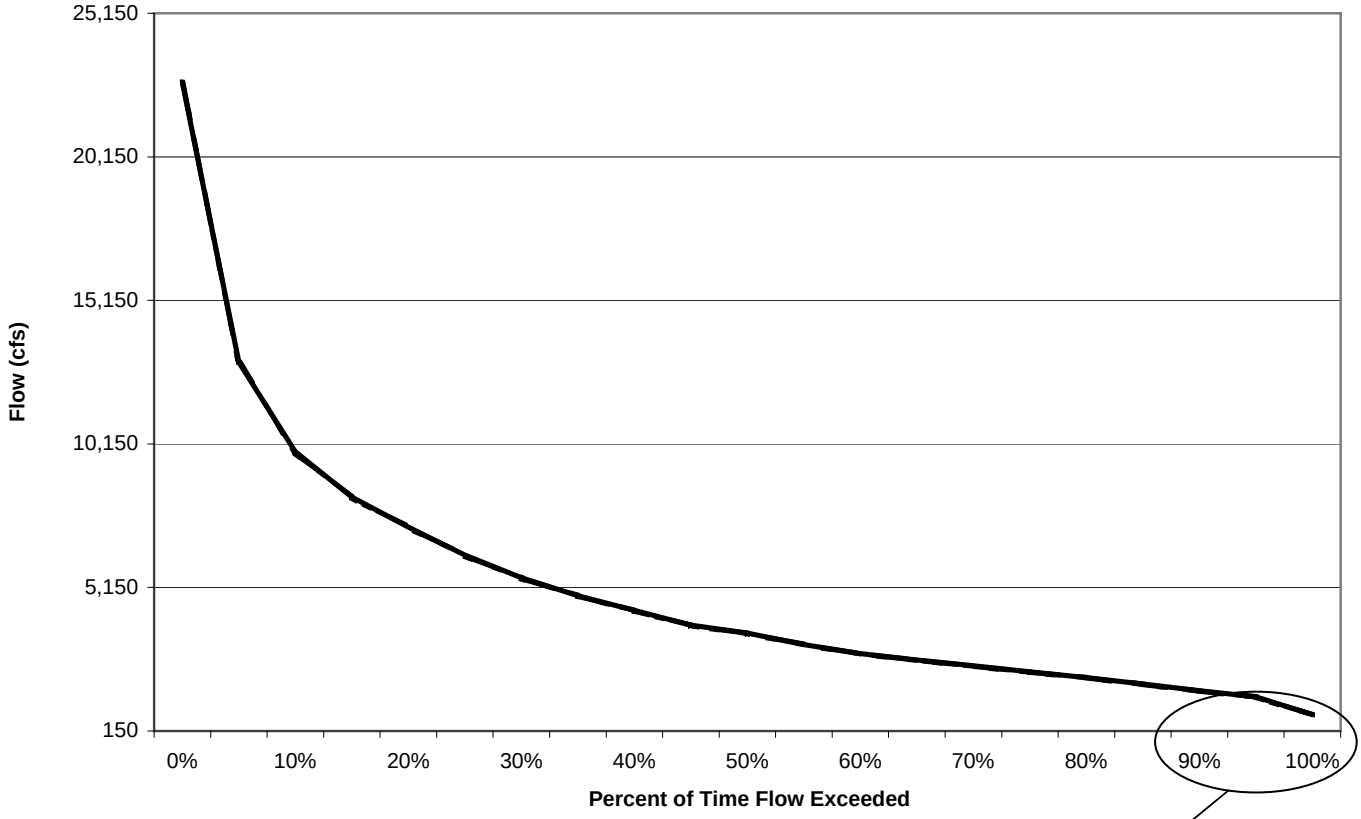


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Current Scenarios

March



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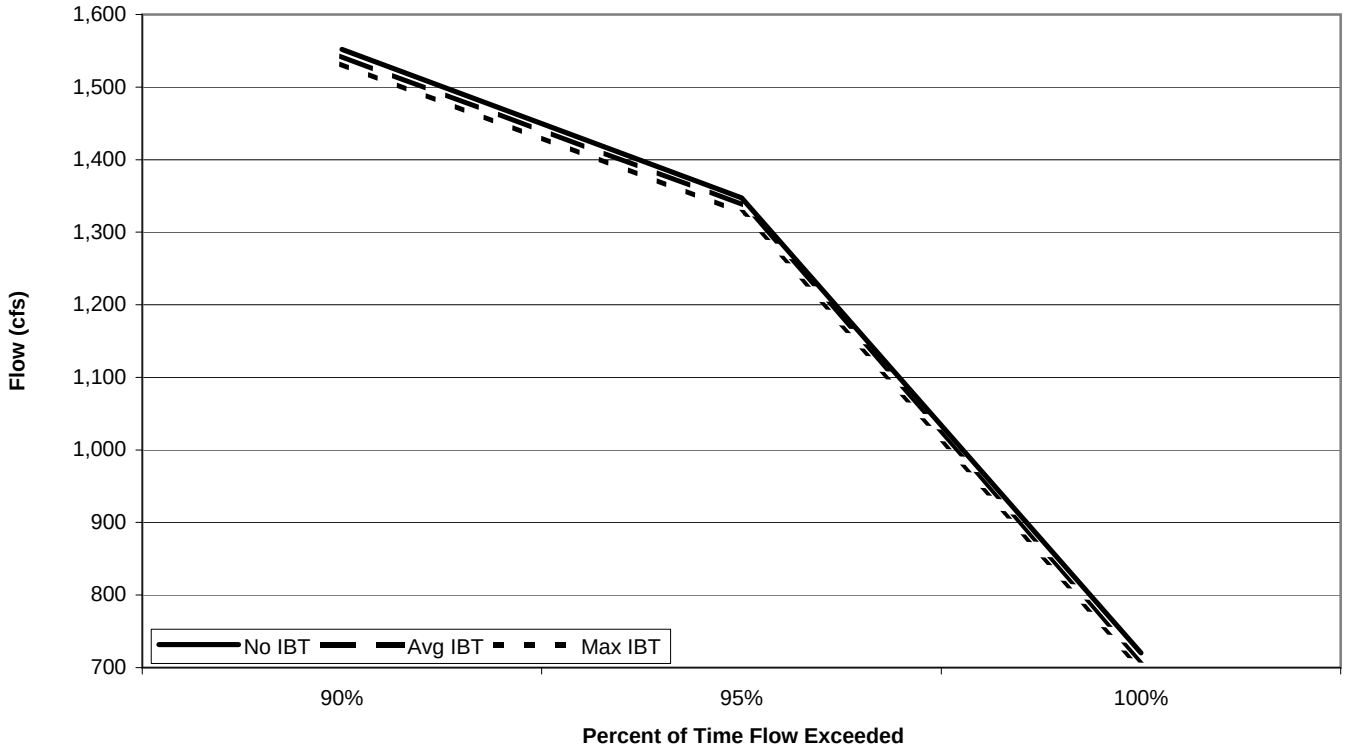
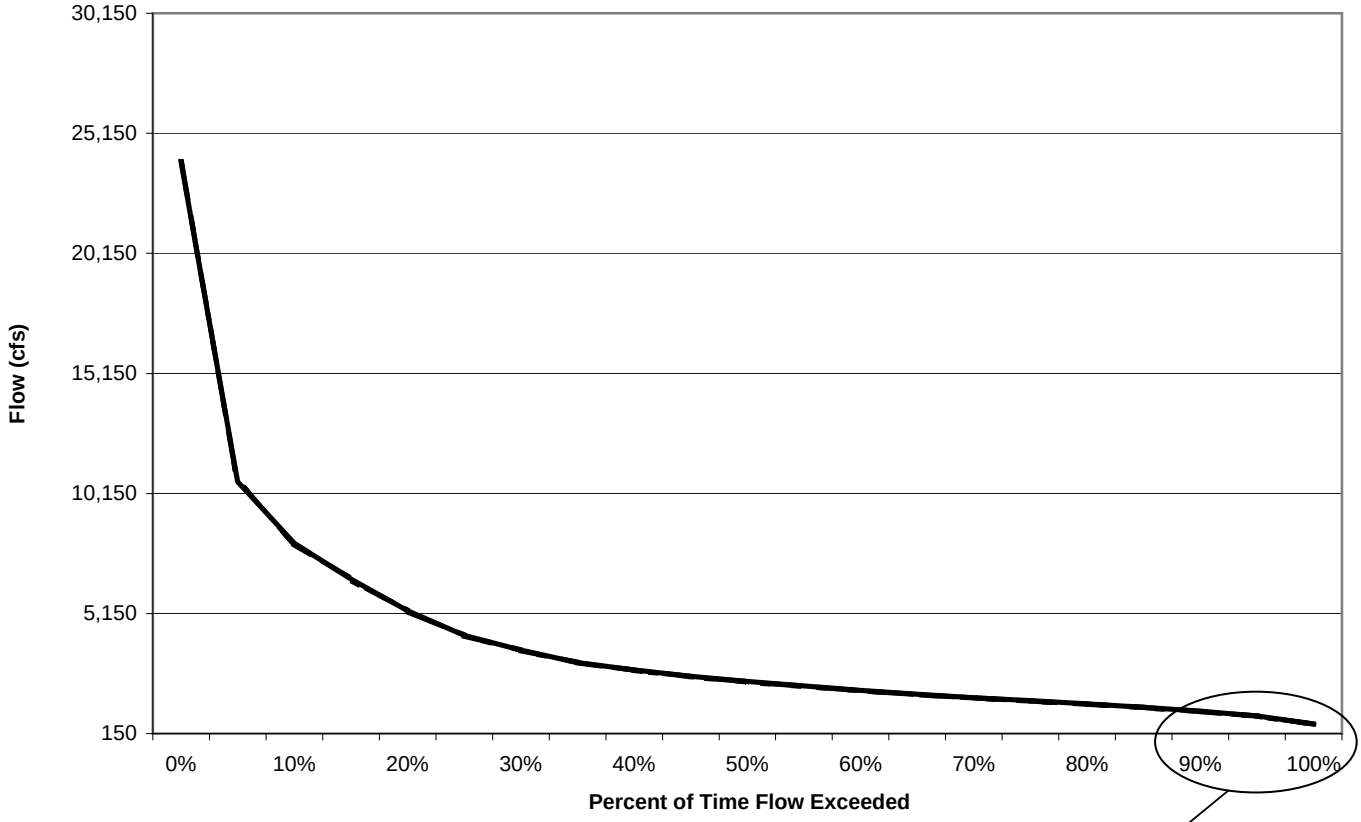


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Current Scenarios

April



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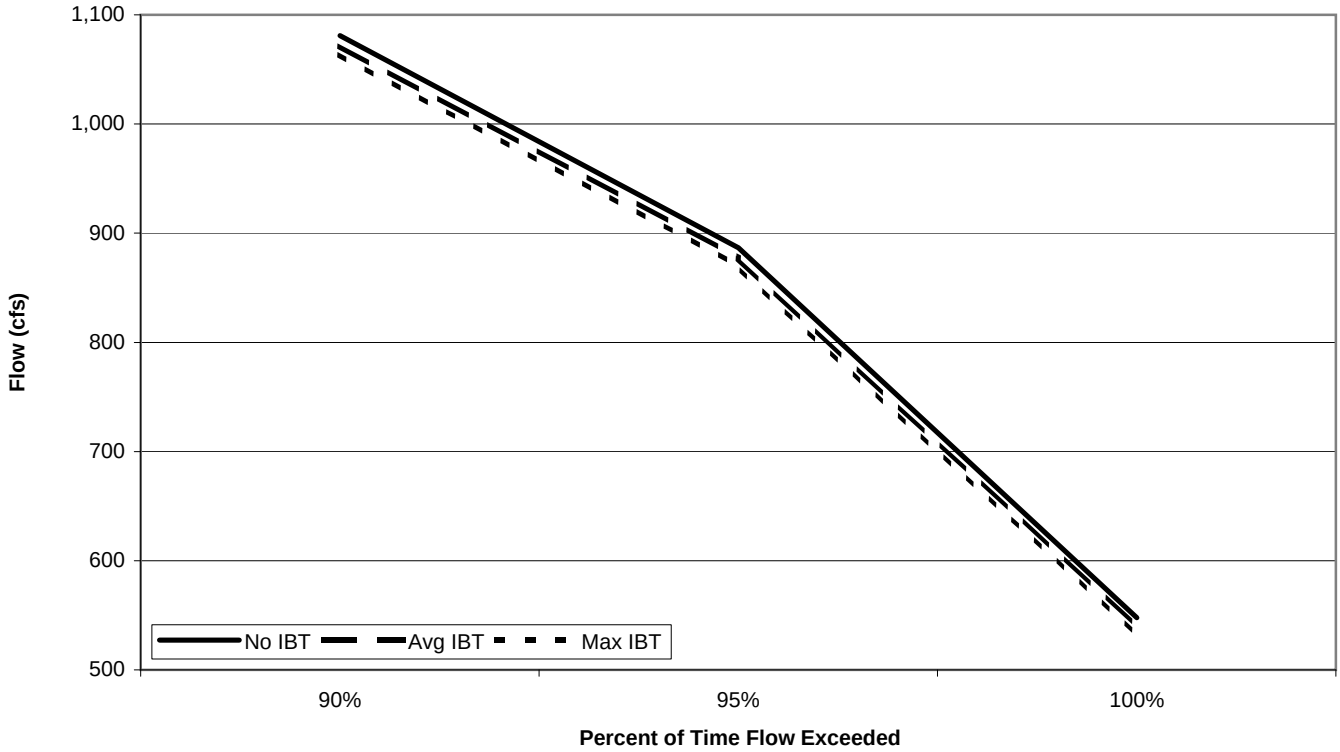
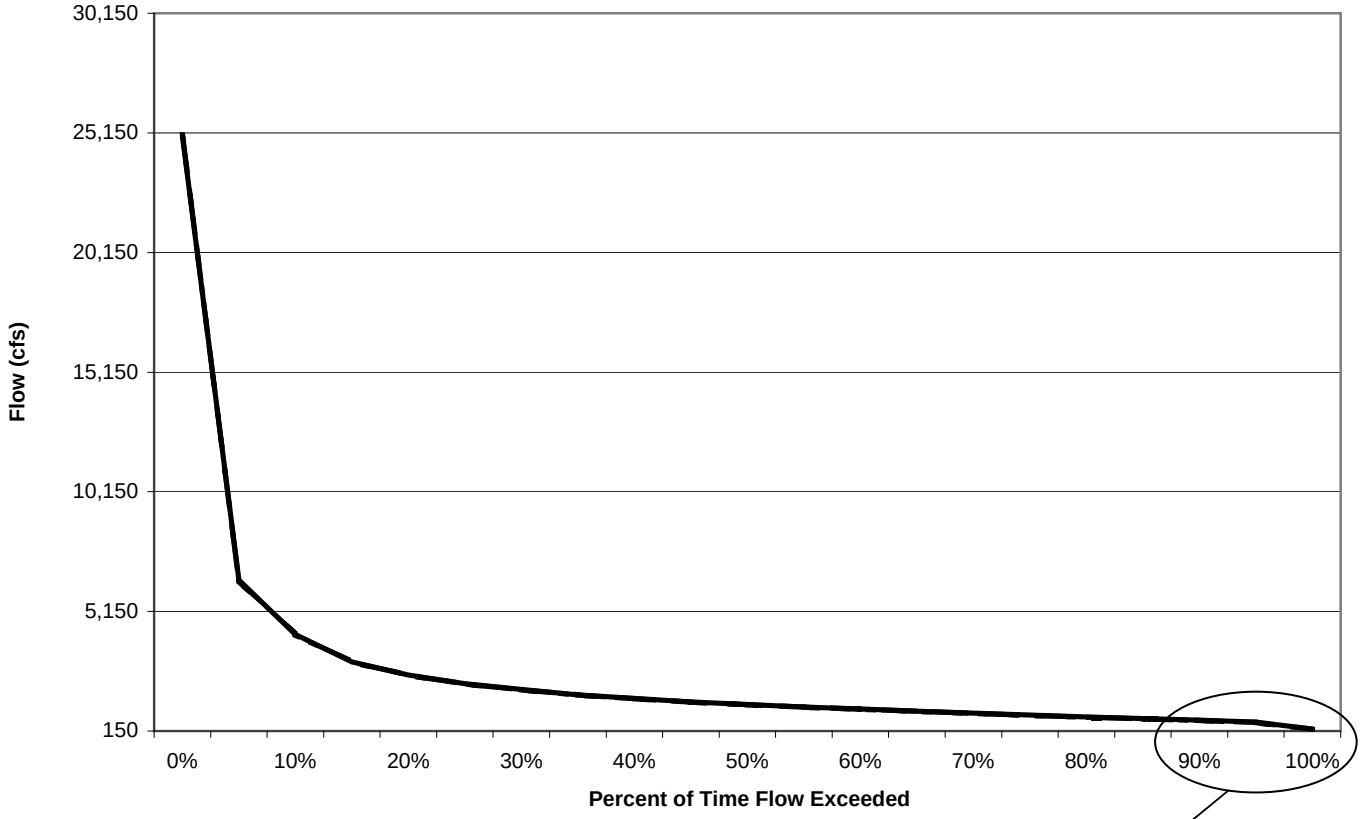


cfs - Cubic feet per second.

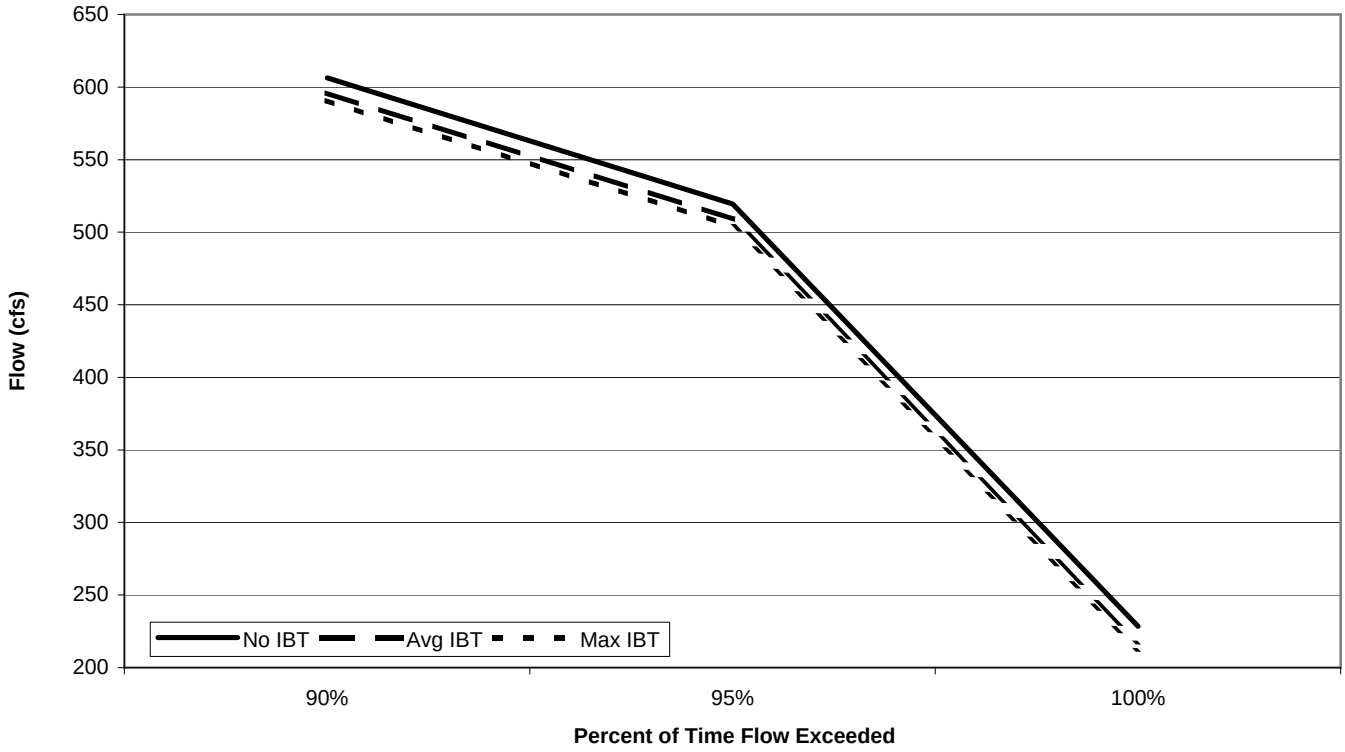
Flow Duration Curves

Greenville Gage Station - Current Scenarios

May



Low-Flow Detail

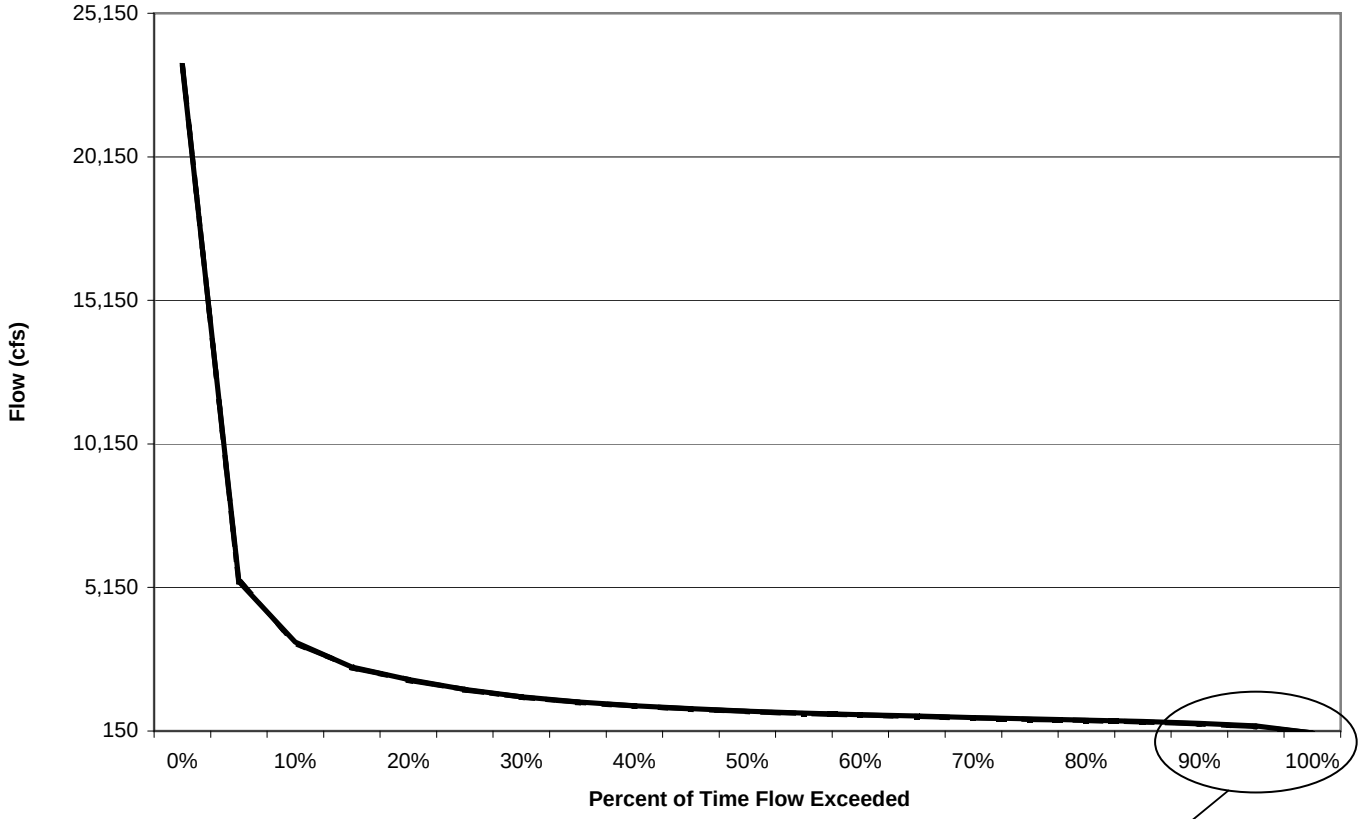


cfs - Cubic feet per second.

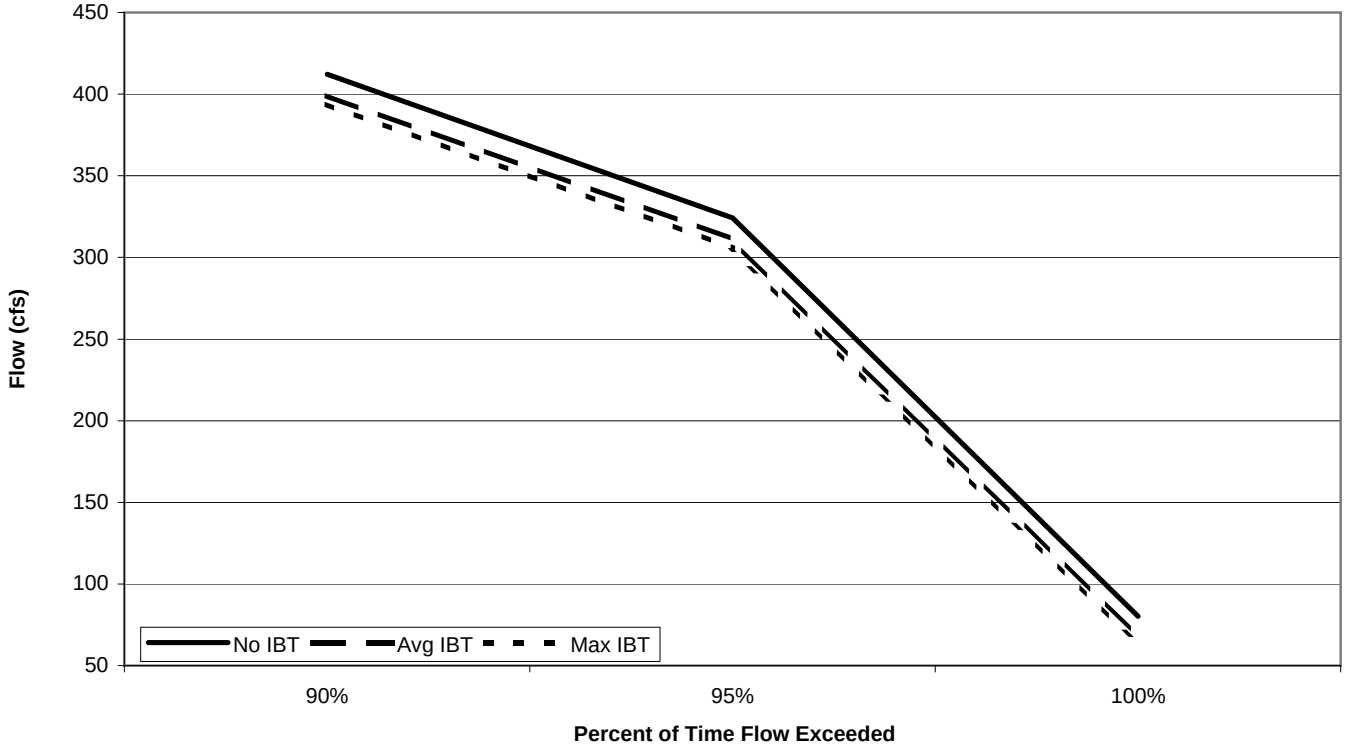
Flow Duration Curves

Greenville Gage Station - Current Scenarios

June



Low-Flow Detail

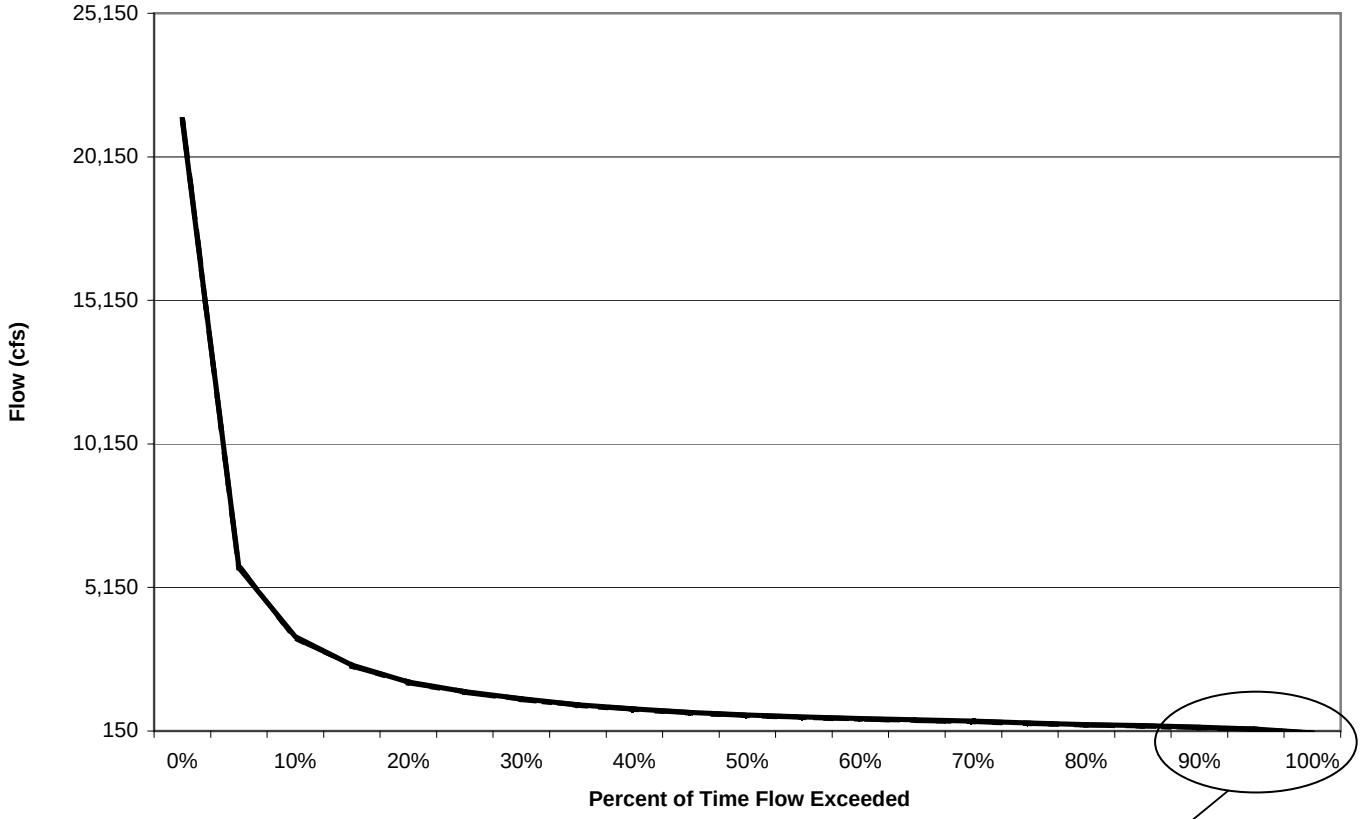


cfs - Cubic feet per second.

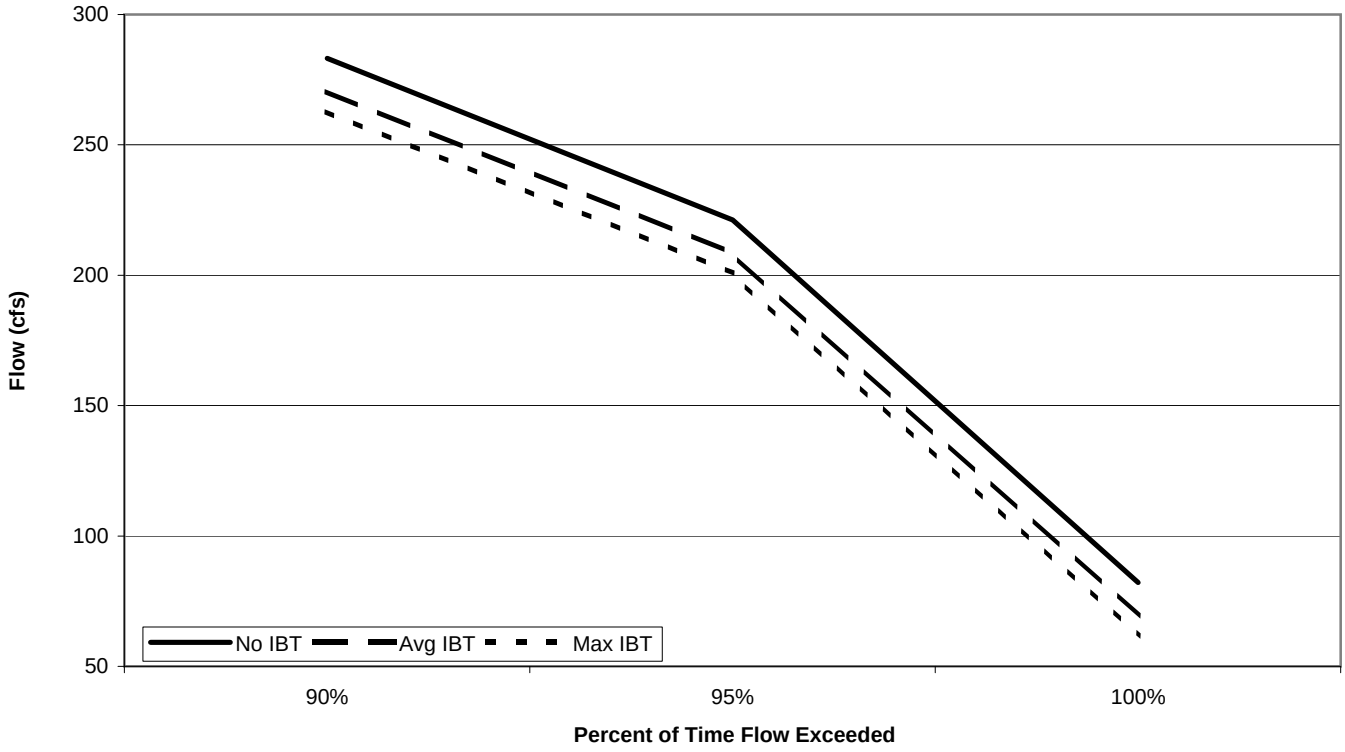
Flow Duration Curves

Greenville Gage Station - Current Scenarios

July



Low-Flow Detail

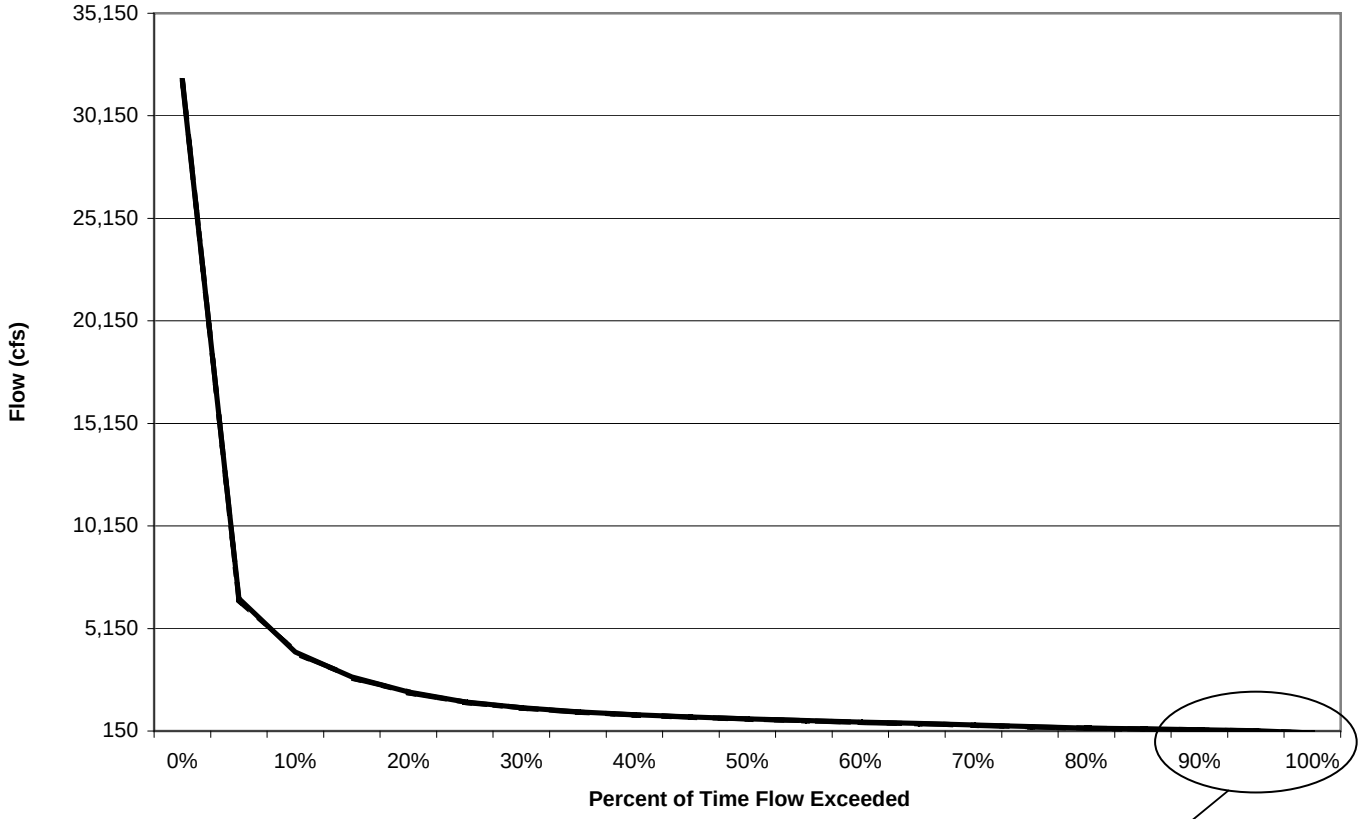


cfs - Cubic feet per second.

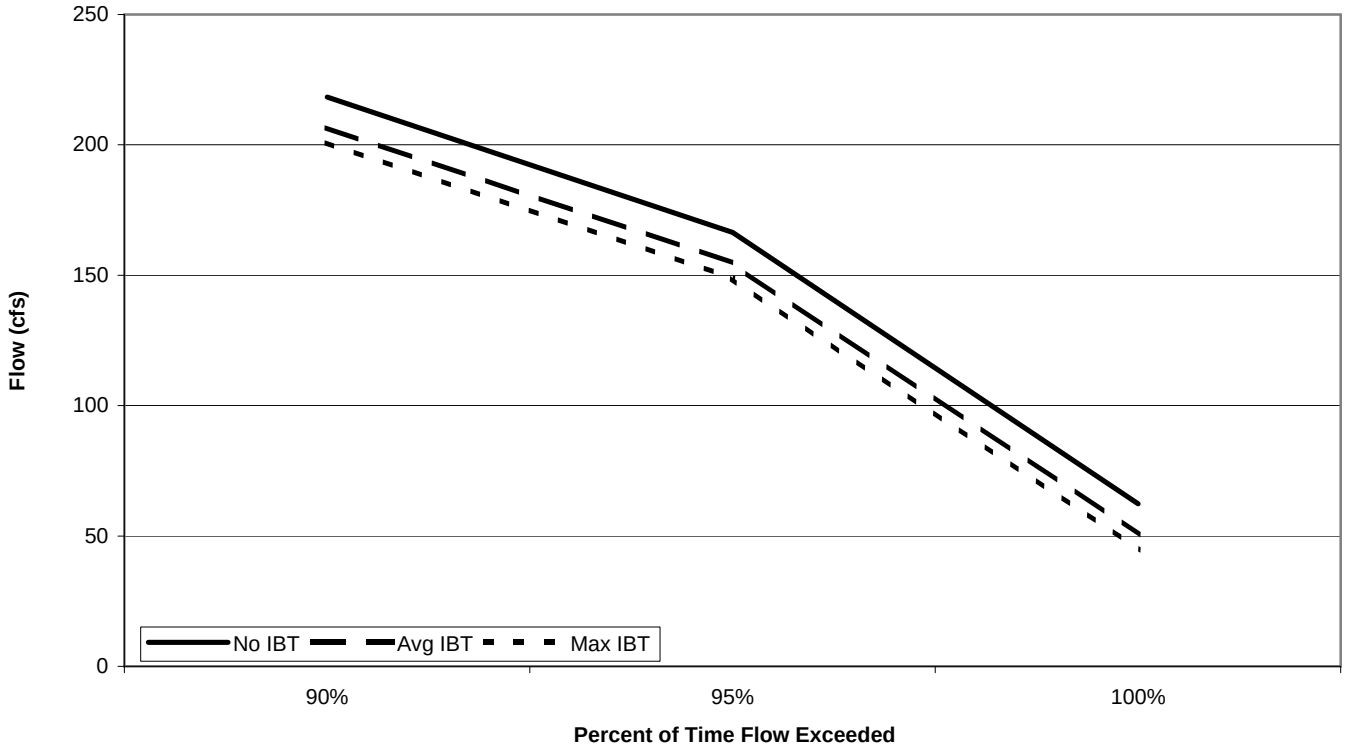
Flow Duration Curves

Greenville Gage Station - Current Scenarios

August



Low-Flow Detail

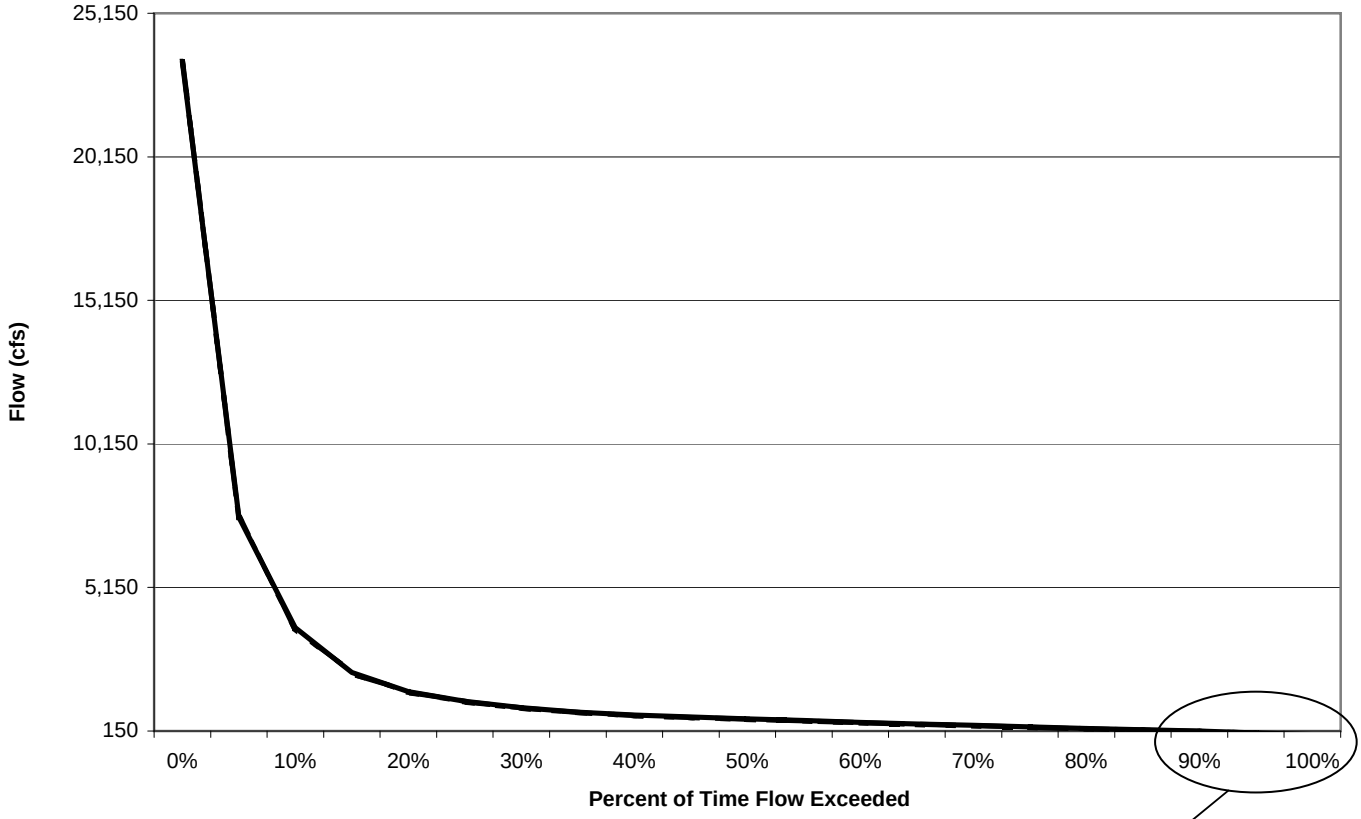


cfs - Cubic feet per second.

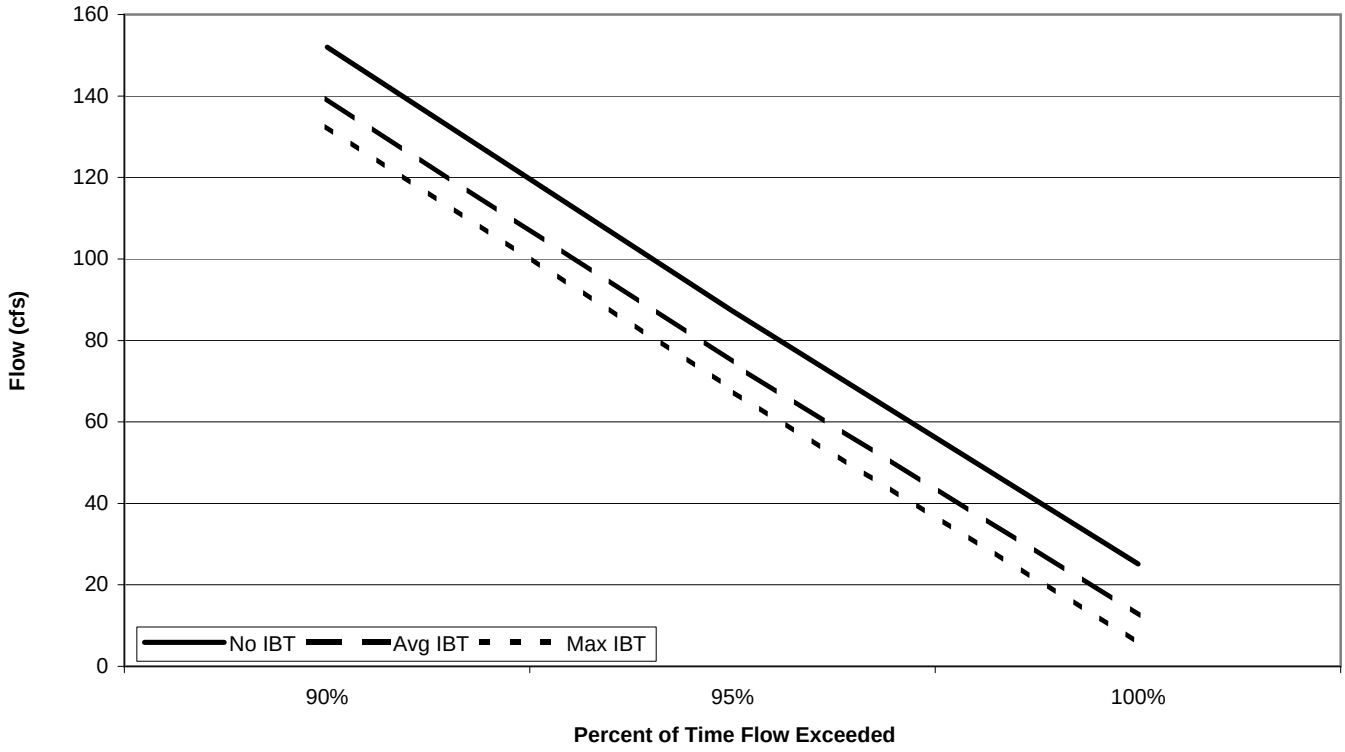
Flow Duration Curves

Greenville Gage Station - Current Scenarios

September



Low-Flow Detail

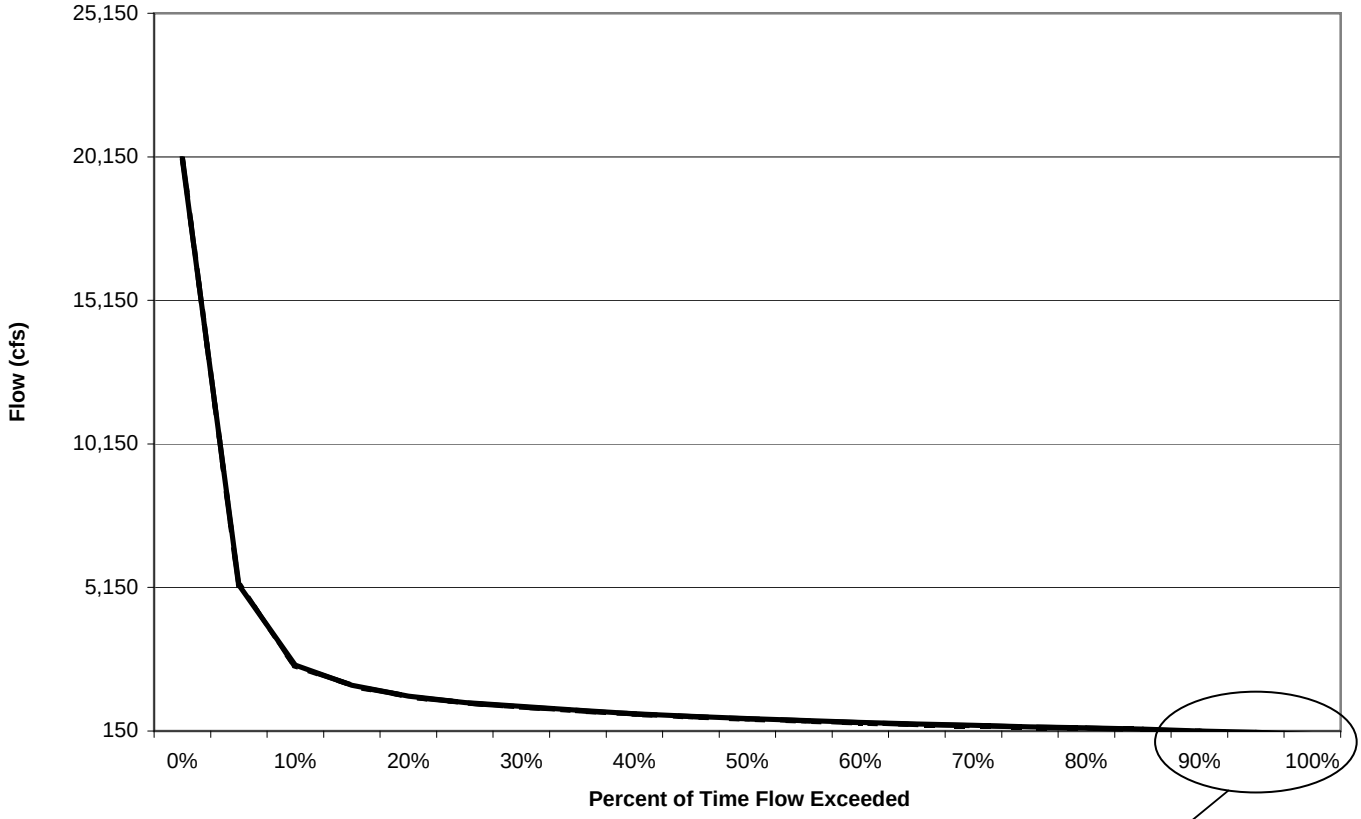


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Current Scenarios

October



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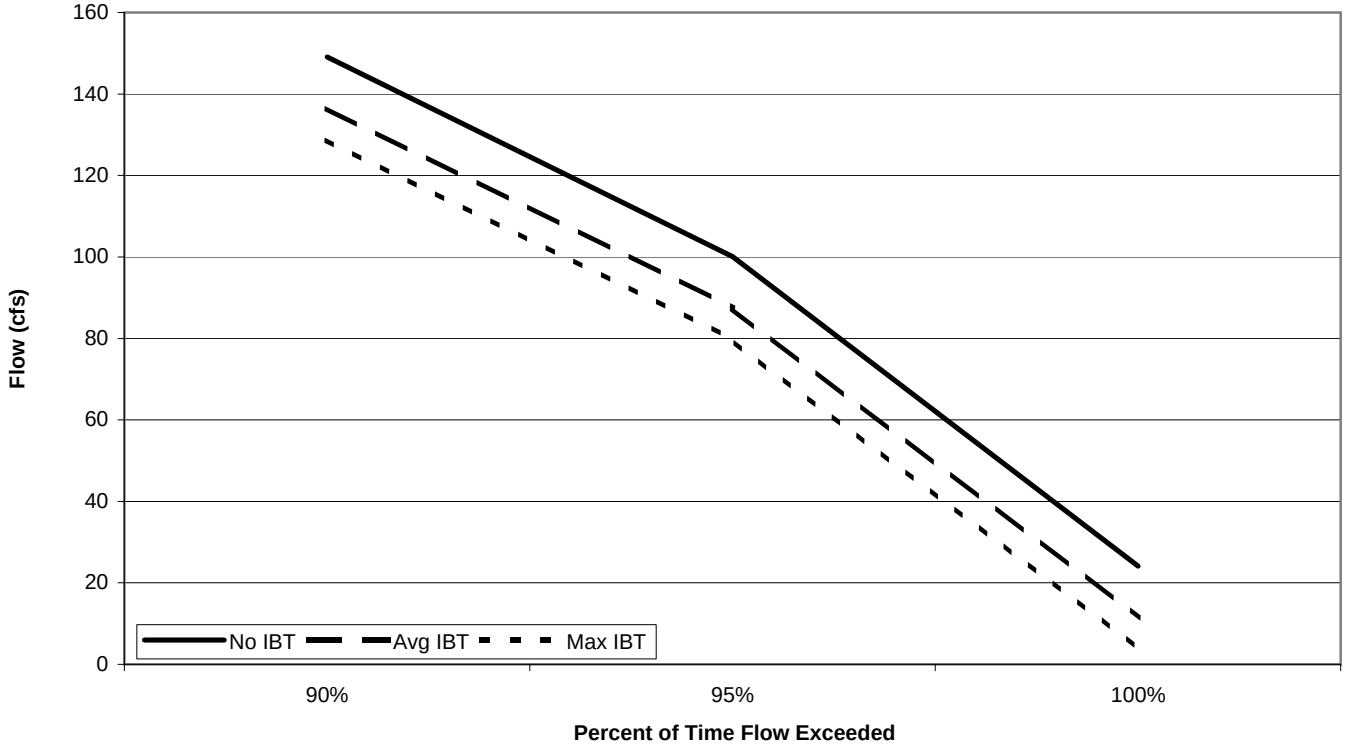
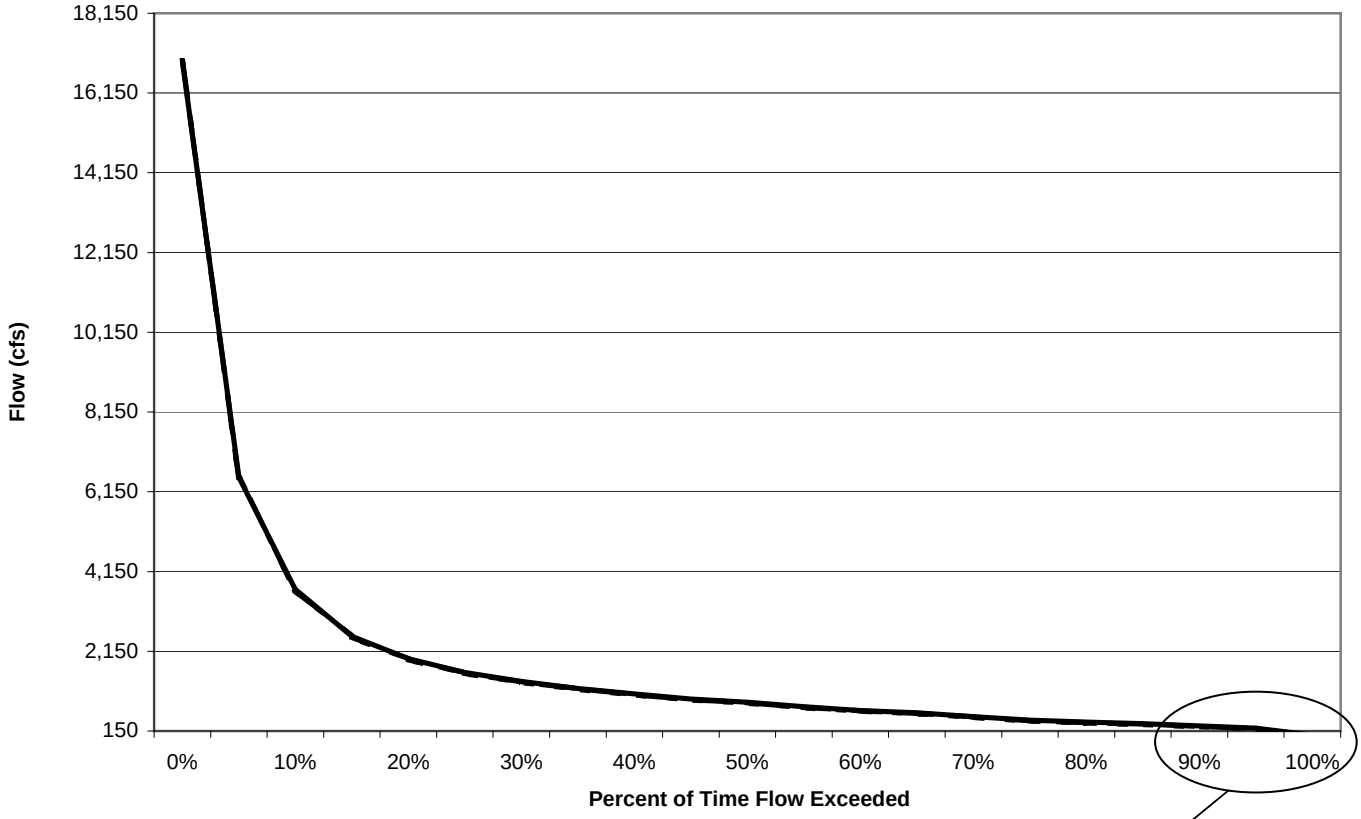


cfs - Cubic feet per second.

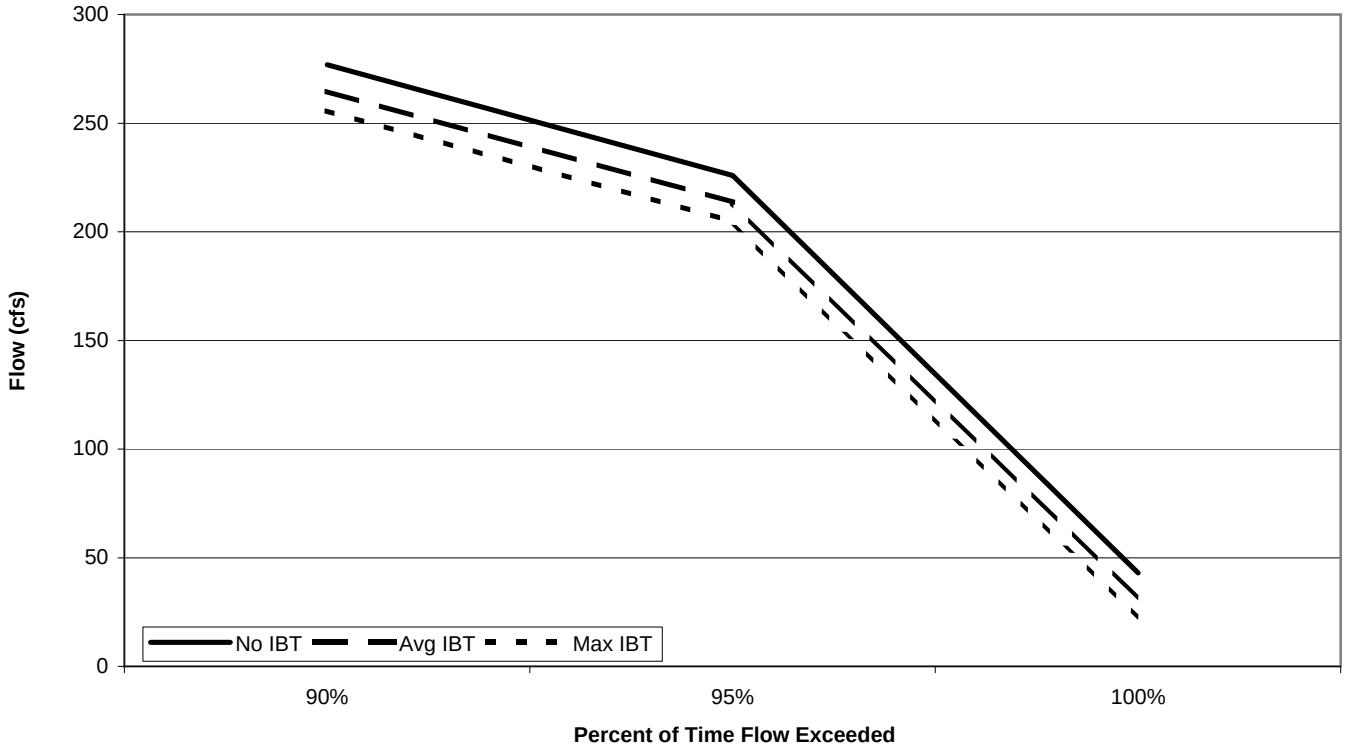
Flow Duration Curves

Greenville Gage Station - Current Scenarios

November



Low-Flow Detail

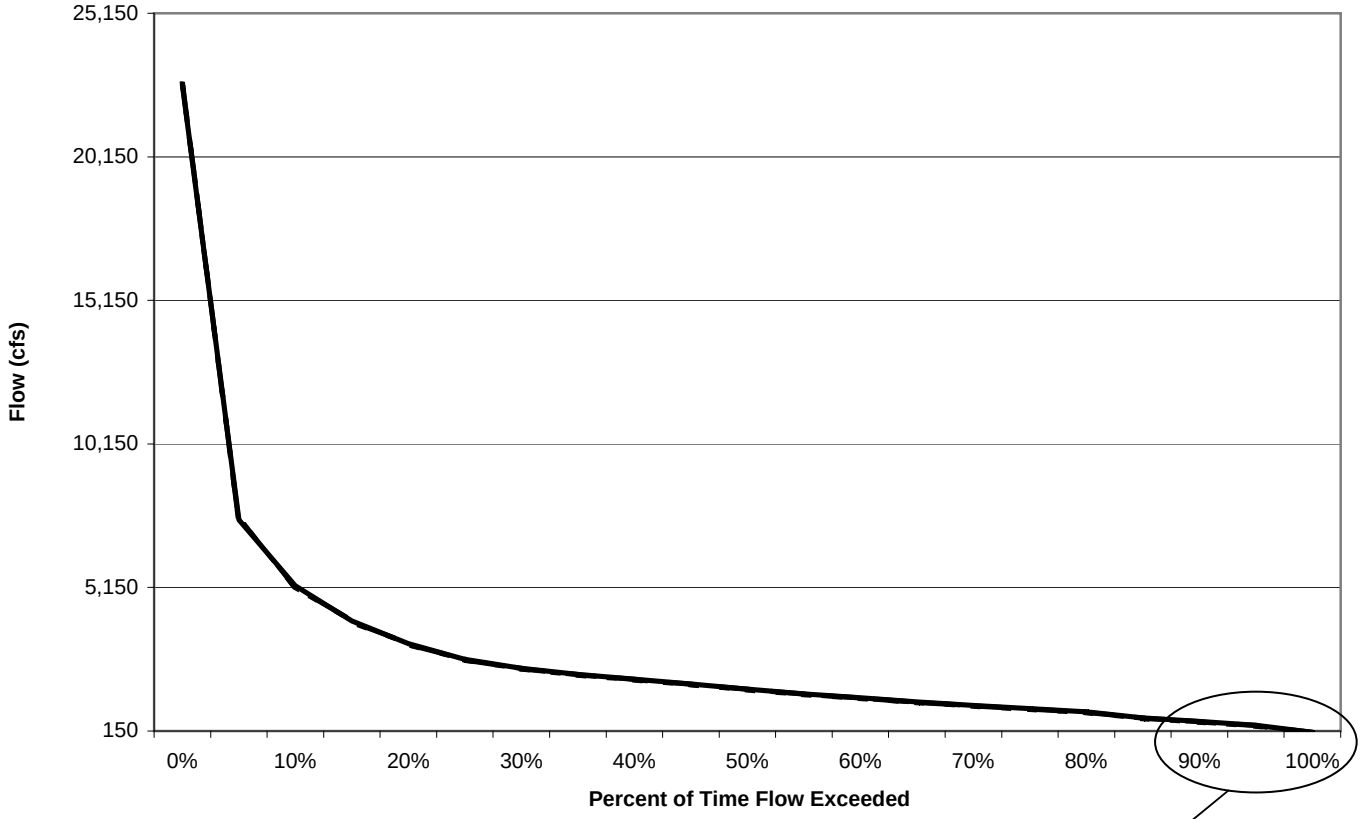


cfs - Cubic feet per second.

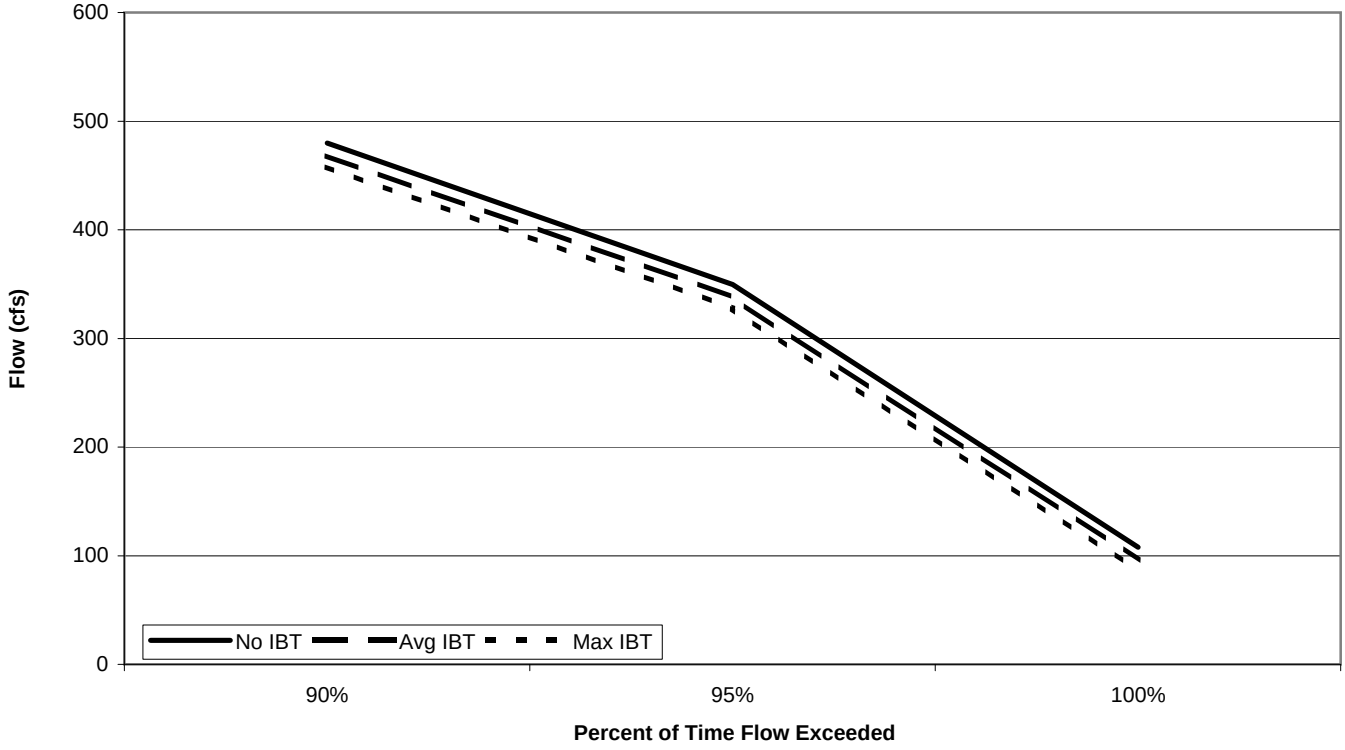
Flow Duration Curves

Greenville Gage Station - Current Scenarios

December



Low-Flow Detail

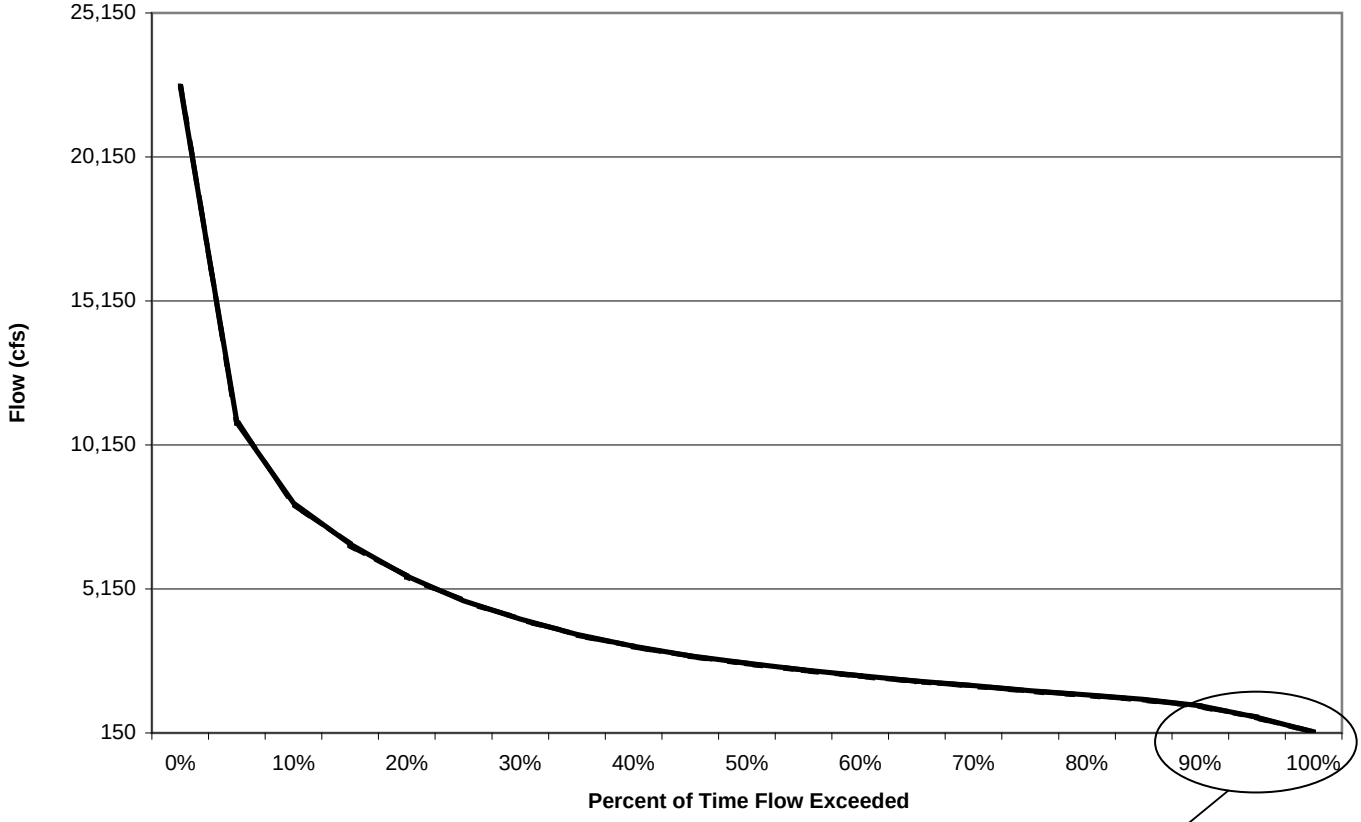


cfs - Cubic feet per second.

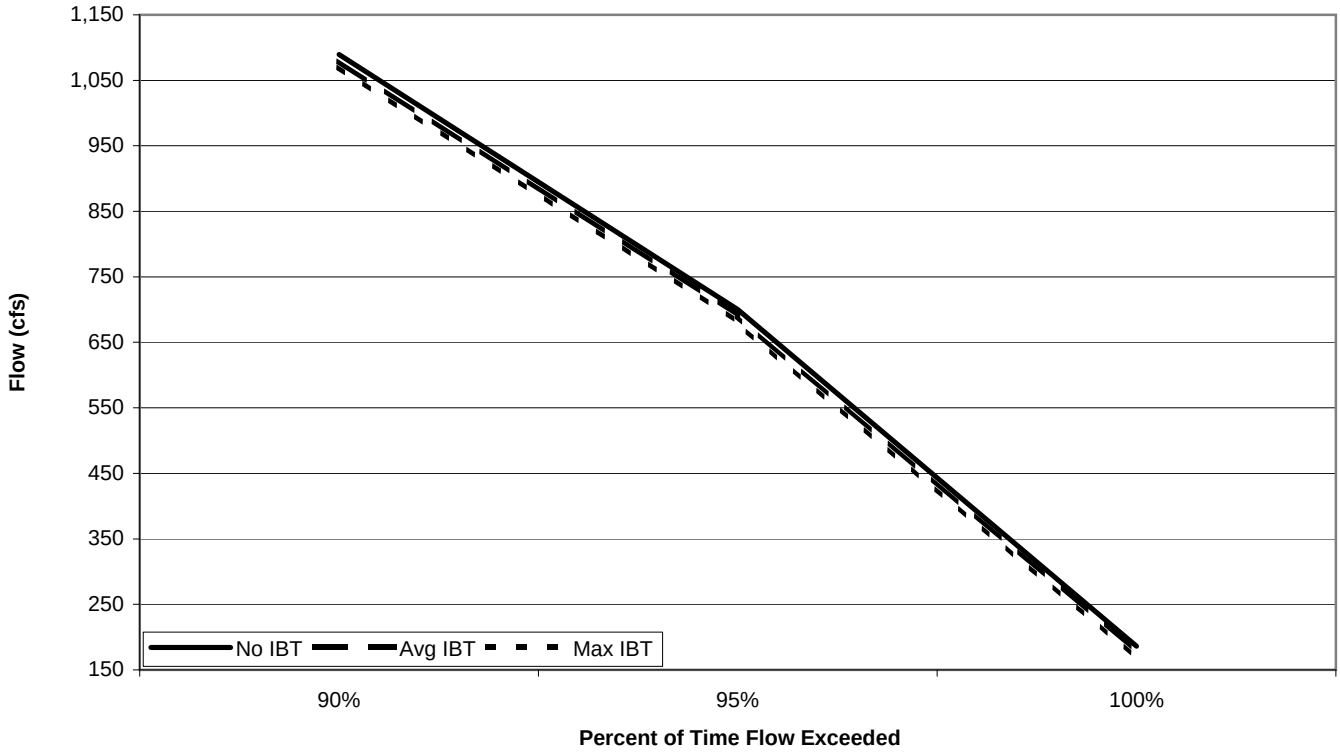
Flow Duration Curves

Greenville Gage Station - Future Scenarios

January



Low-Flow Detail

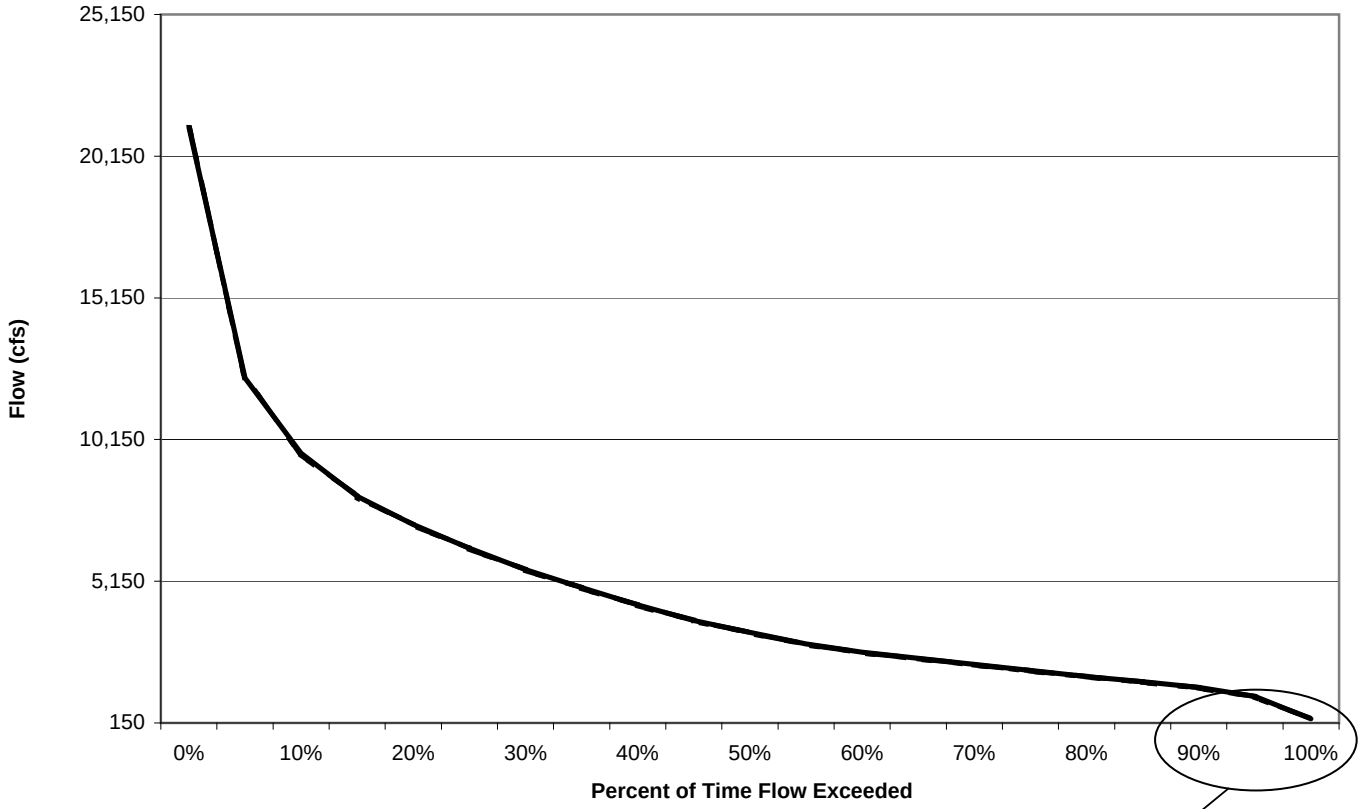


cfs - Cubic feet per second.

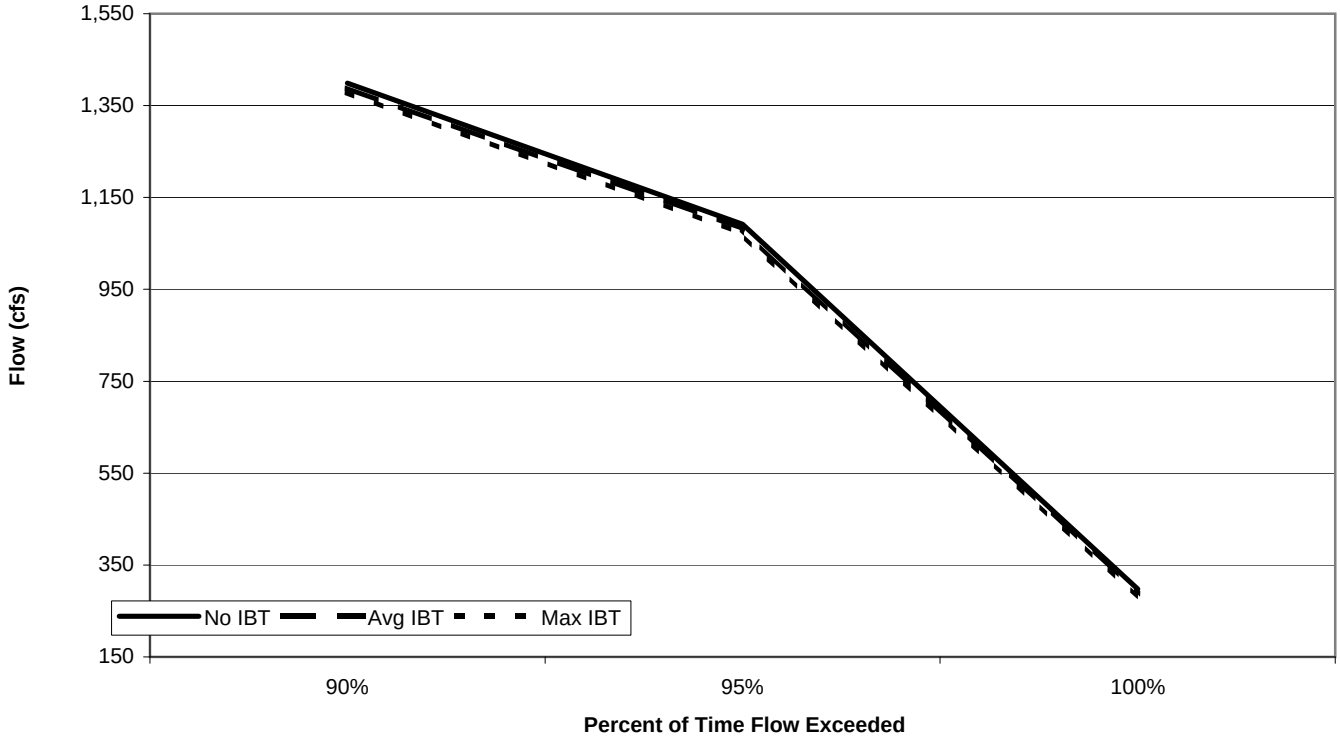
Flow Duration Curves

Greenville Gage Station - Future Scenarios

February



Low-Flow Detail

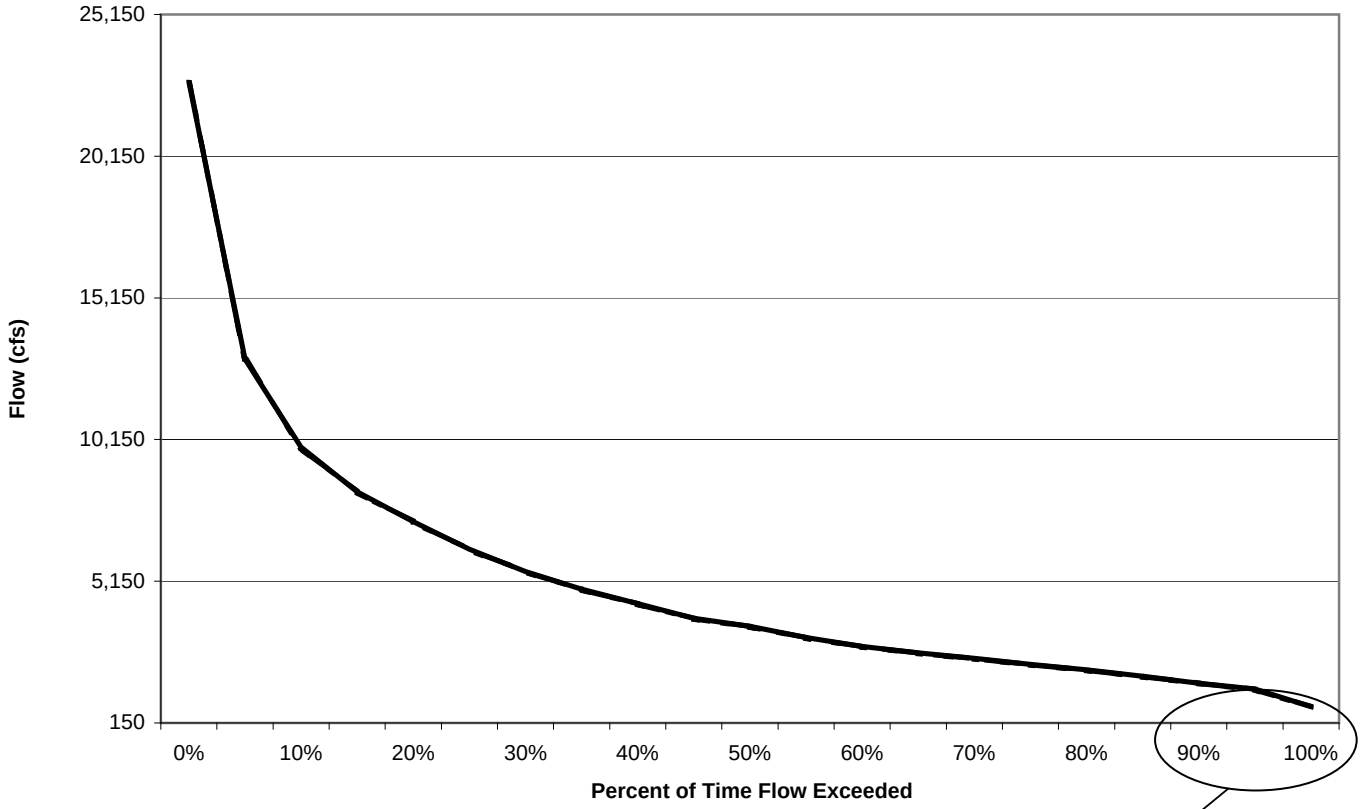


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

March



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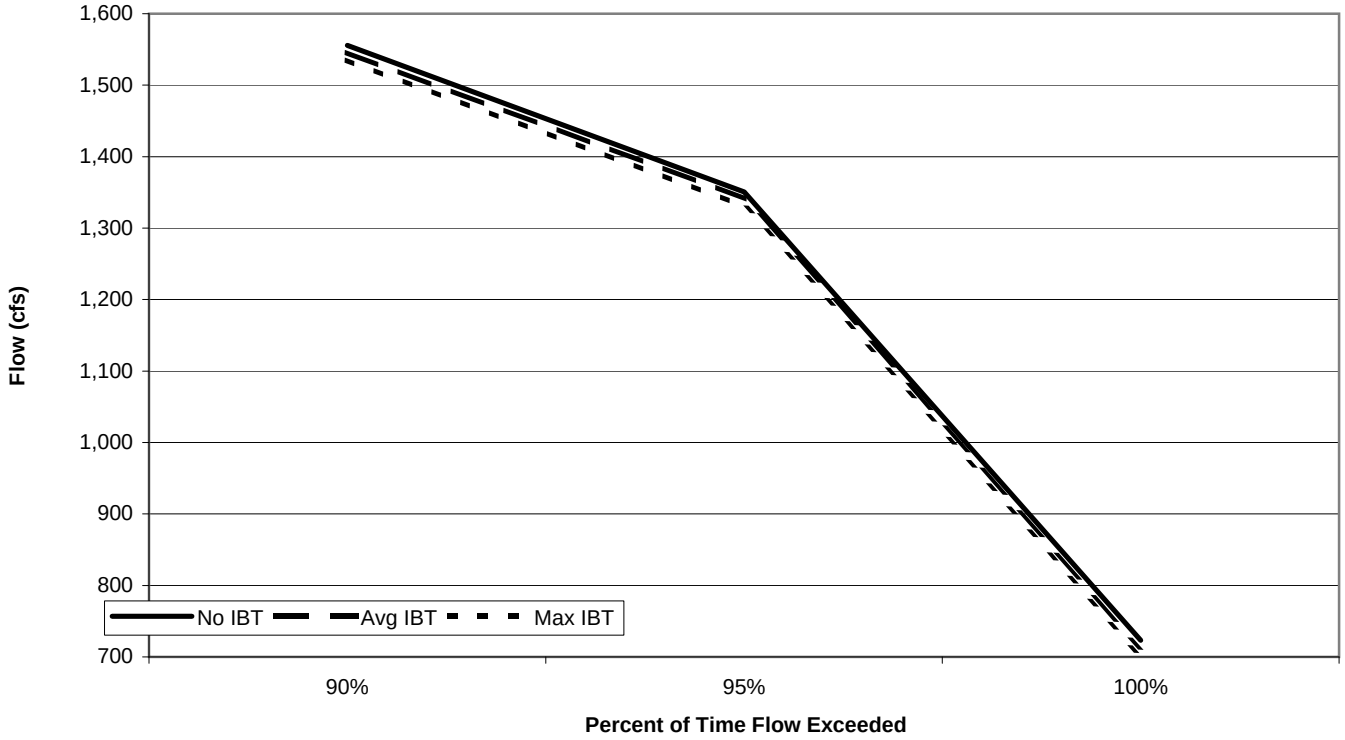
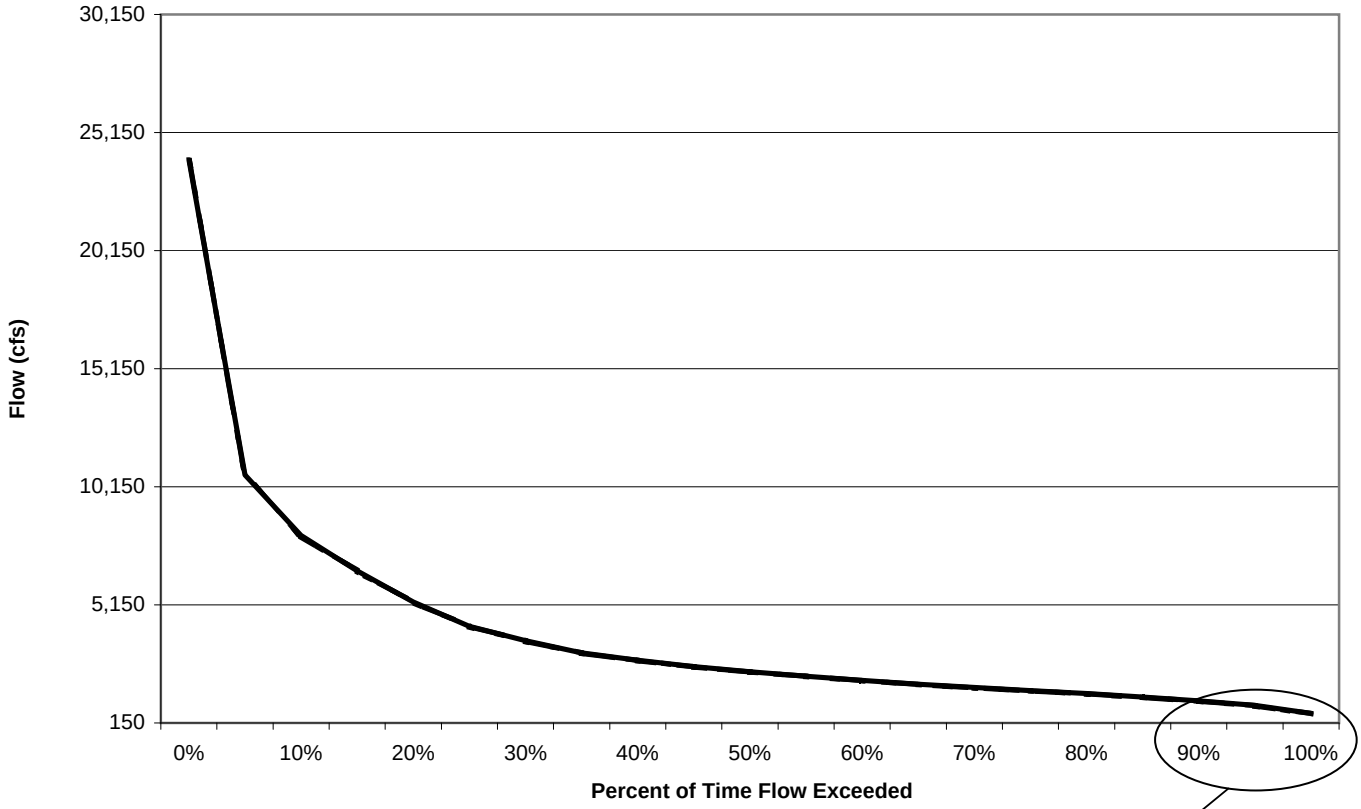


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

April



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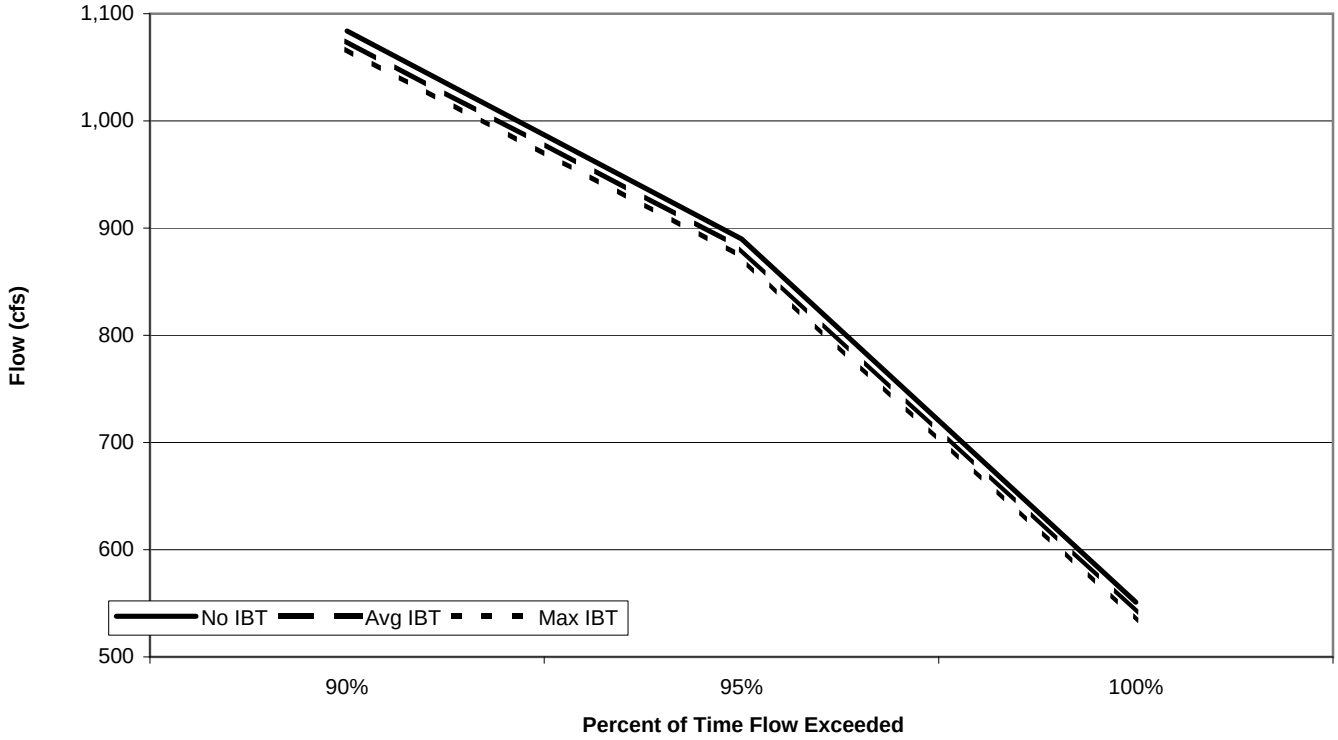
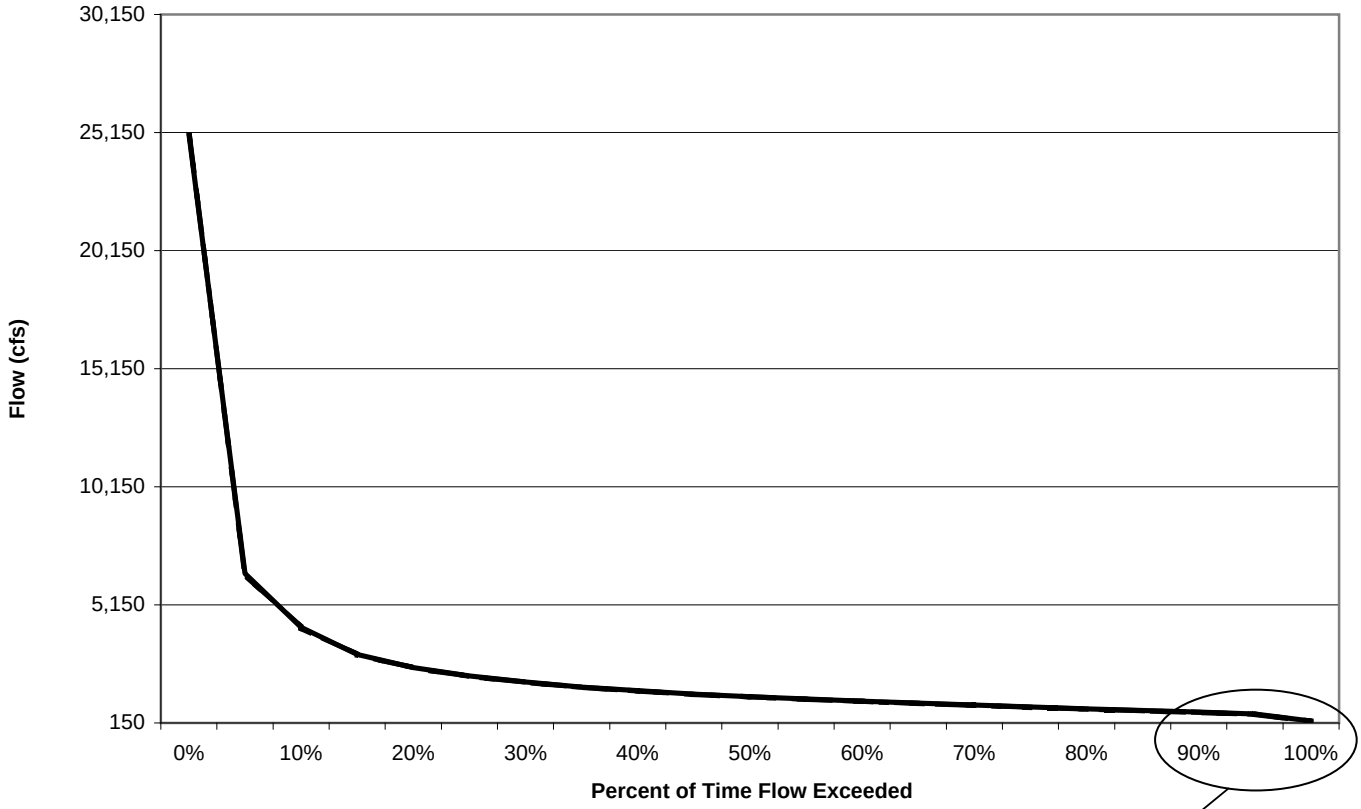


cfs - Cubic feet per second.

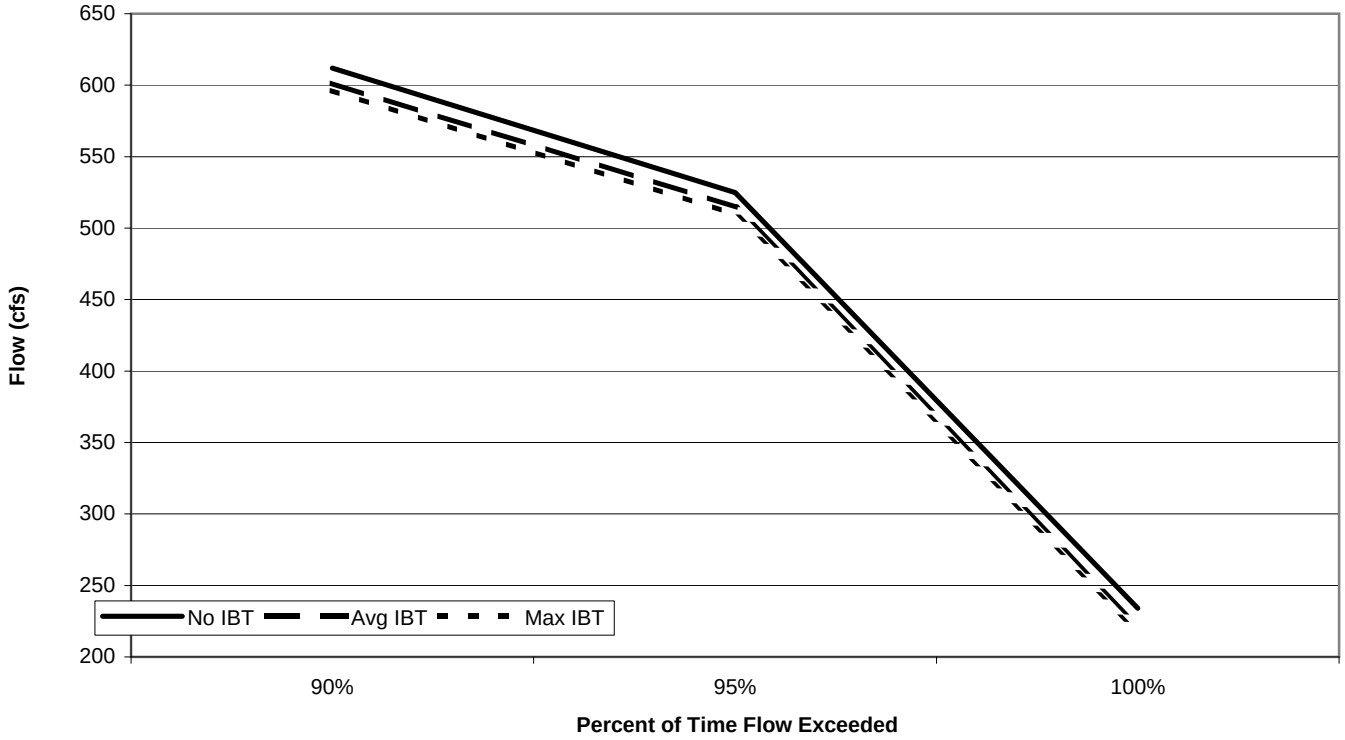
Flow Duration Curves

Greenville Gage Station - Future Scenarios

May



Low-Flow Detail

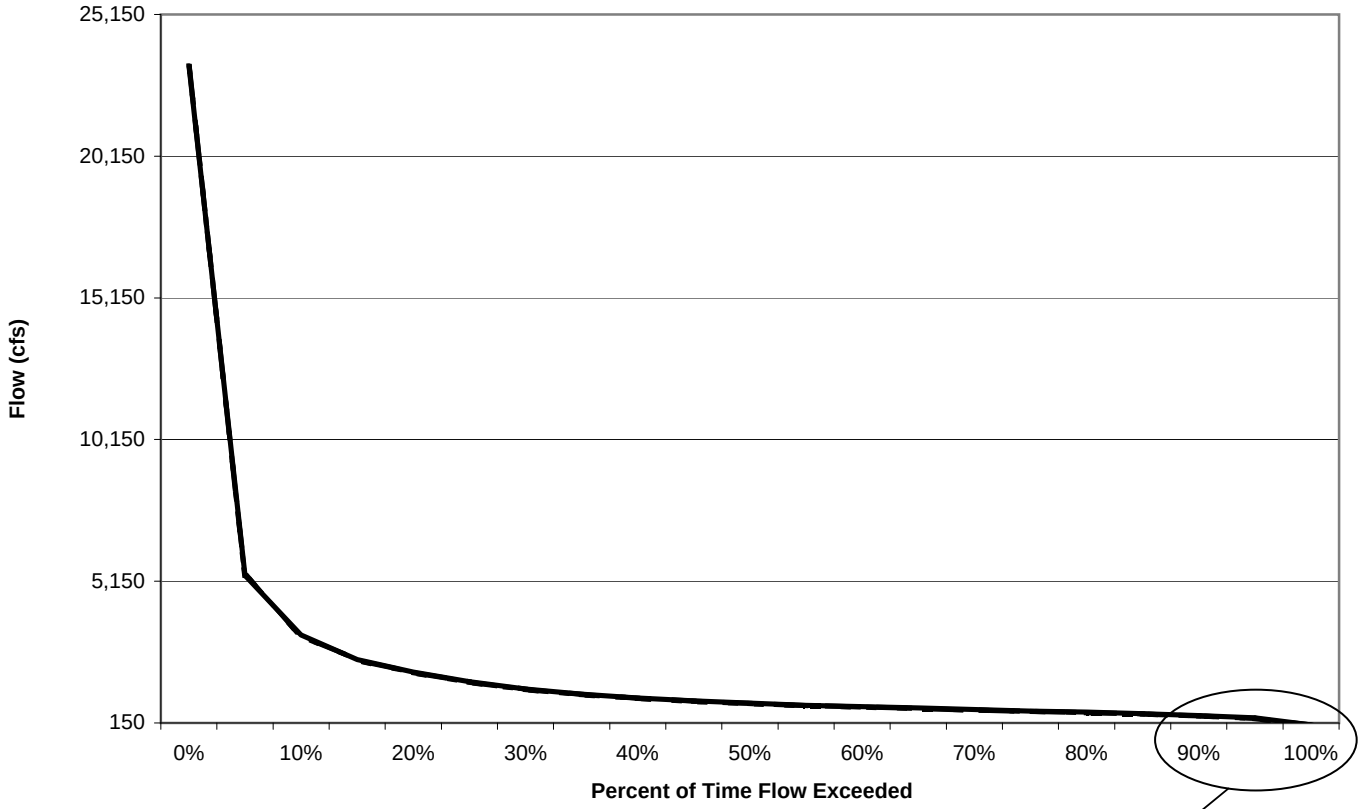


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

June



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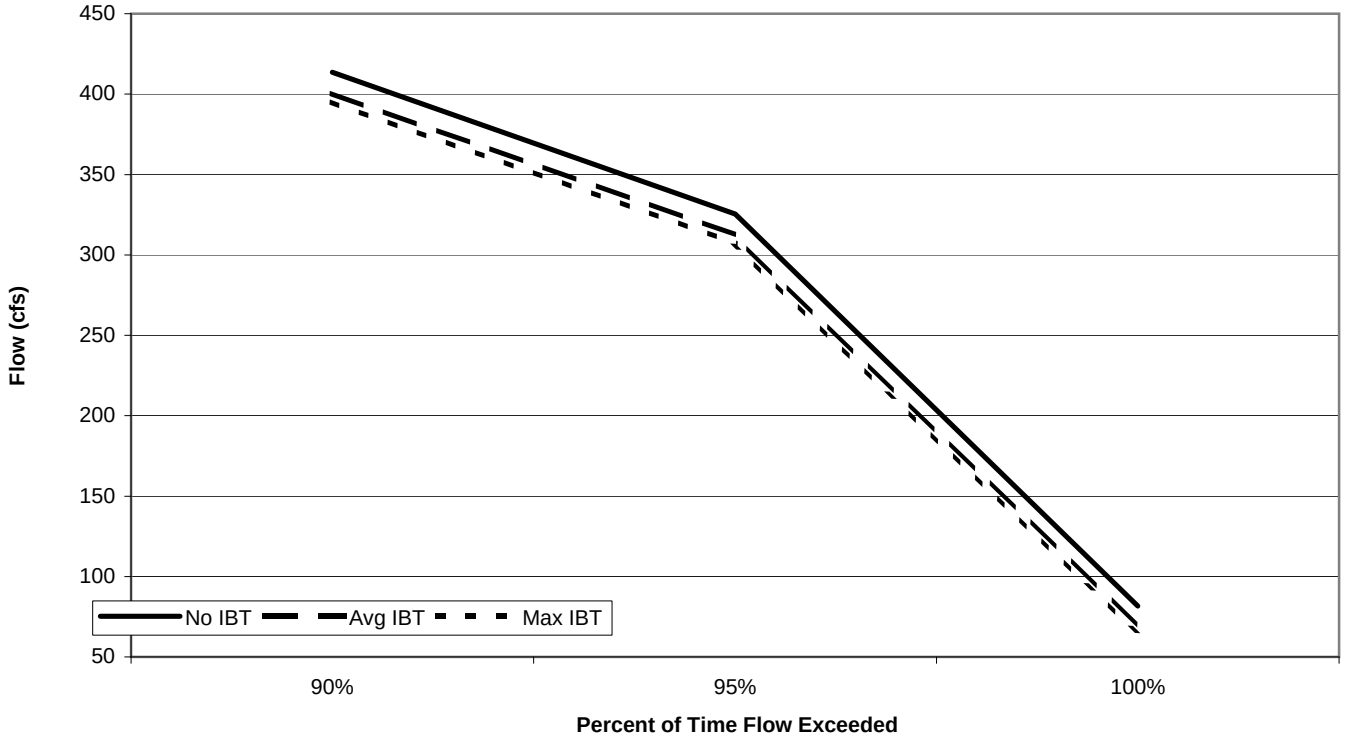
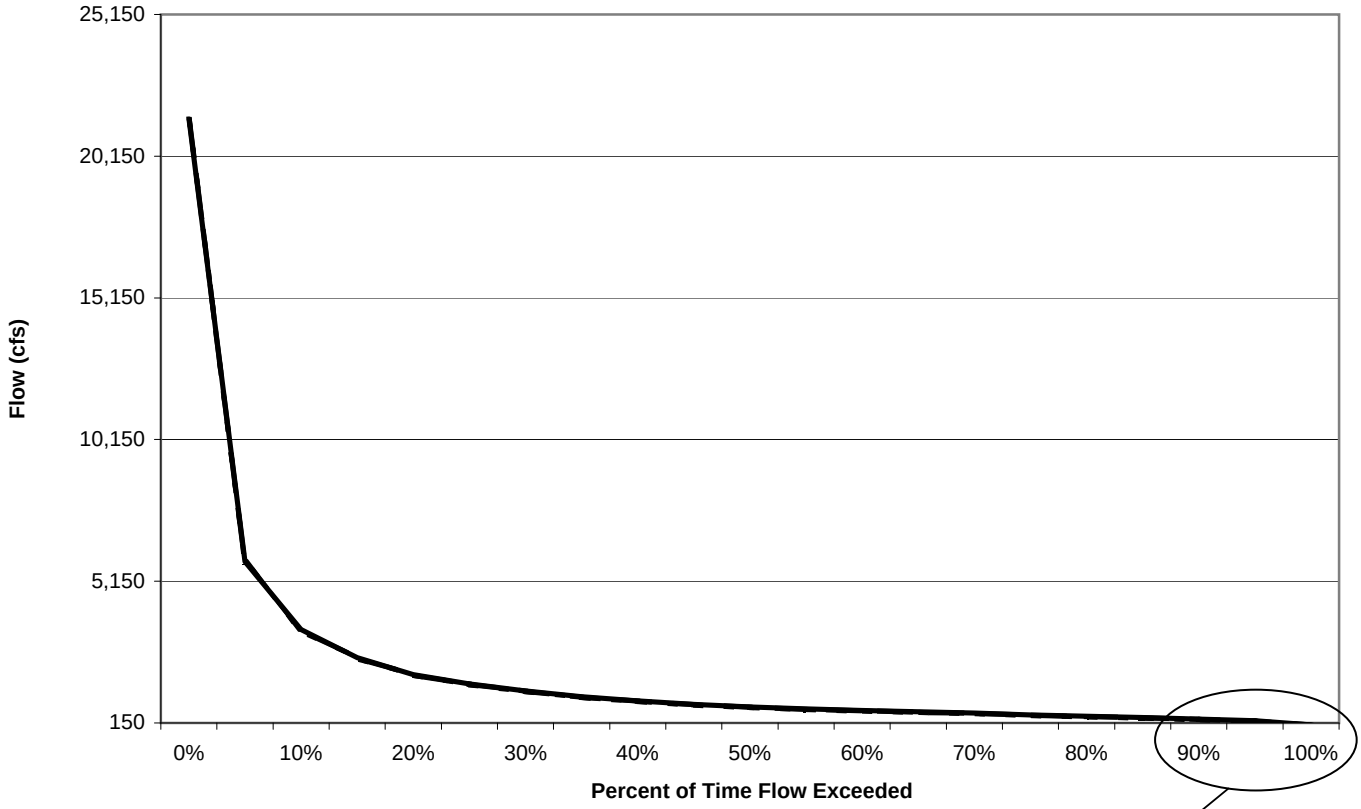


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

July



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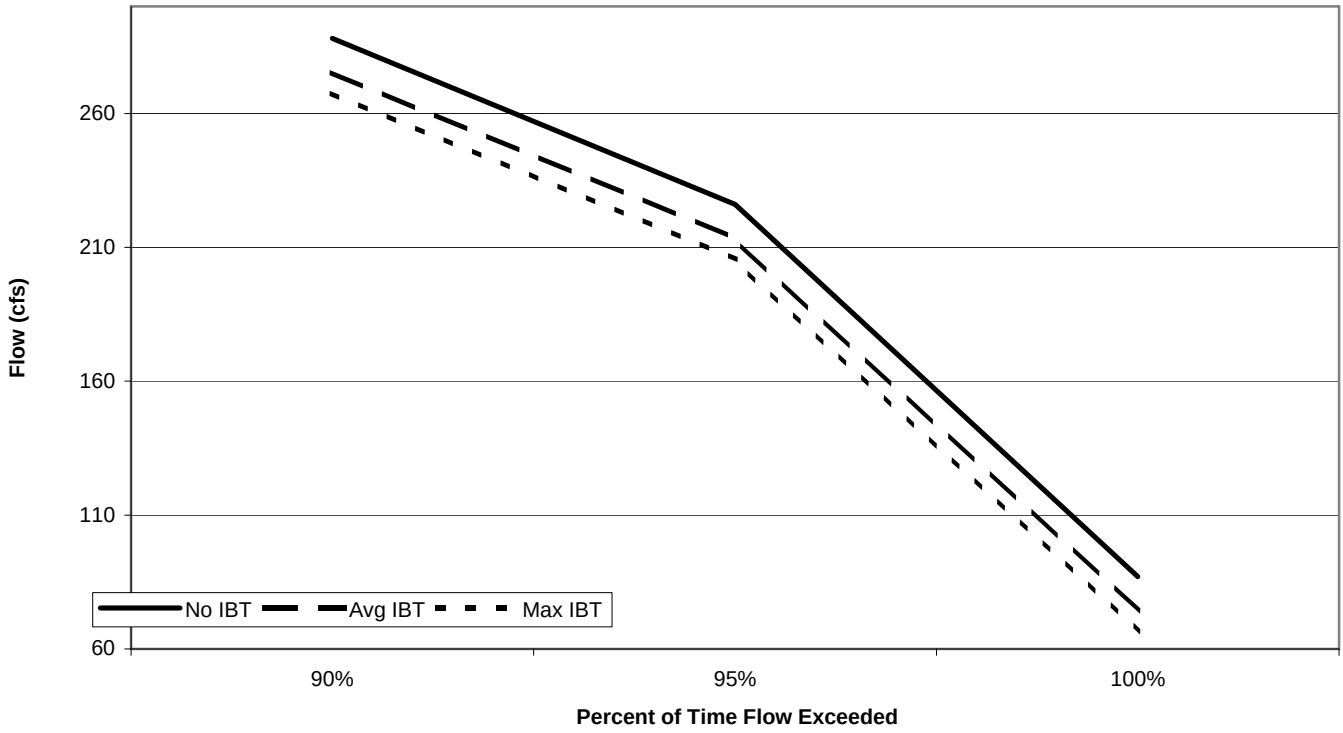
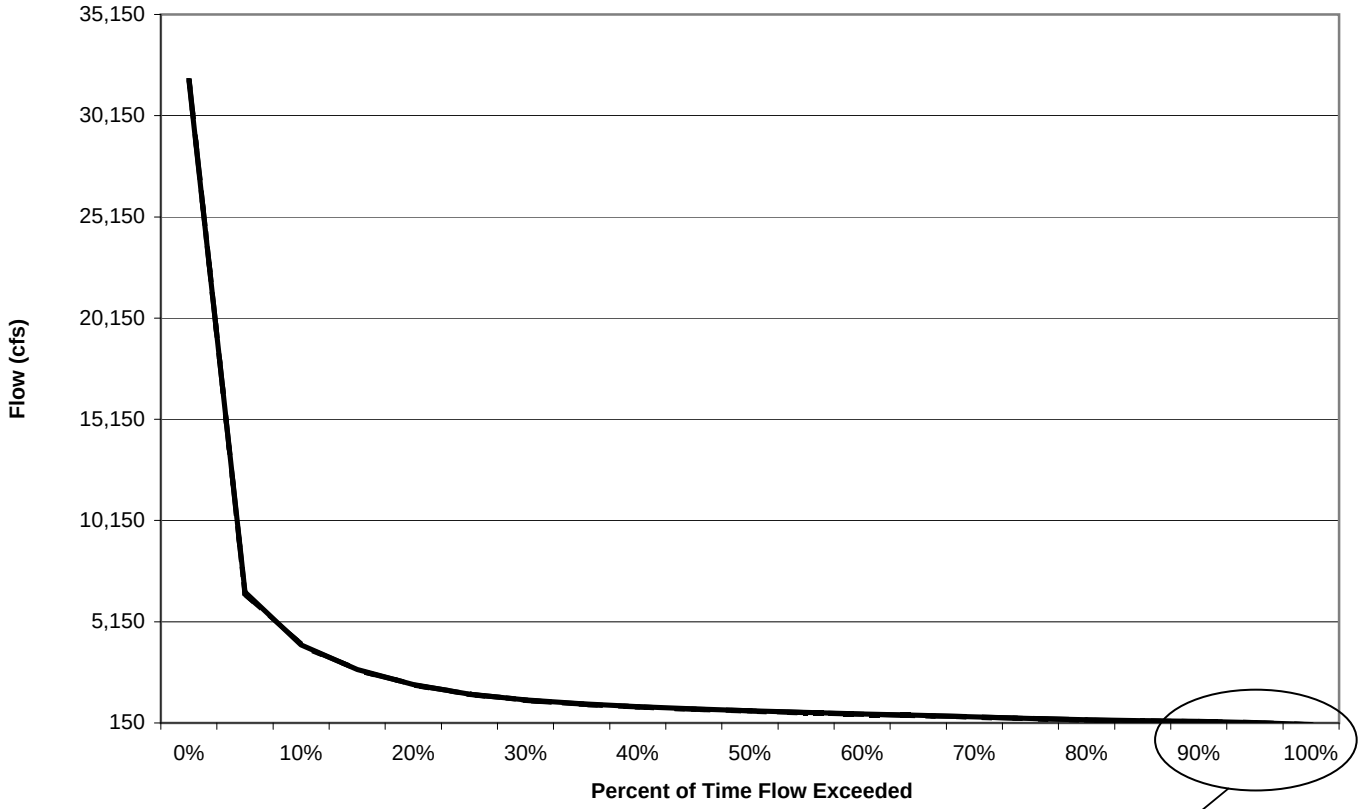


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

August



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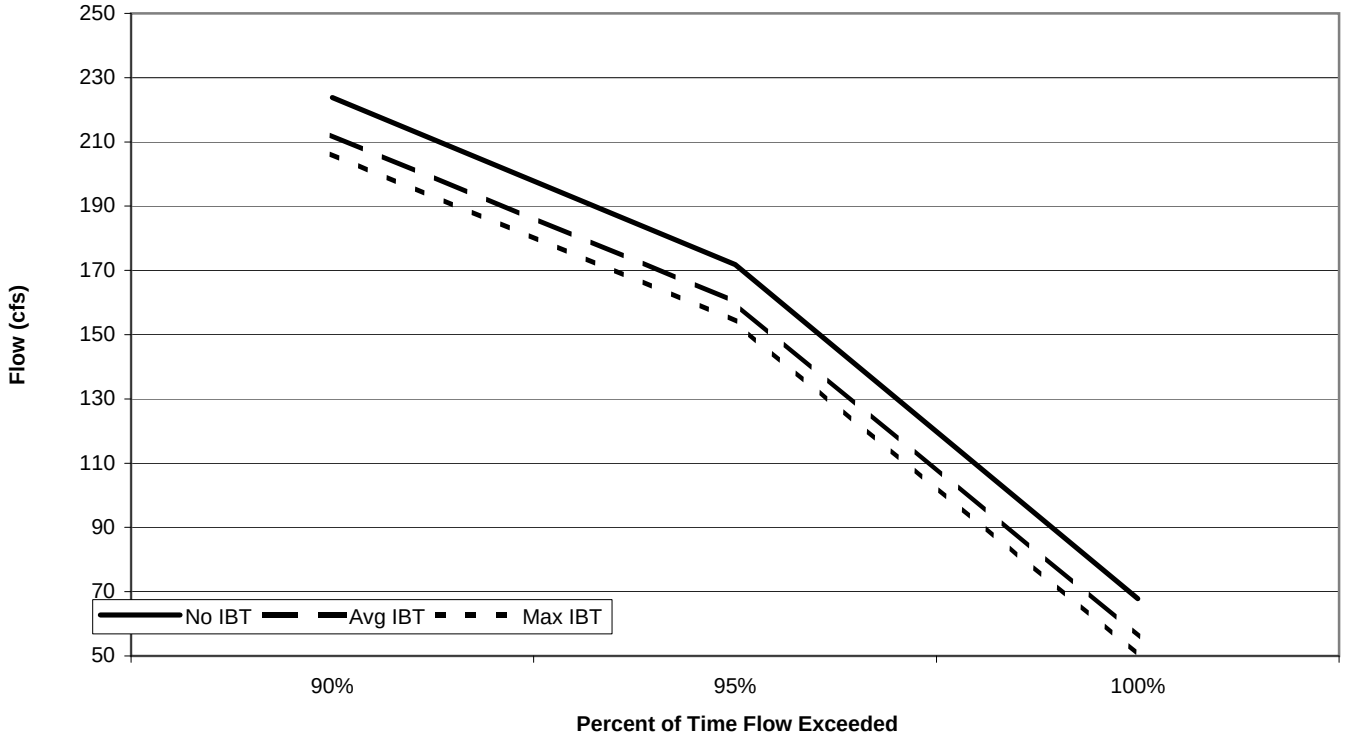
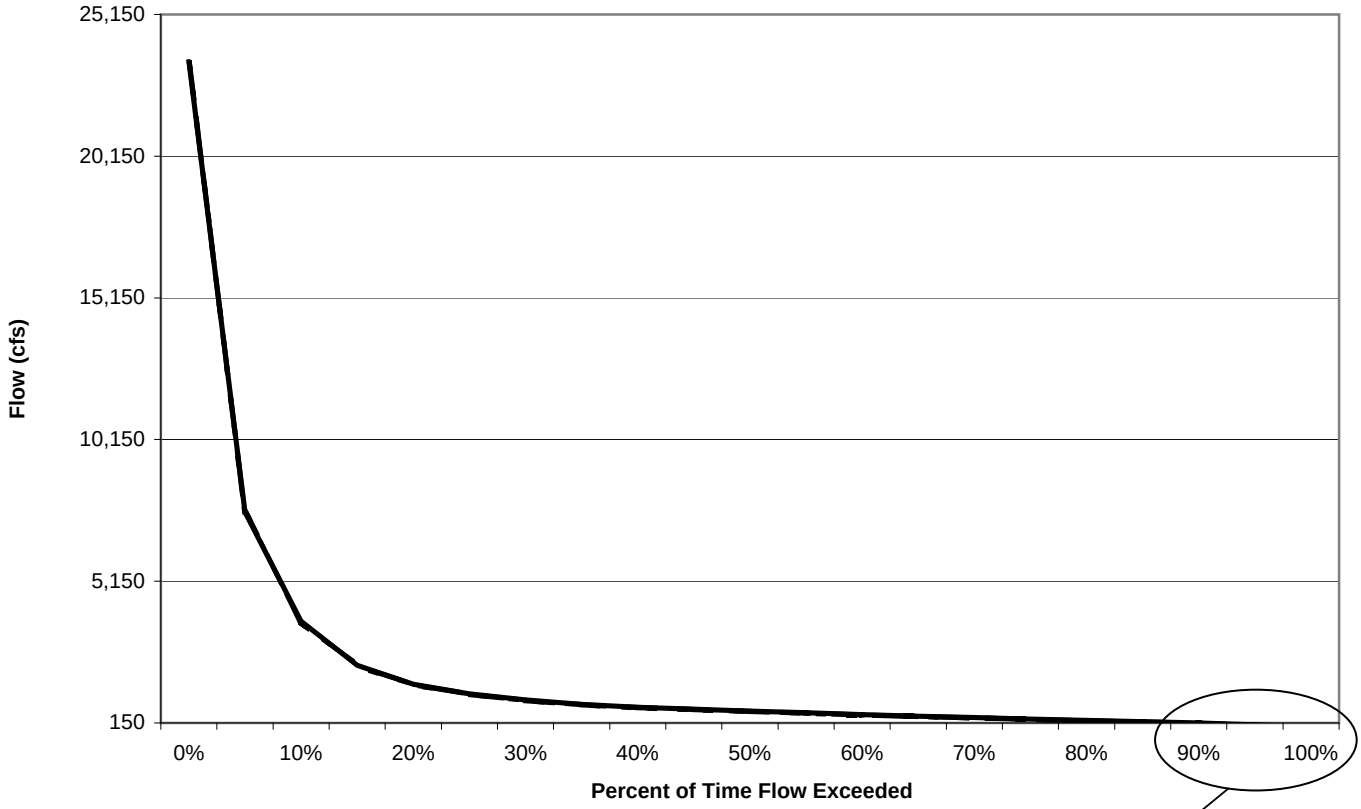


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

September



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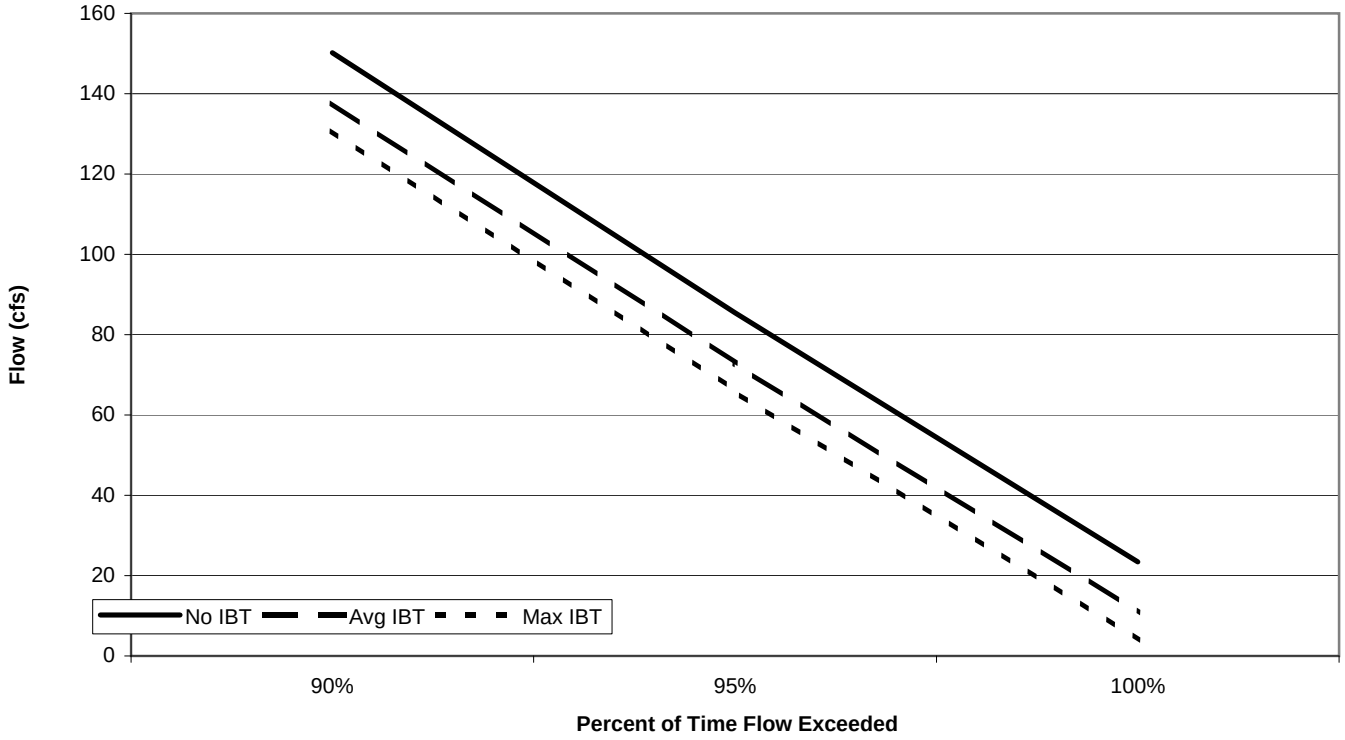
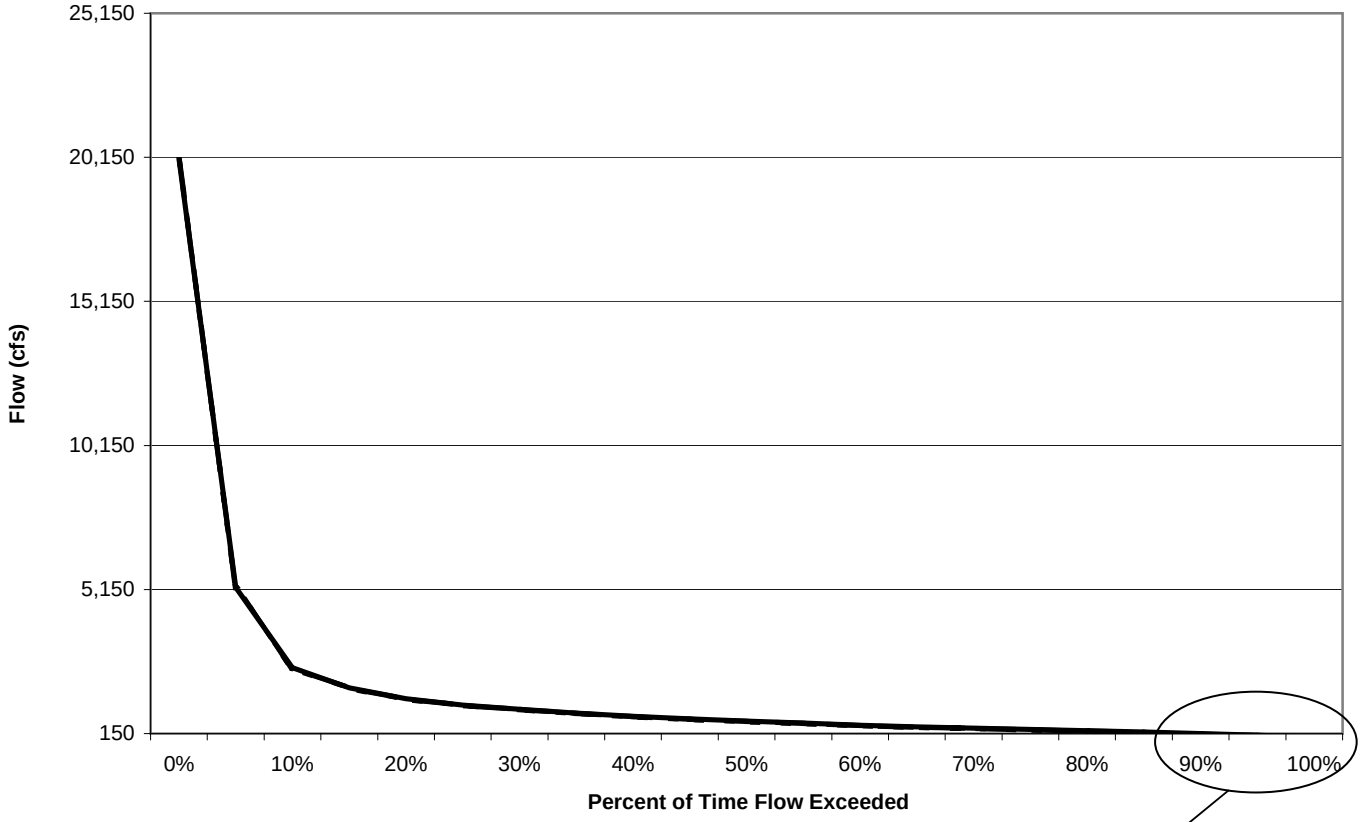


cfs - Cubic feet per second.

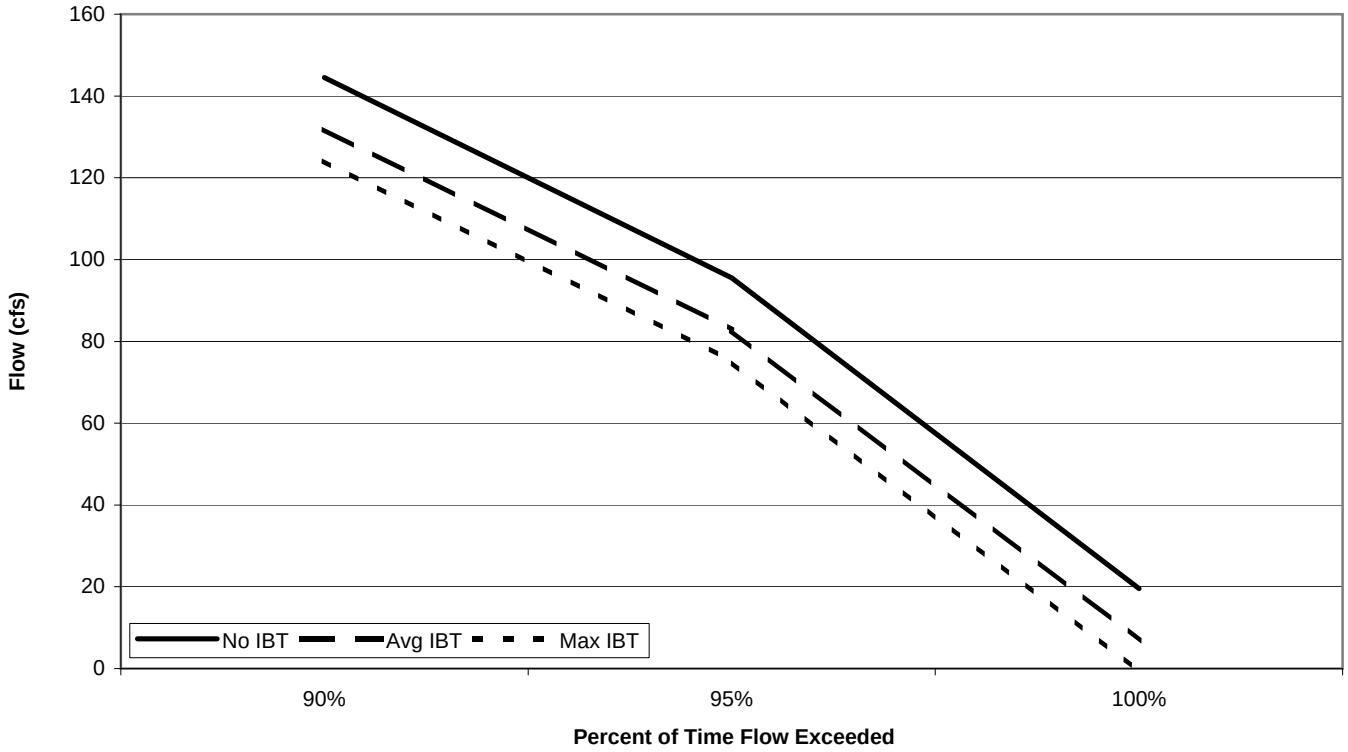
Flow Duration Curves

Greenville Gage Station - Future Scenarios

October



Low-Flow Detail

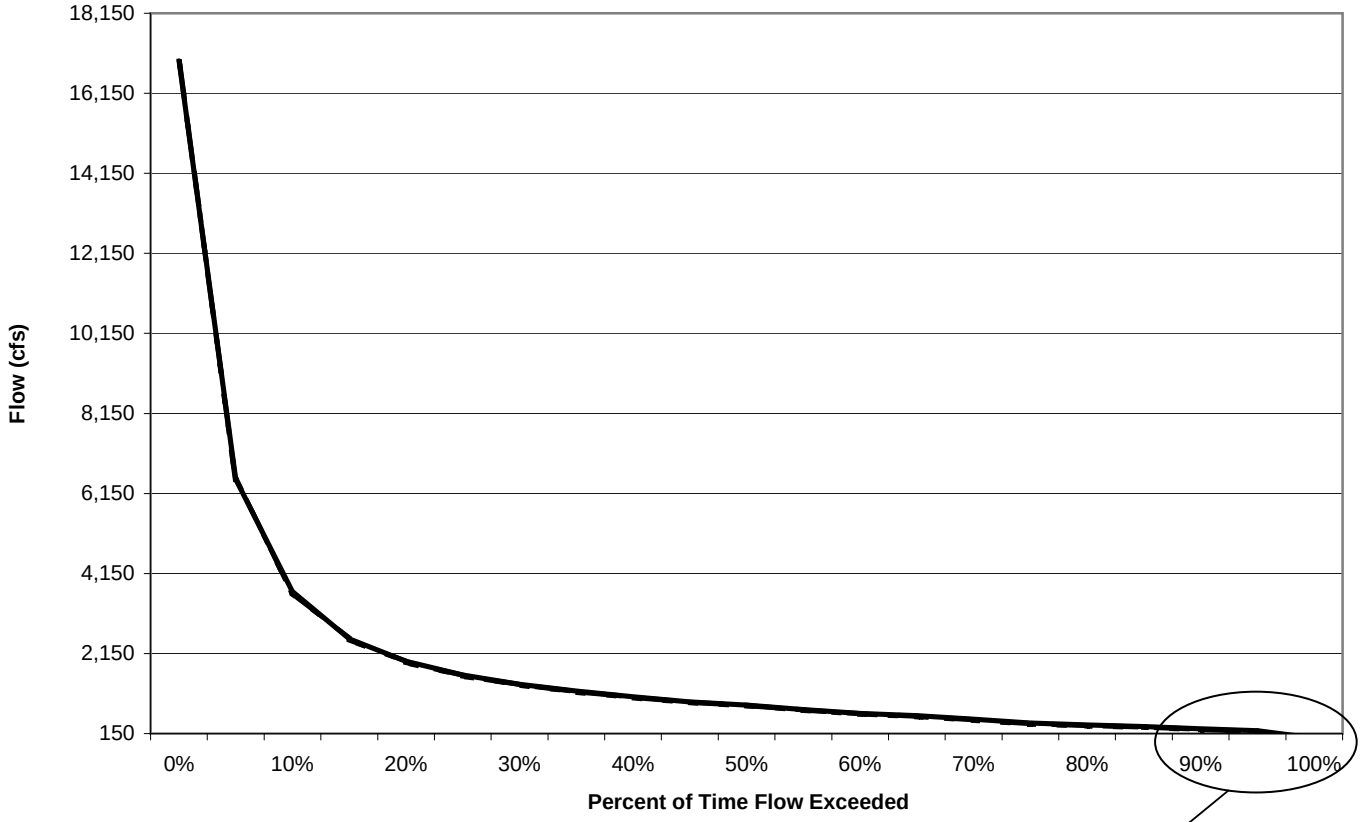


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

November



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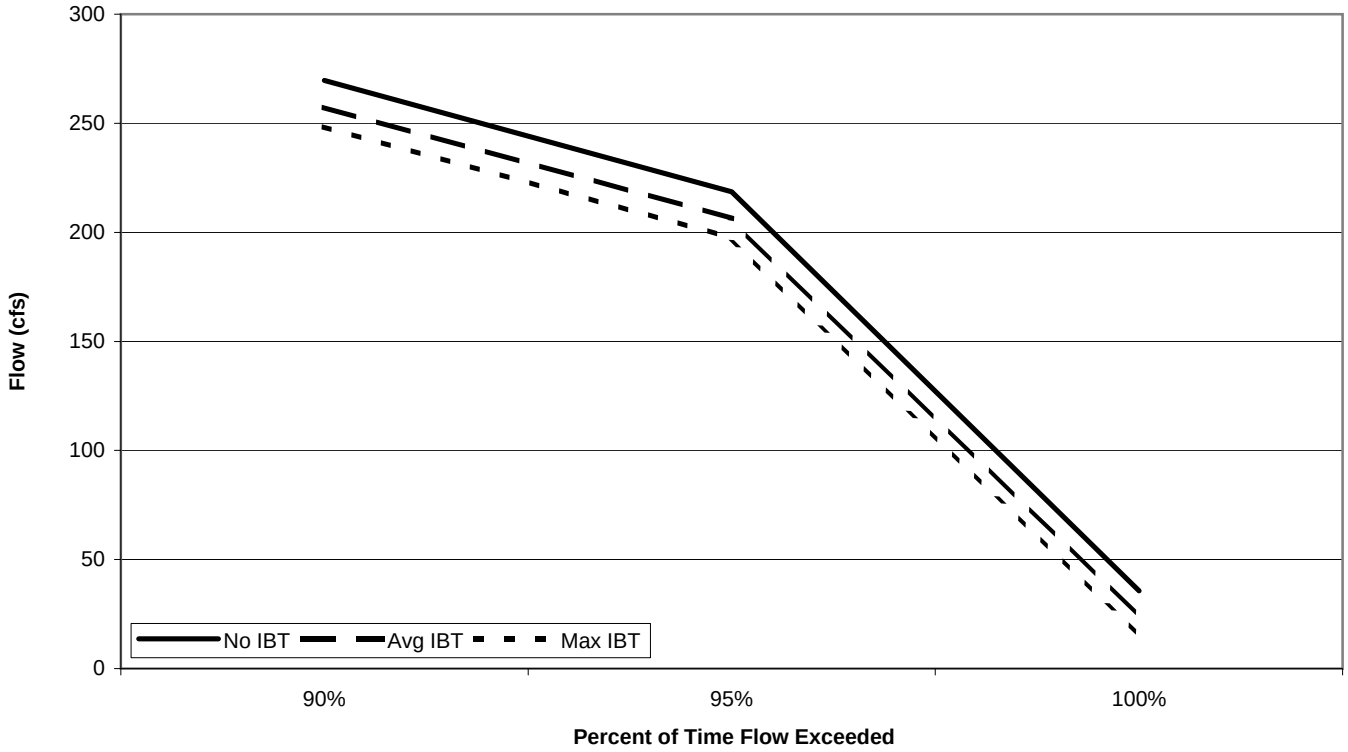
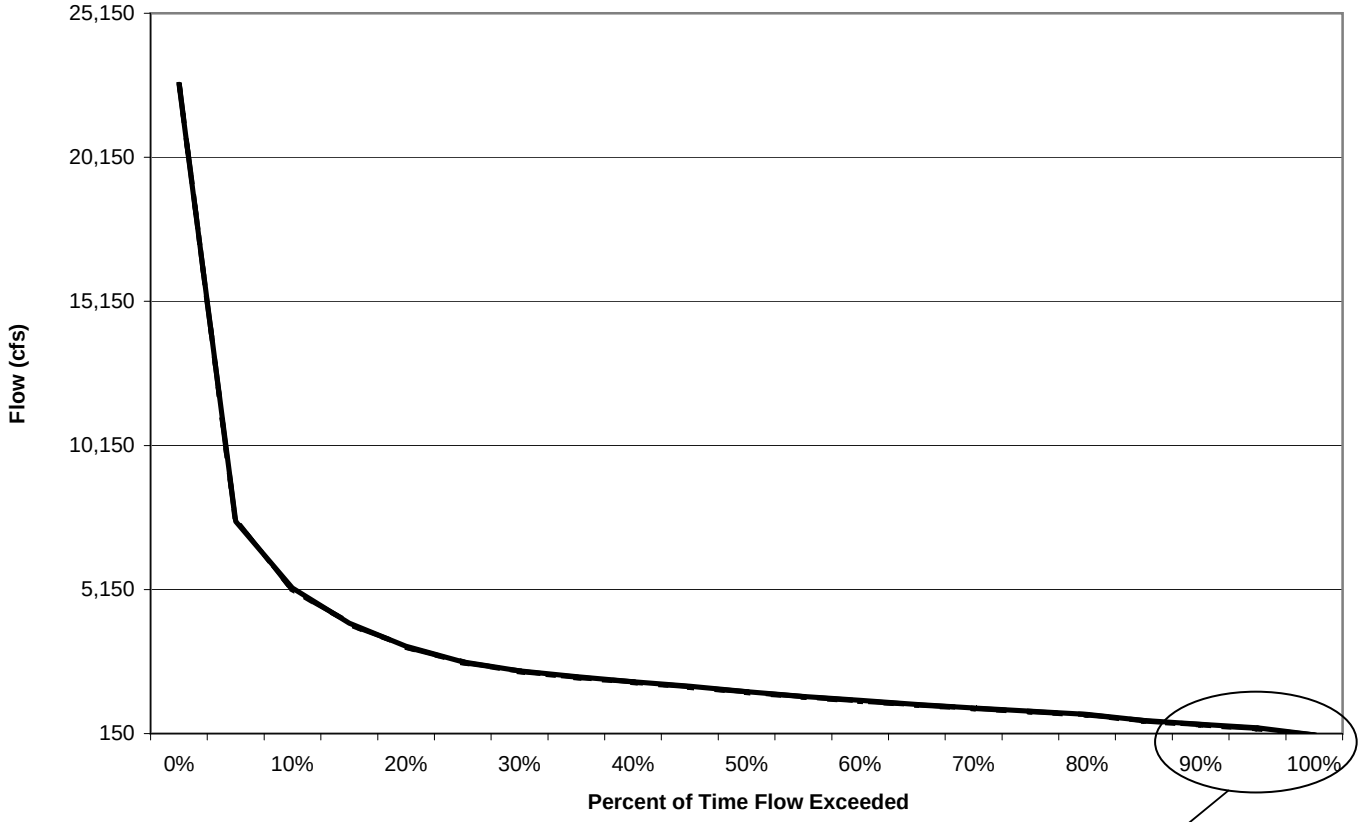


cfs - Cubic feet per second.

Flow Duration Curves

Greenville Gage Station - Future Scenarios

December



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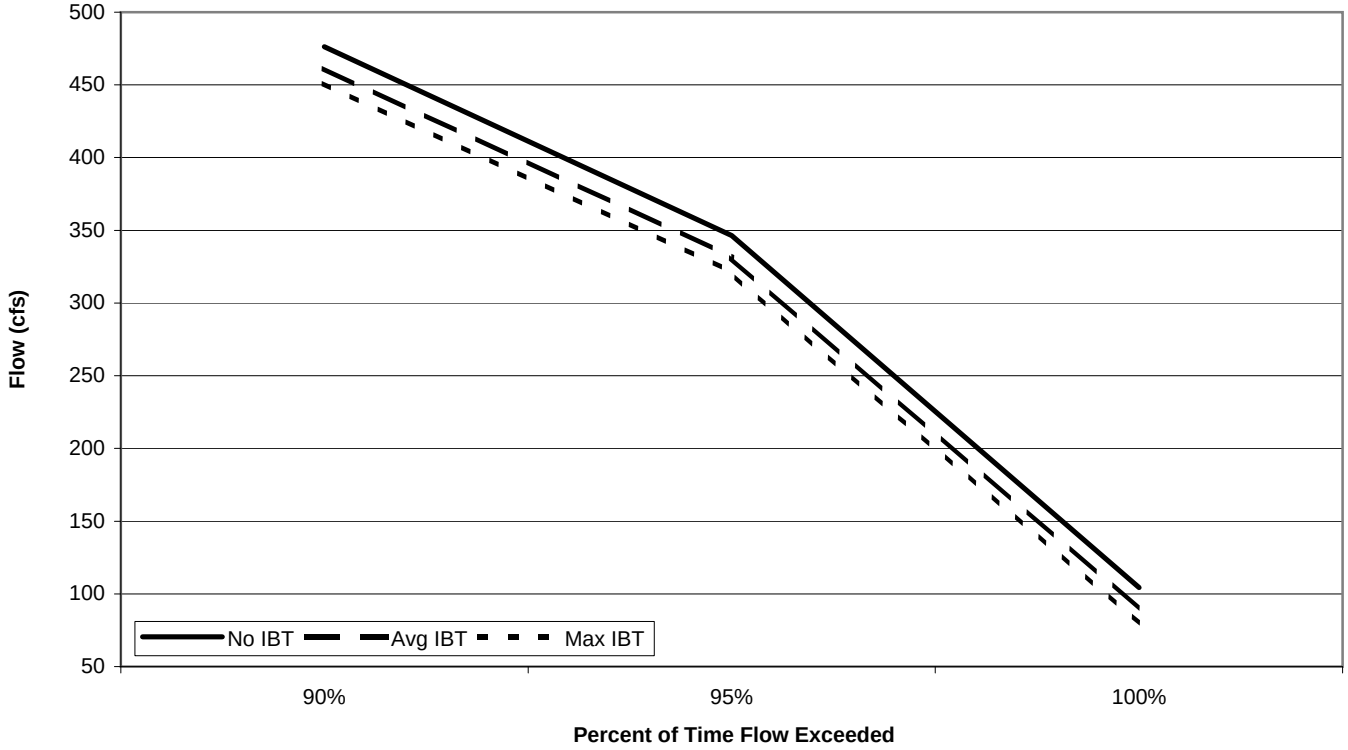
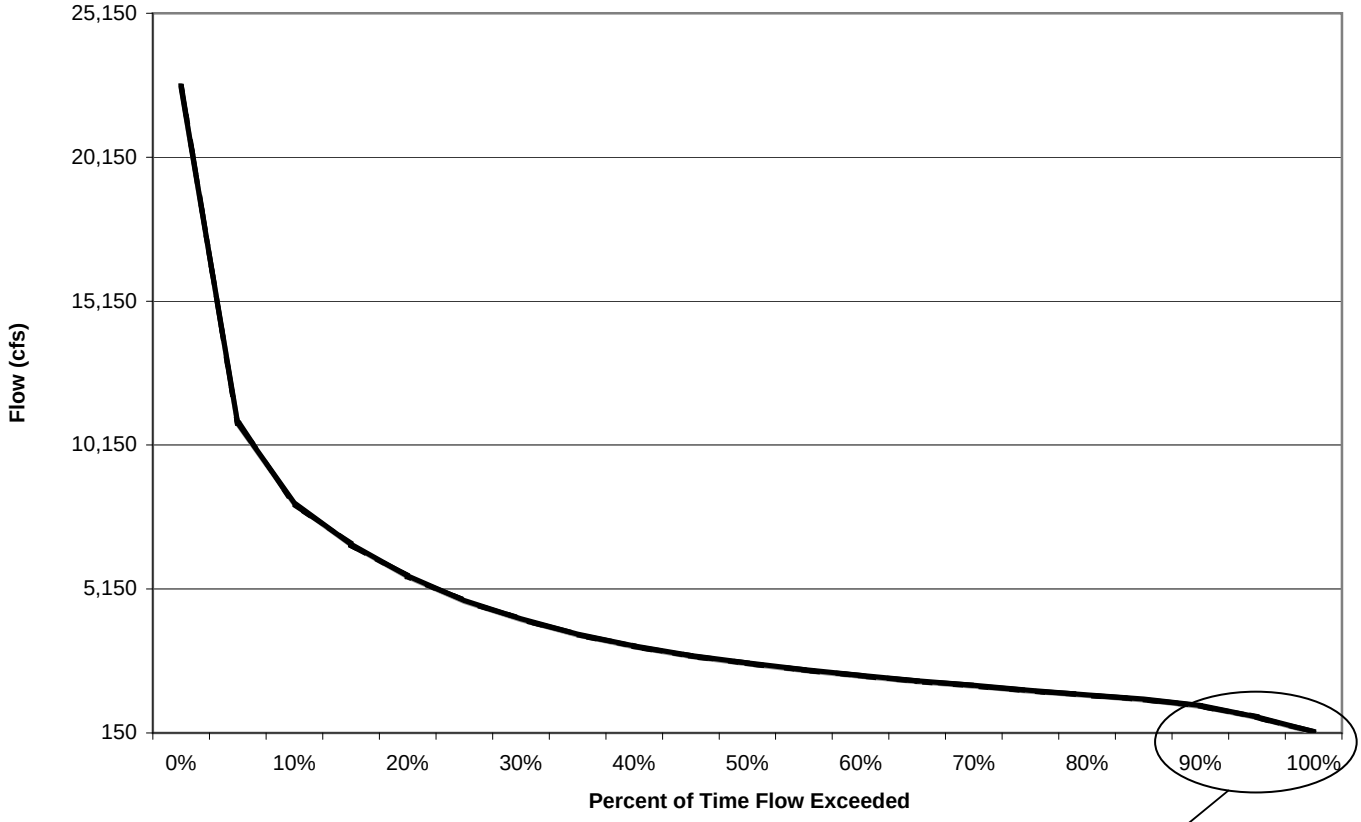


cfs - Cubic feet per second.

Flow Duration Curves

Below Greenville WWTP - Current Scenarios

January



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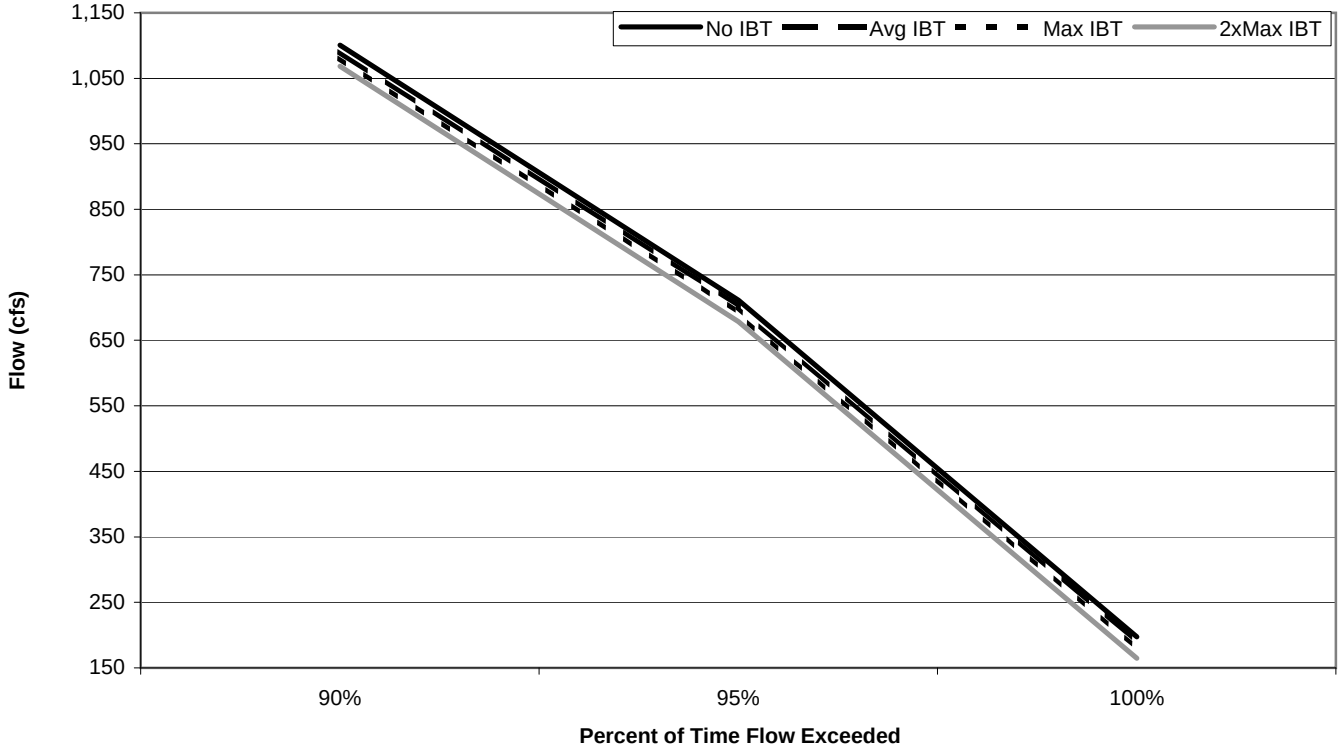


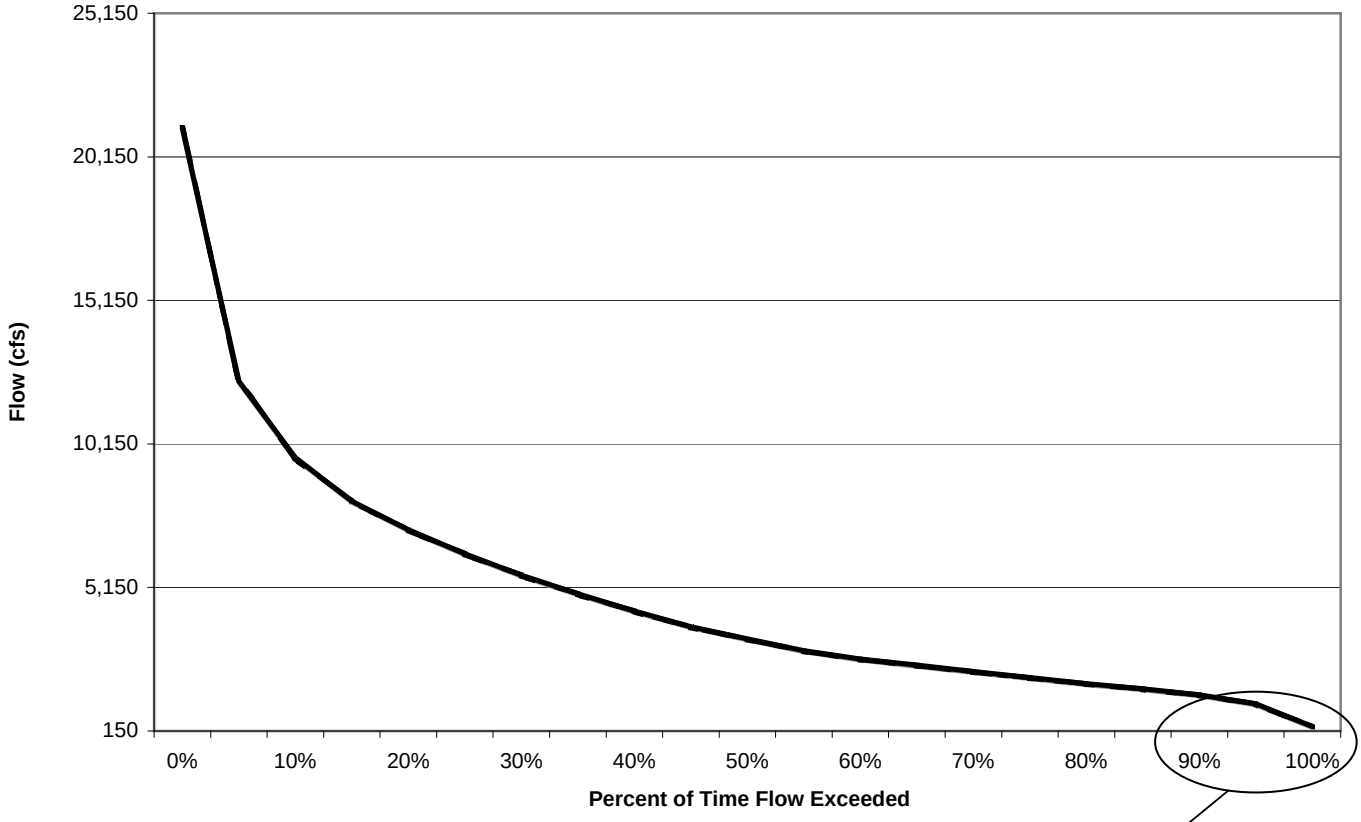
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

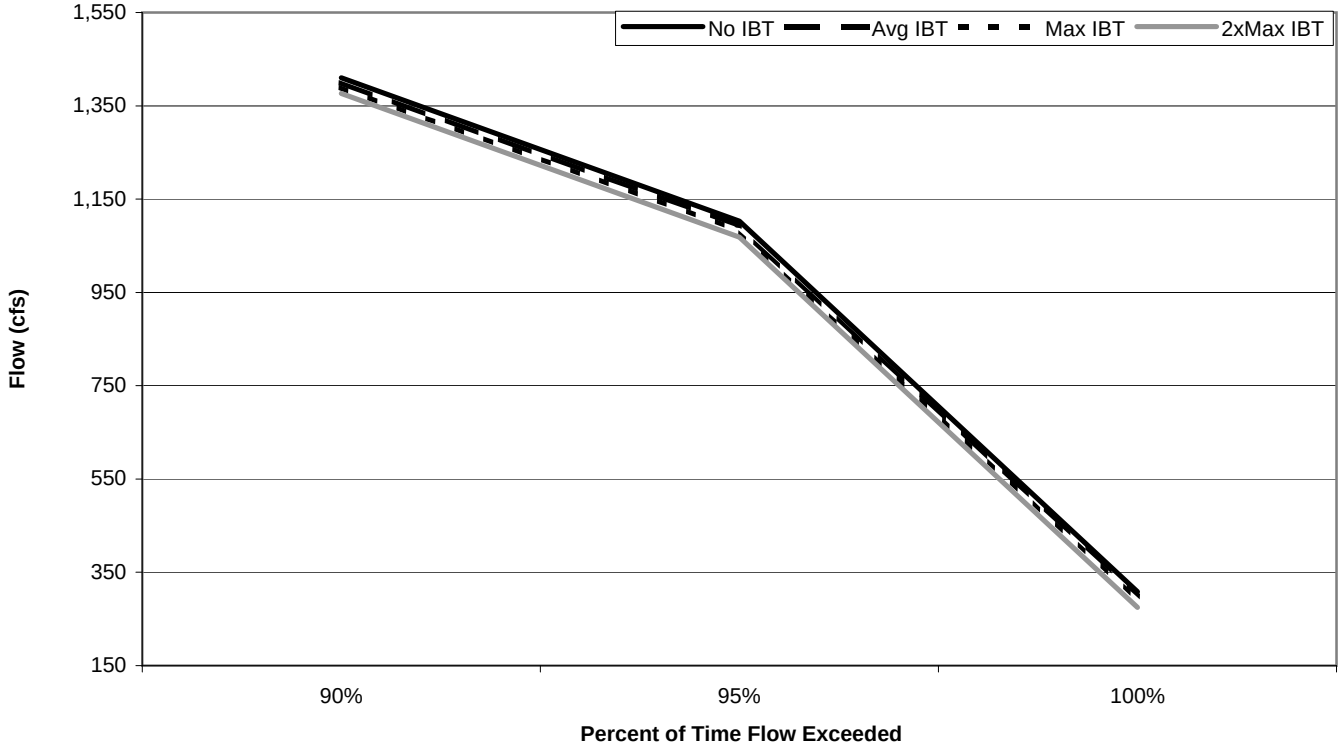
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

February



Low-Flow Detail



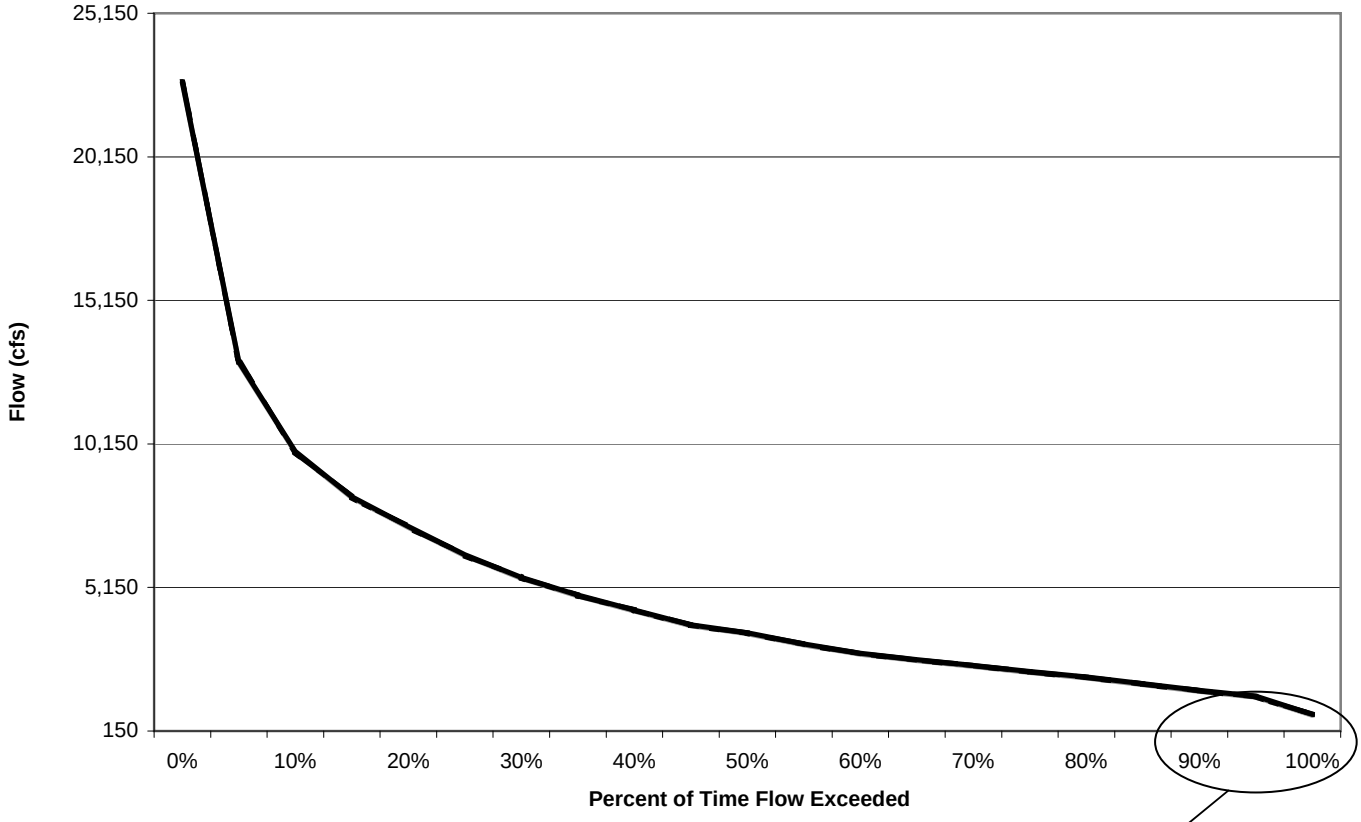
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

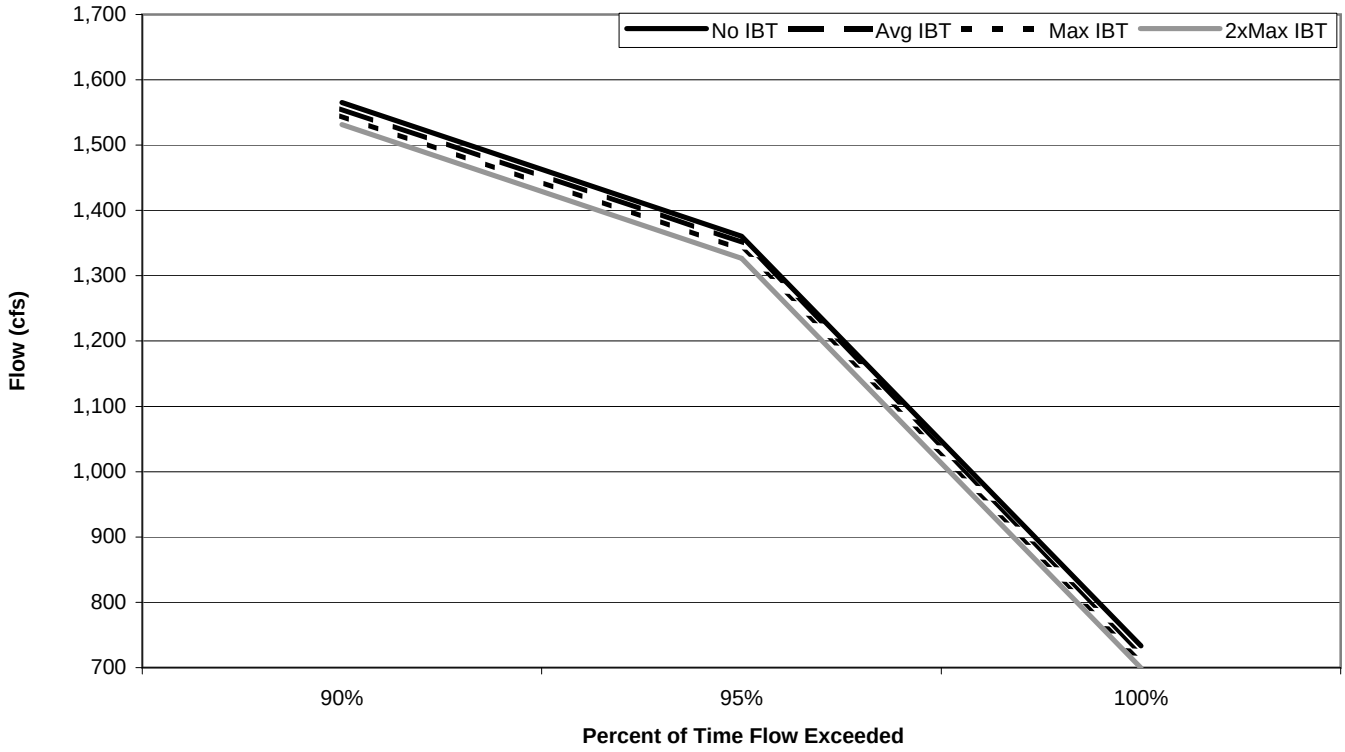
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

March



Low-Flow Detail



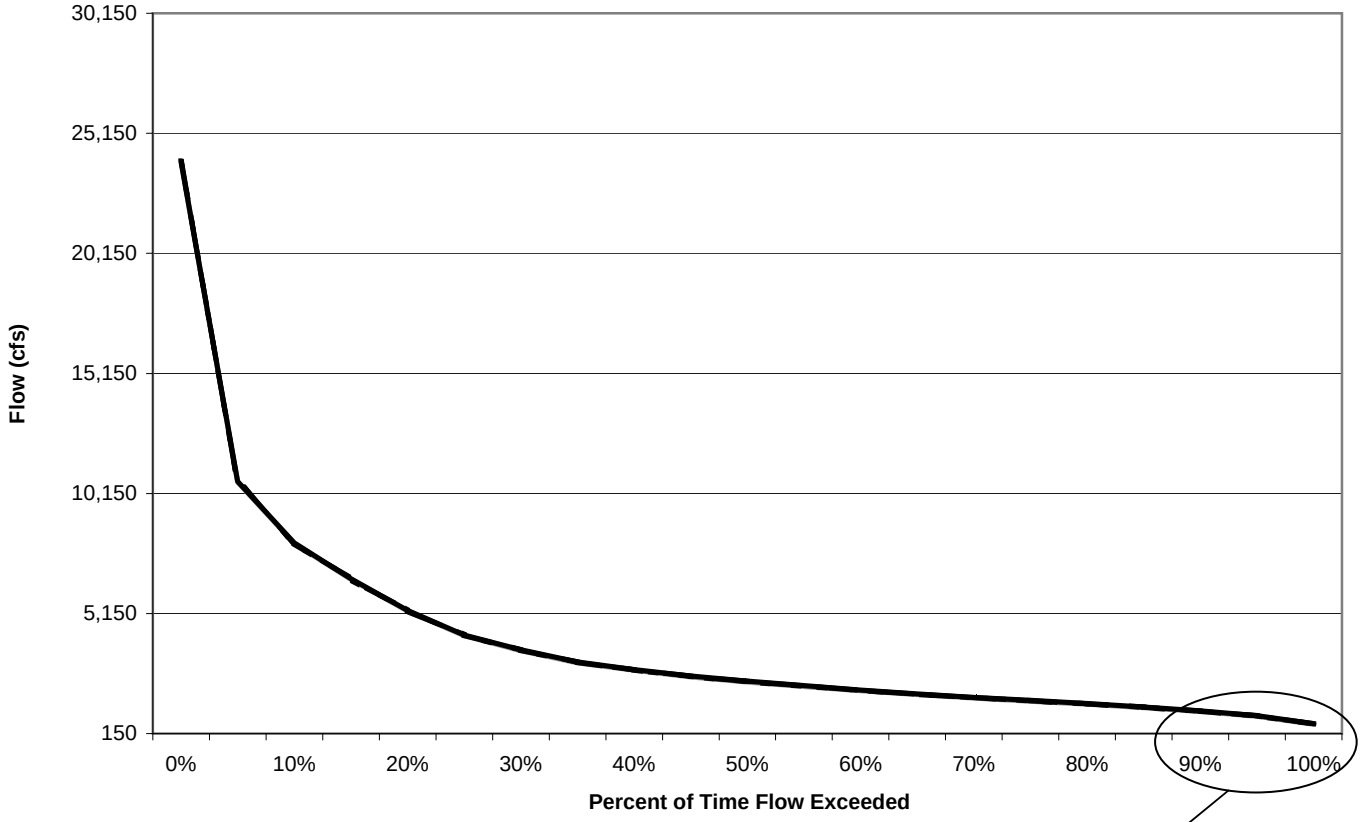
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

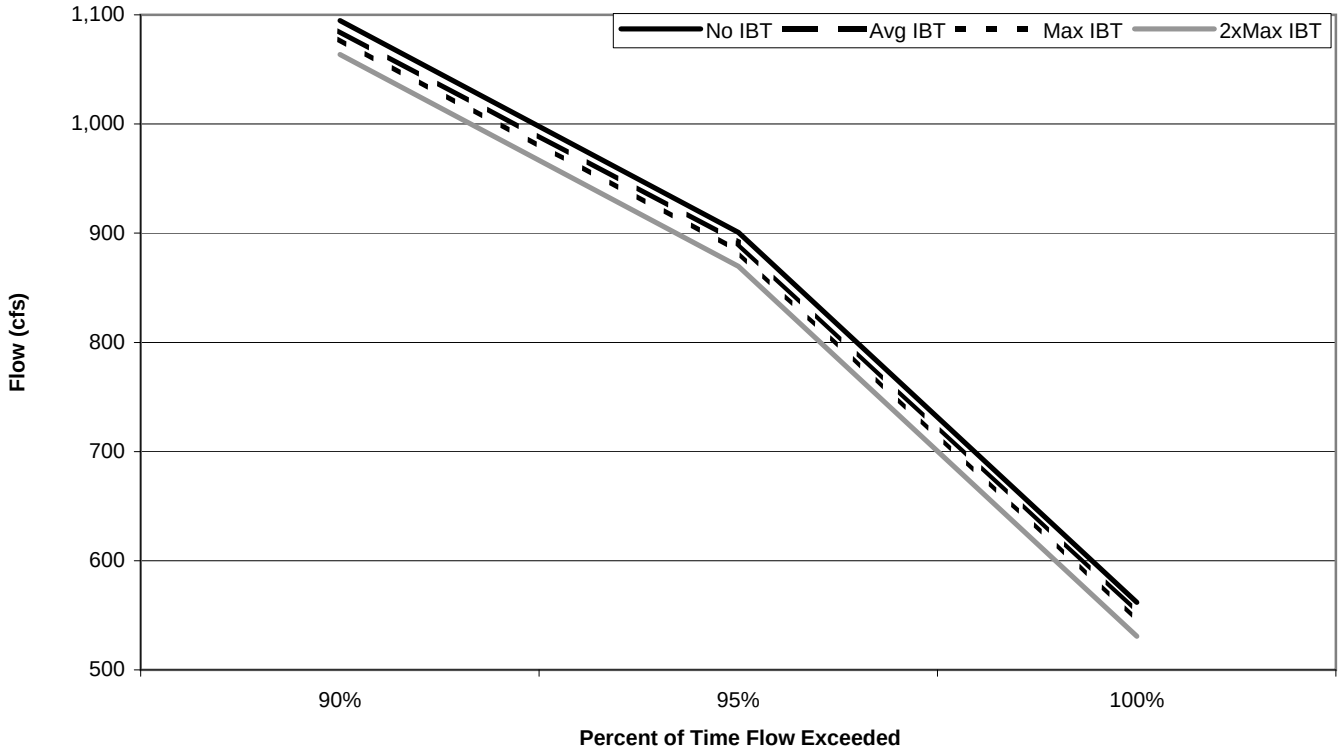
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

April



Low-Flow Detail



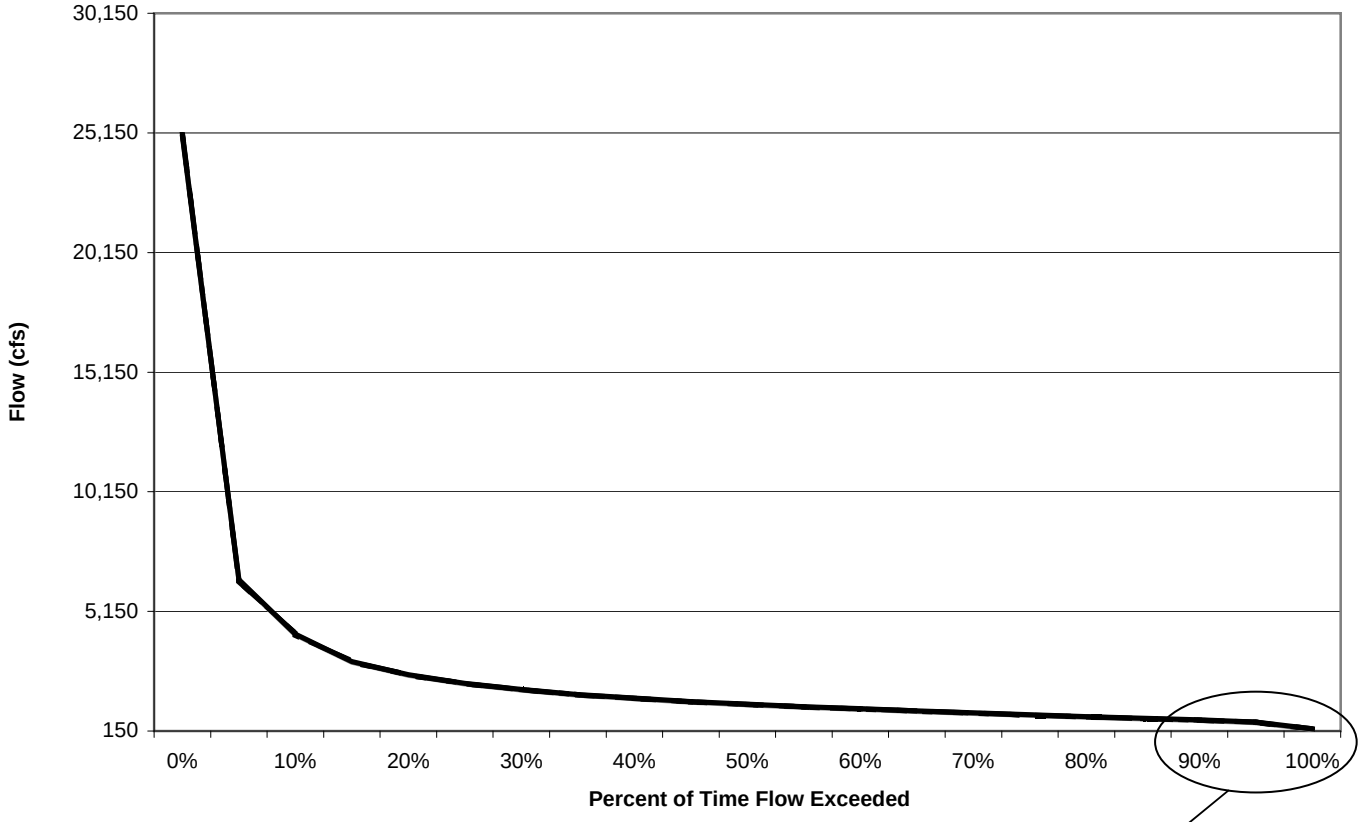
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

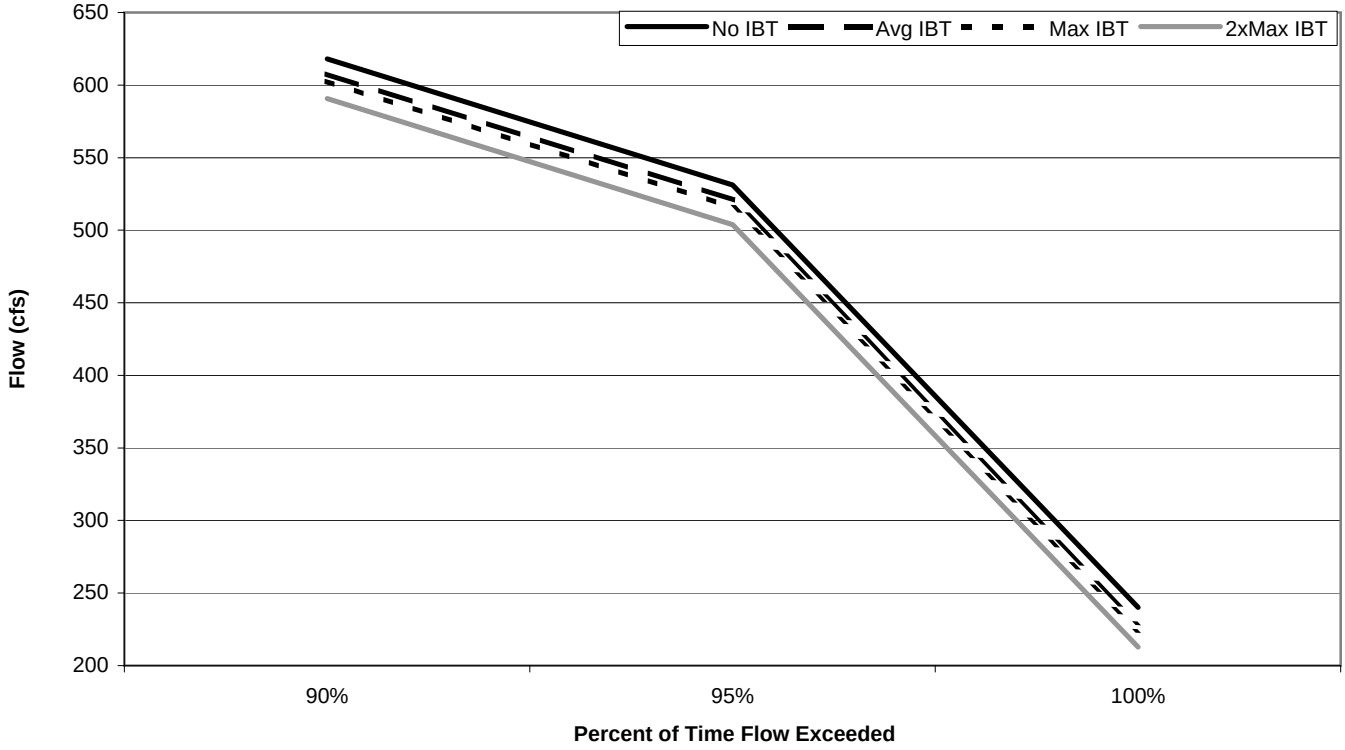
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

May



Low-Flow Detail



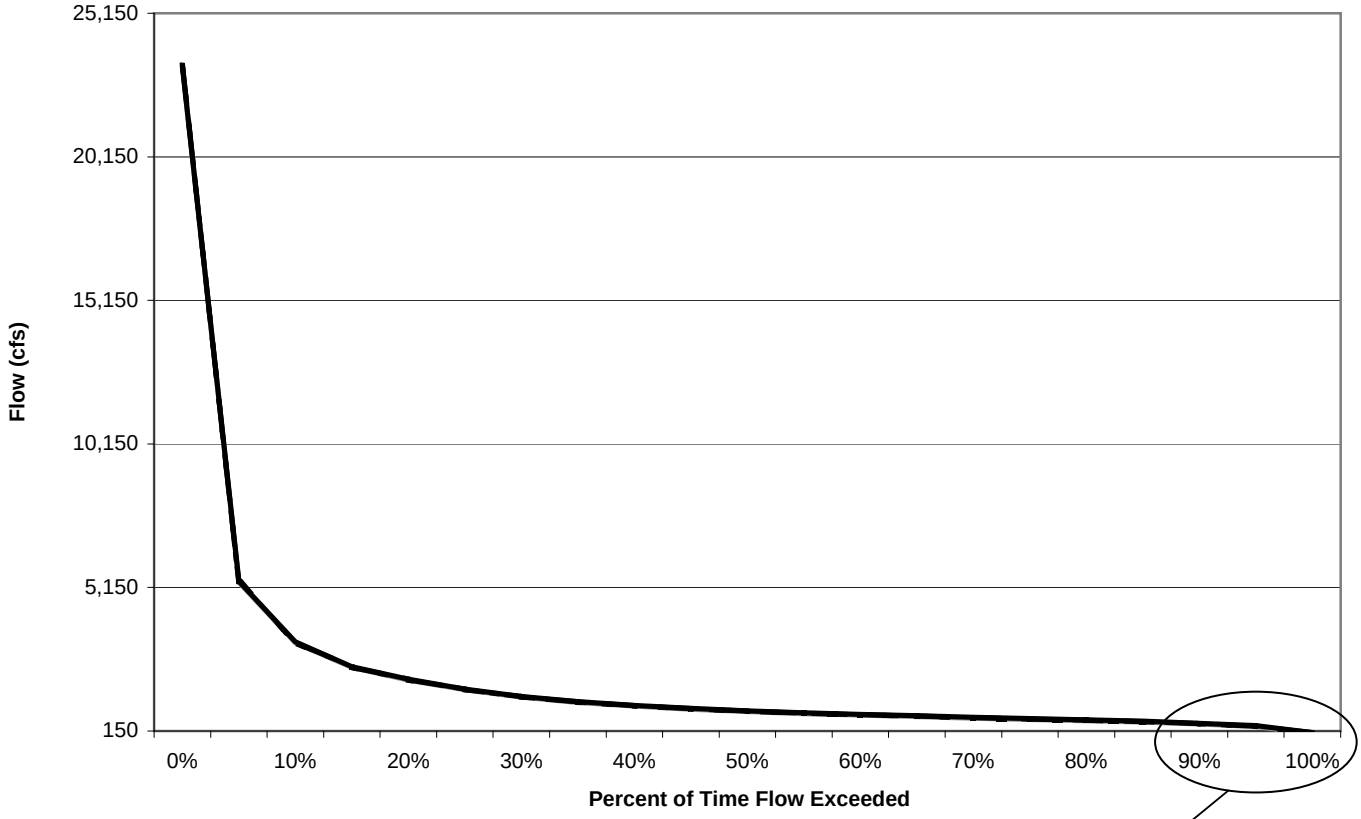
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

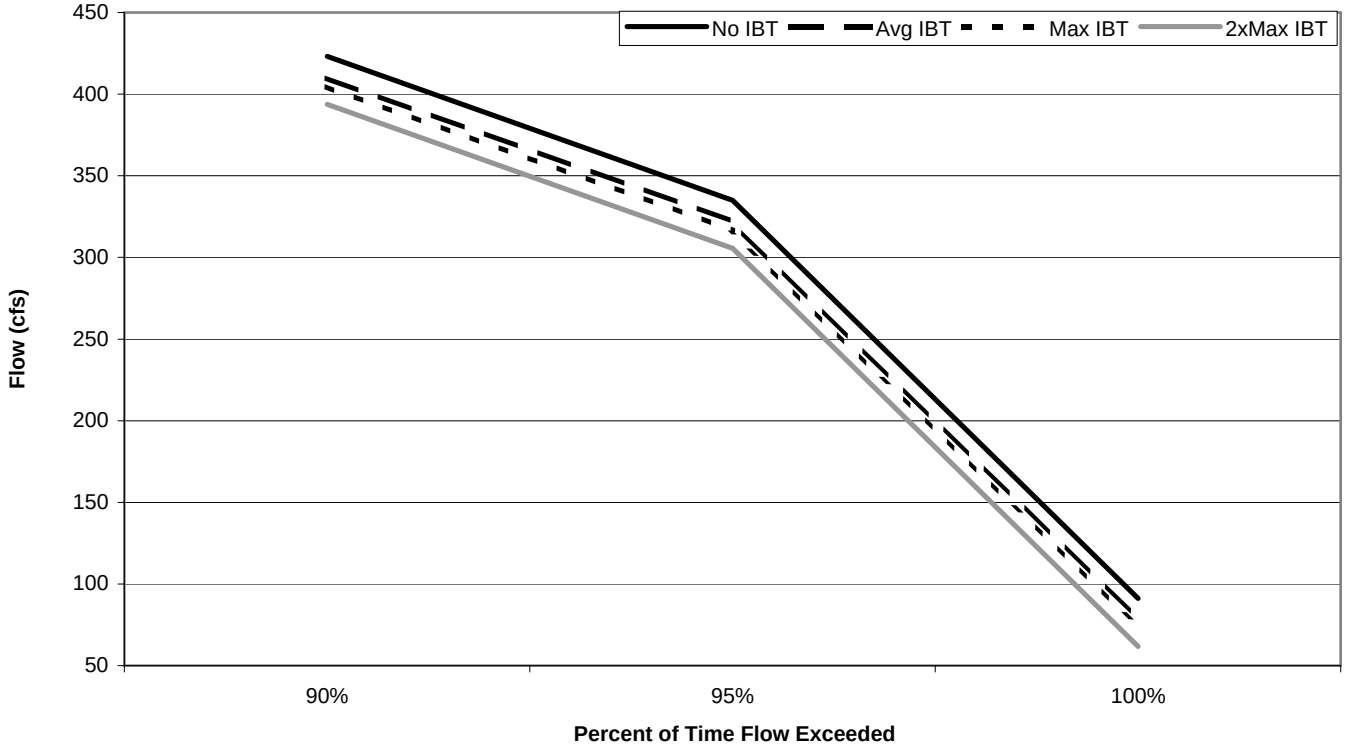
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

June



Low-Flow Detail



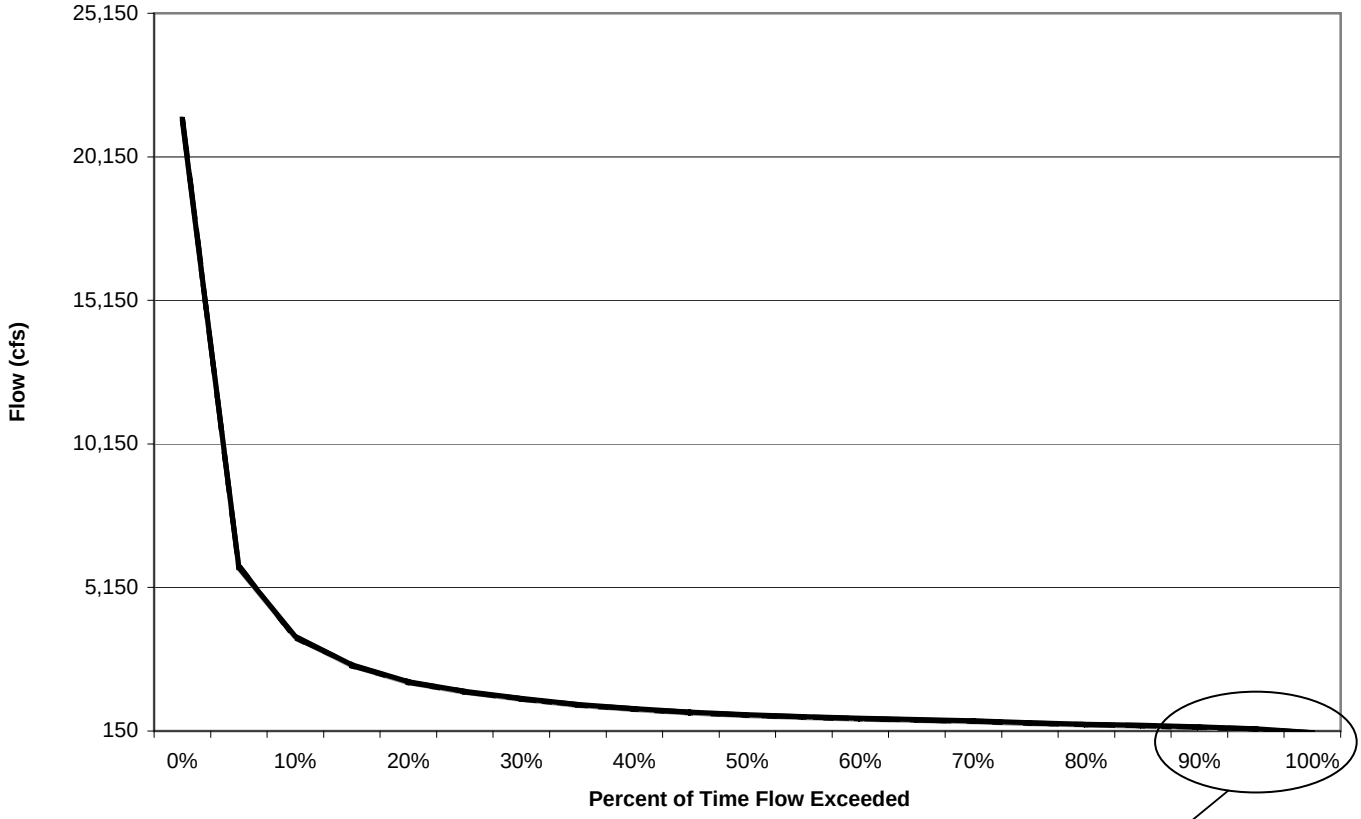
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

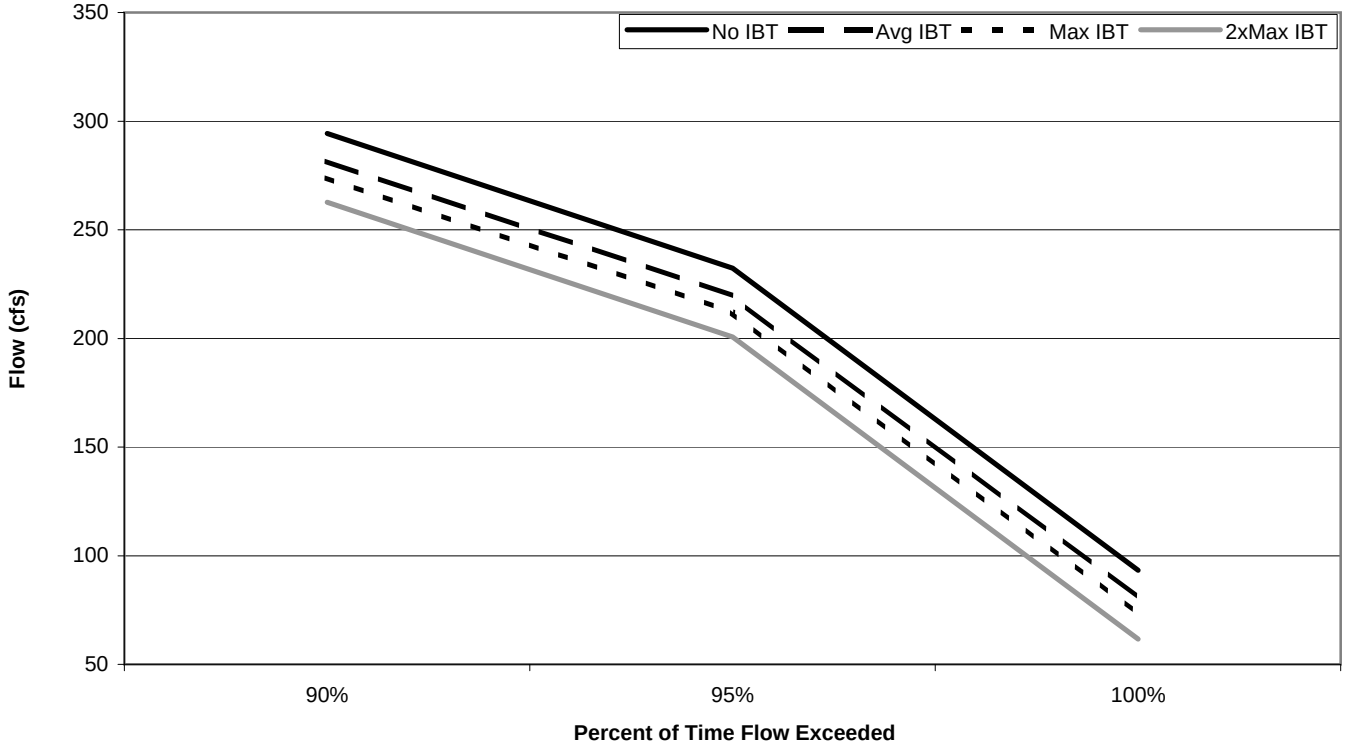
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

July



Low-Flow Detail



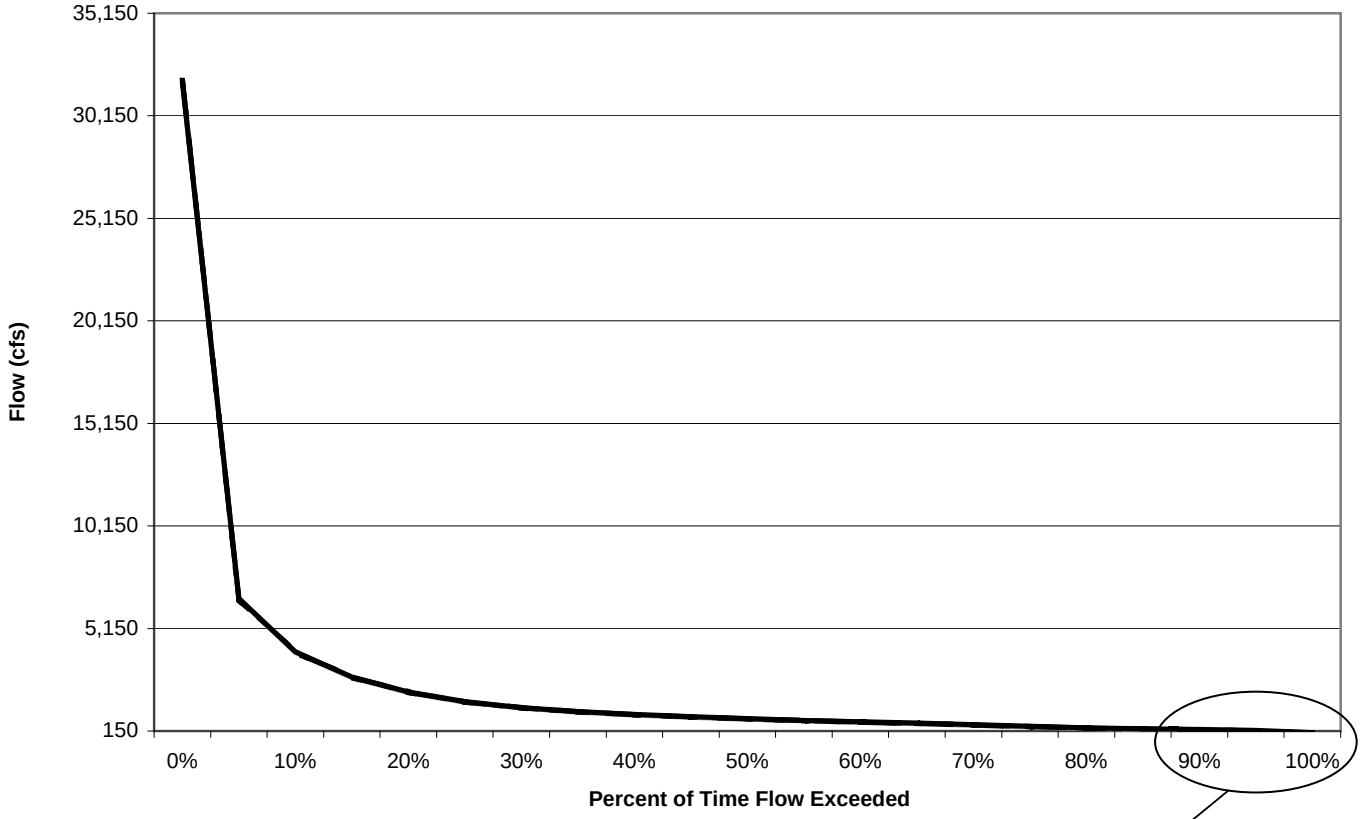
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

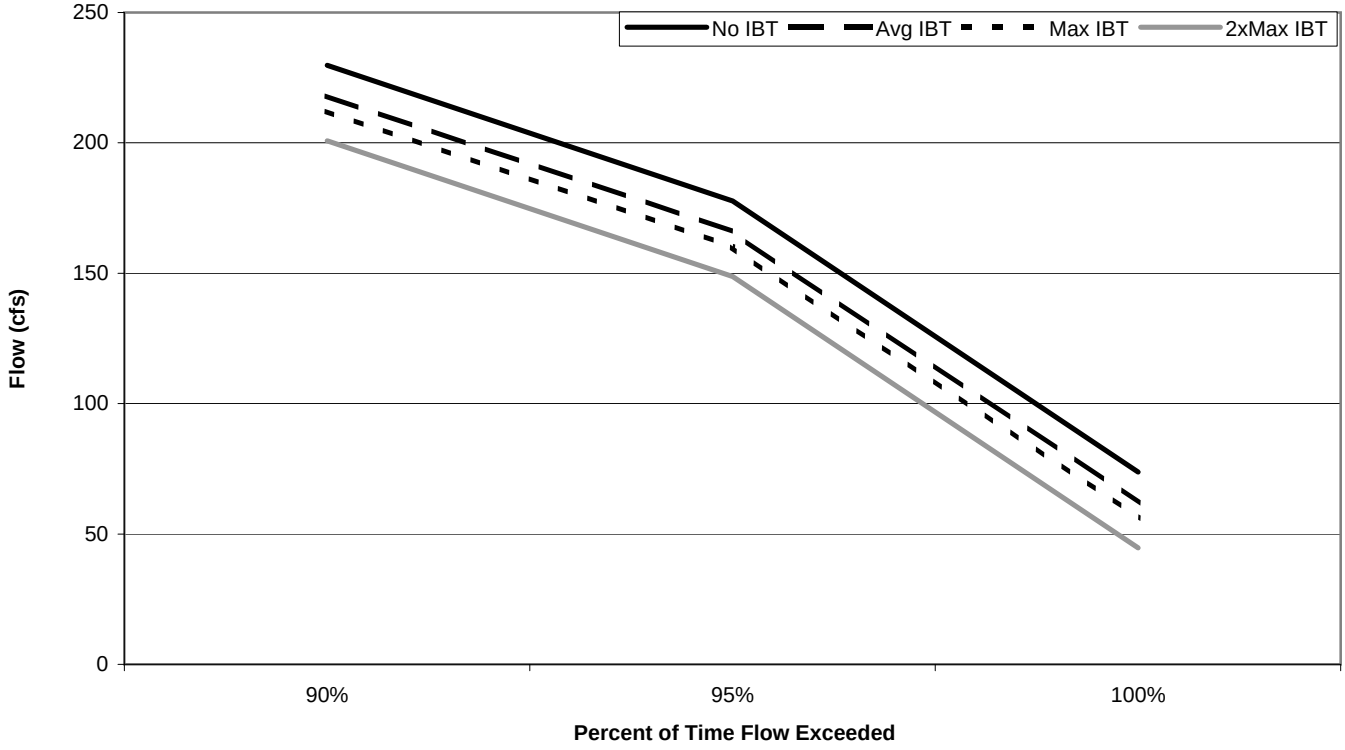
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

August



Low-Flow Detail



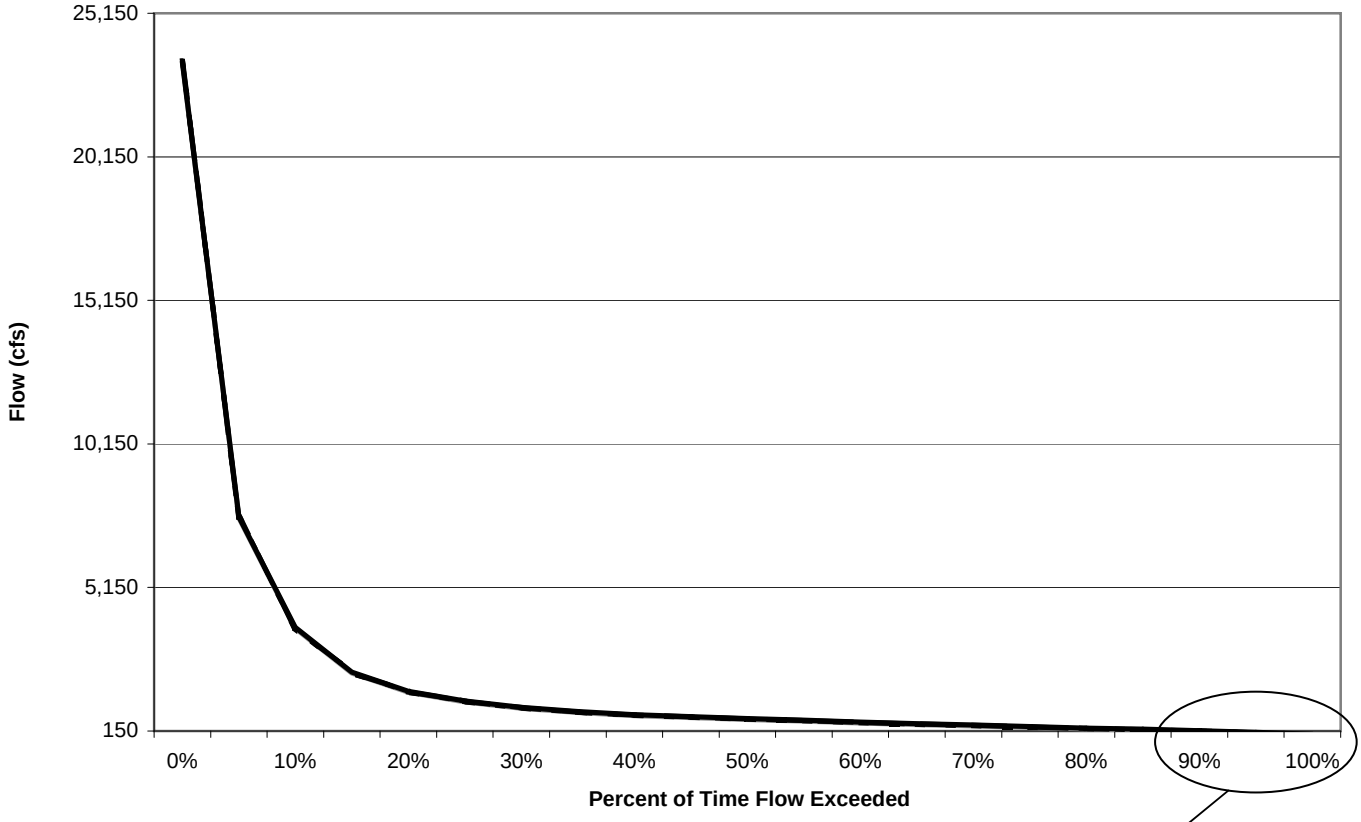
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

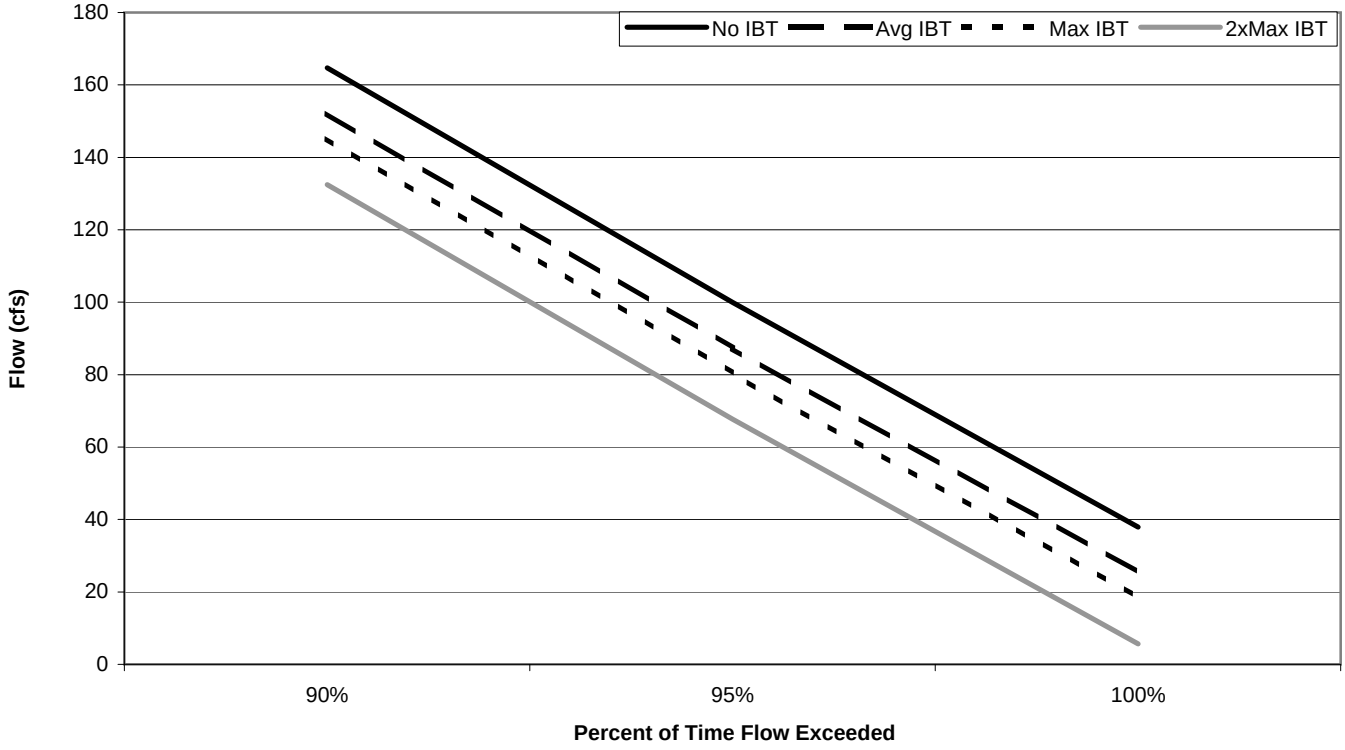
Flow Duration Curves

Below Greenville WWTP - Current Scenarios

September



Low-Flow Detail



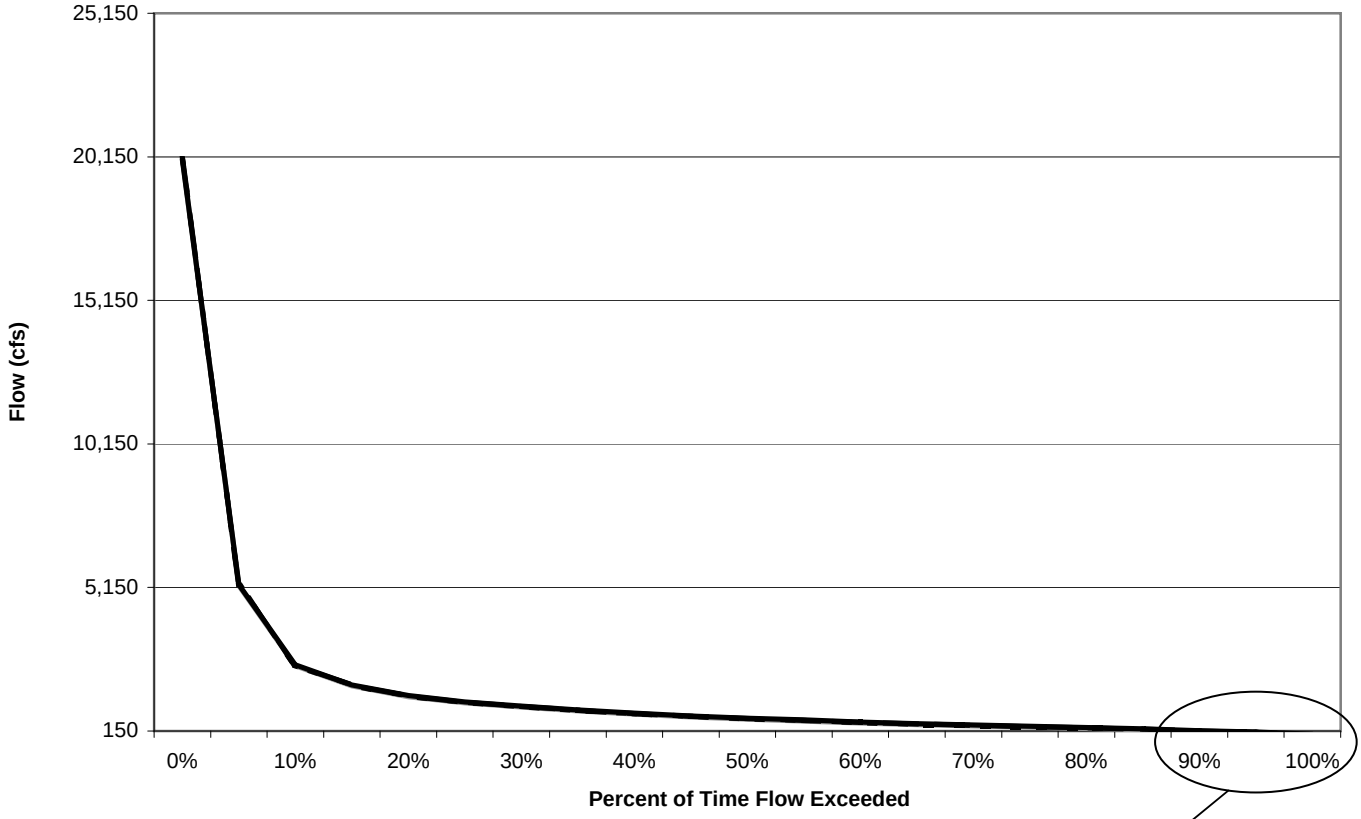
cfs - Cubic feet per second.

WWTP - Wastewater treatment plant.

Flow Duration Curves

Below Greenville WWTP - Current Scenarios

October



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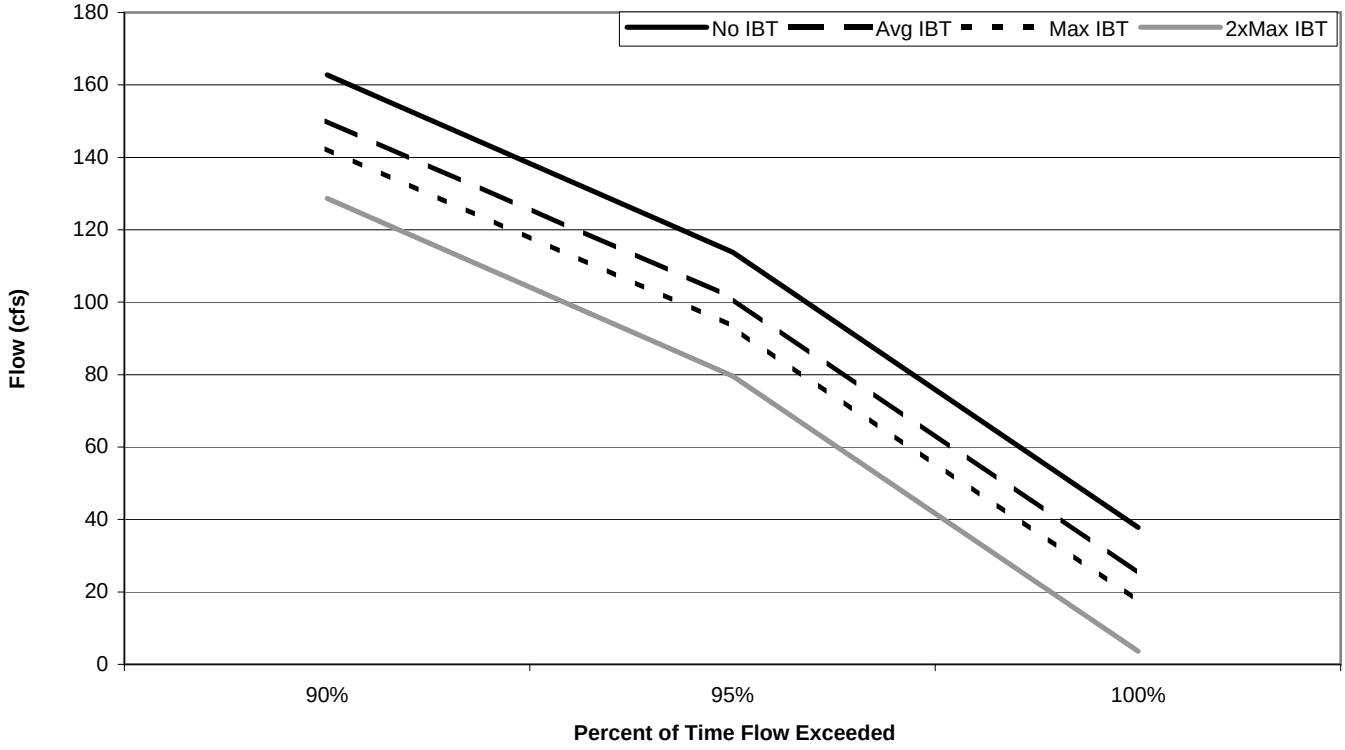

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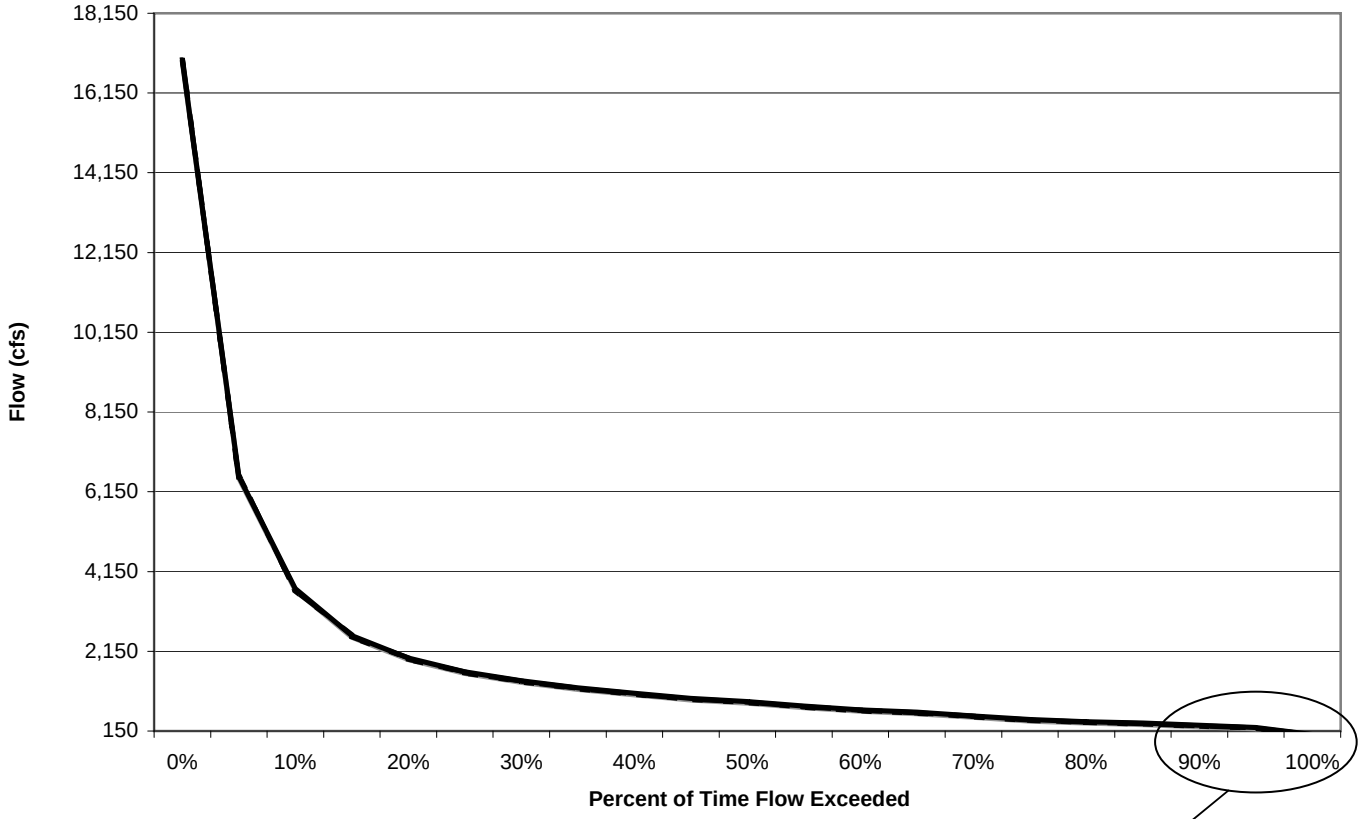
Below Greenville WWTP - Current Scenarios

November



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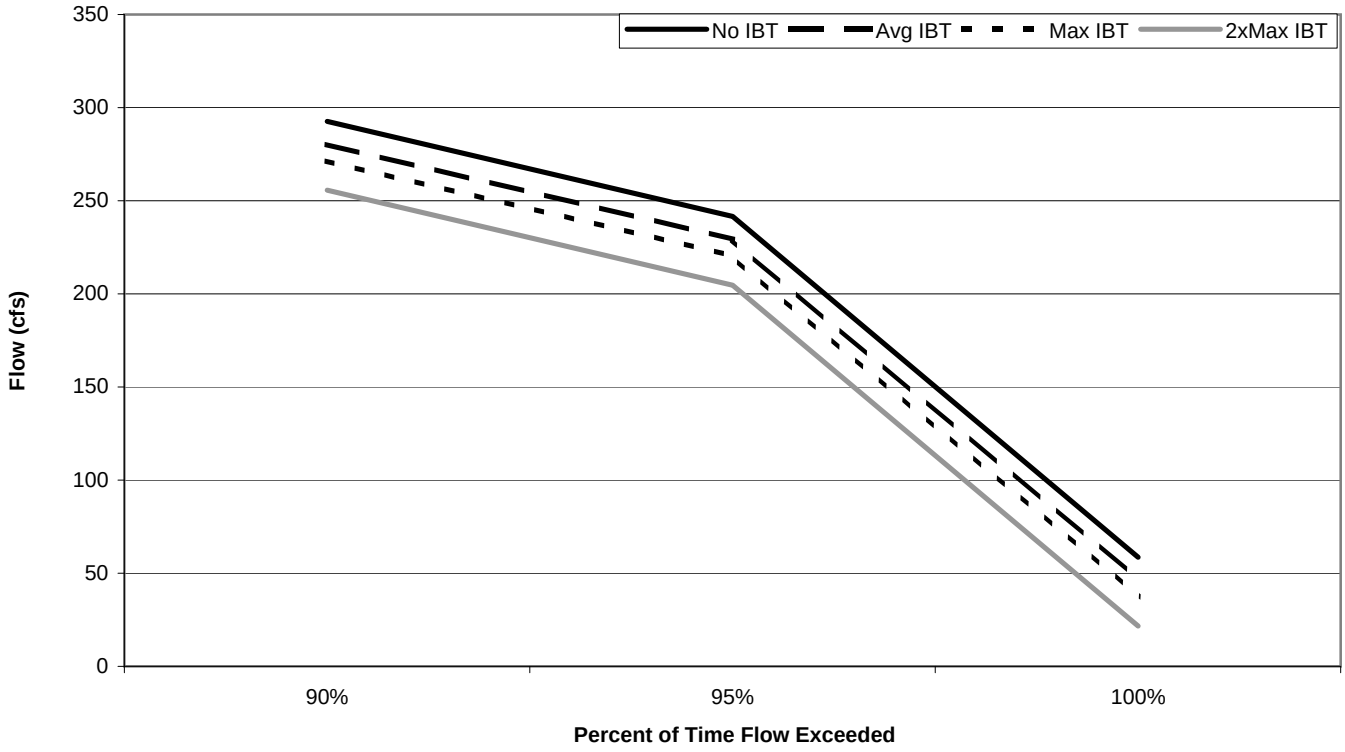

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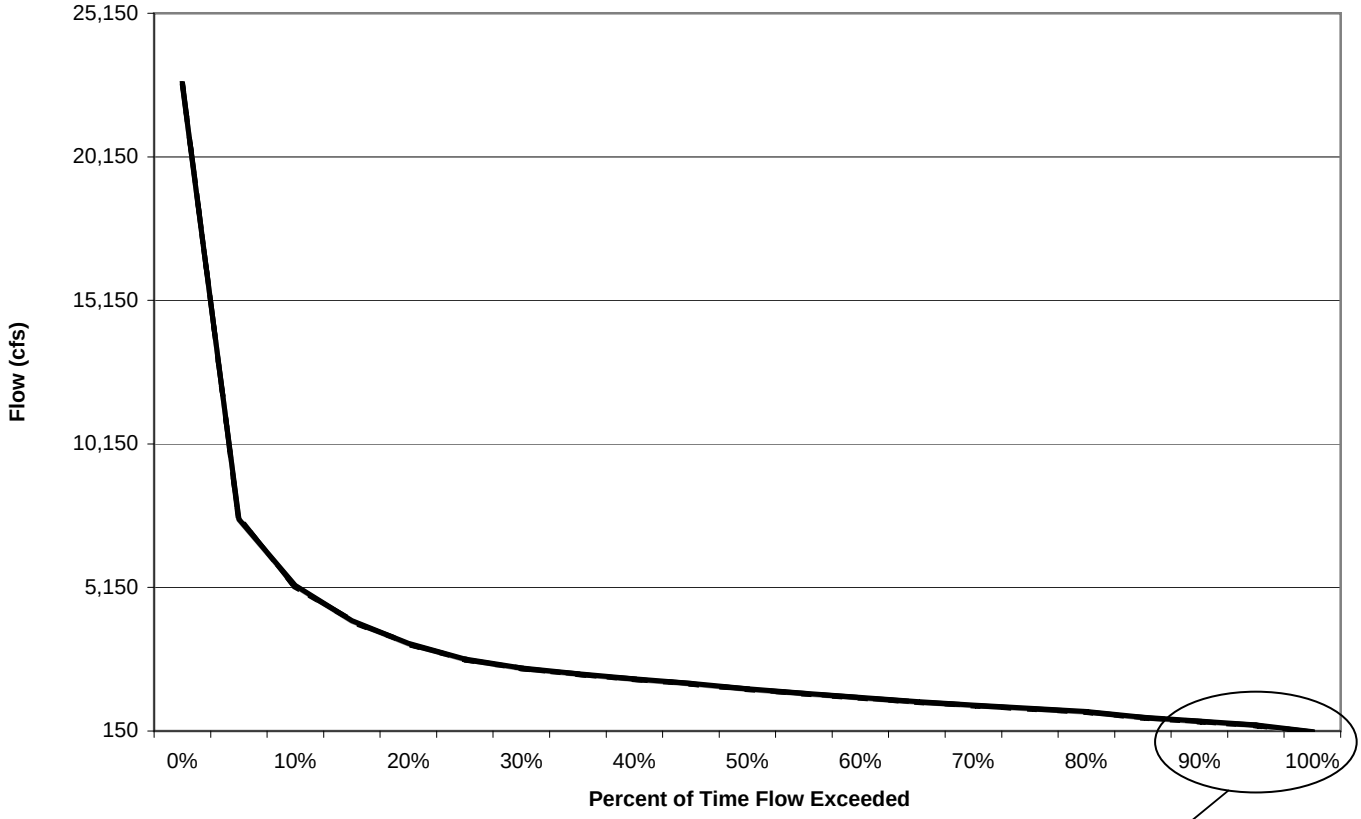
December



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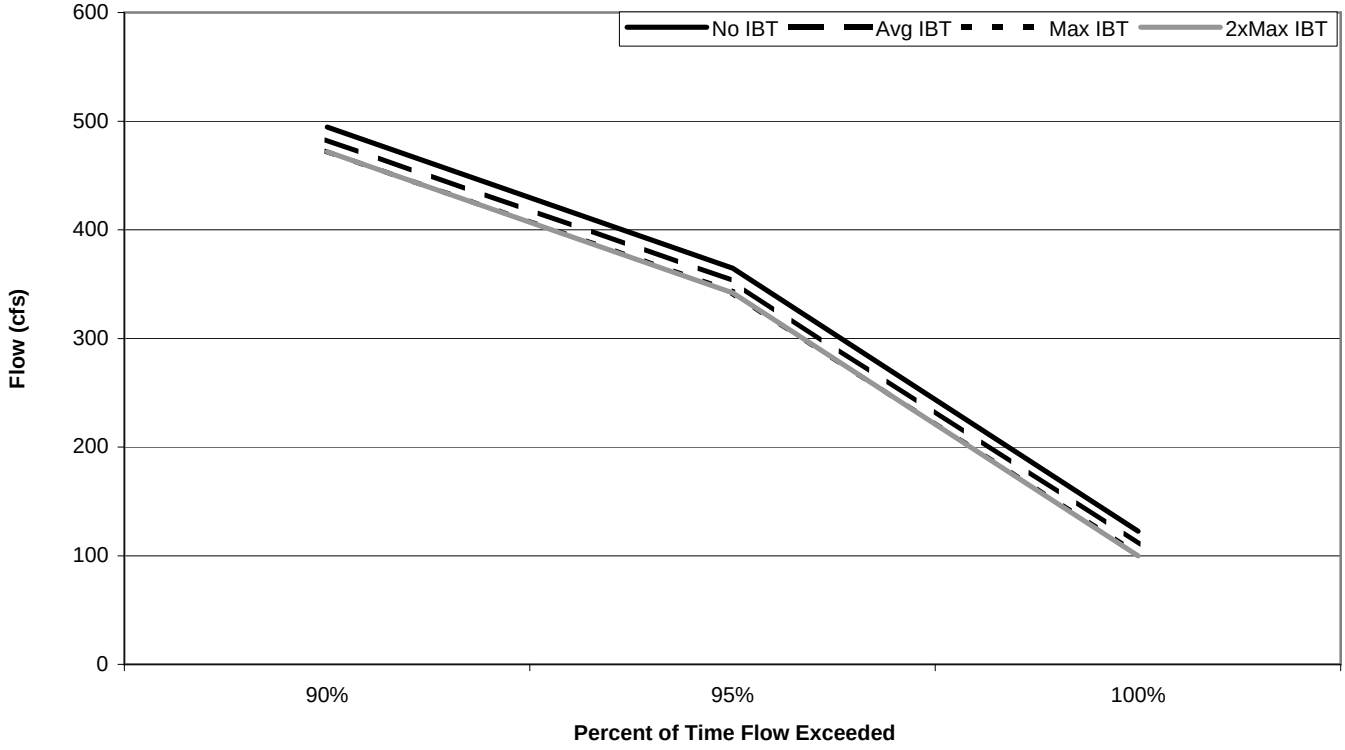

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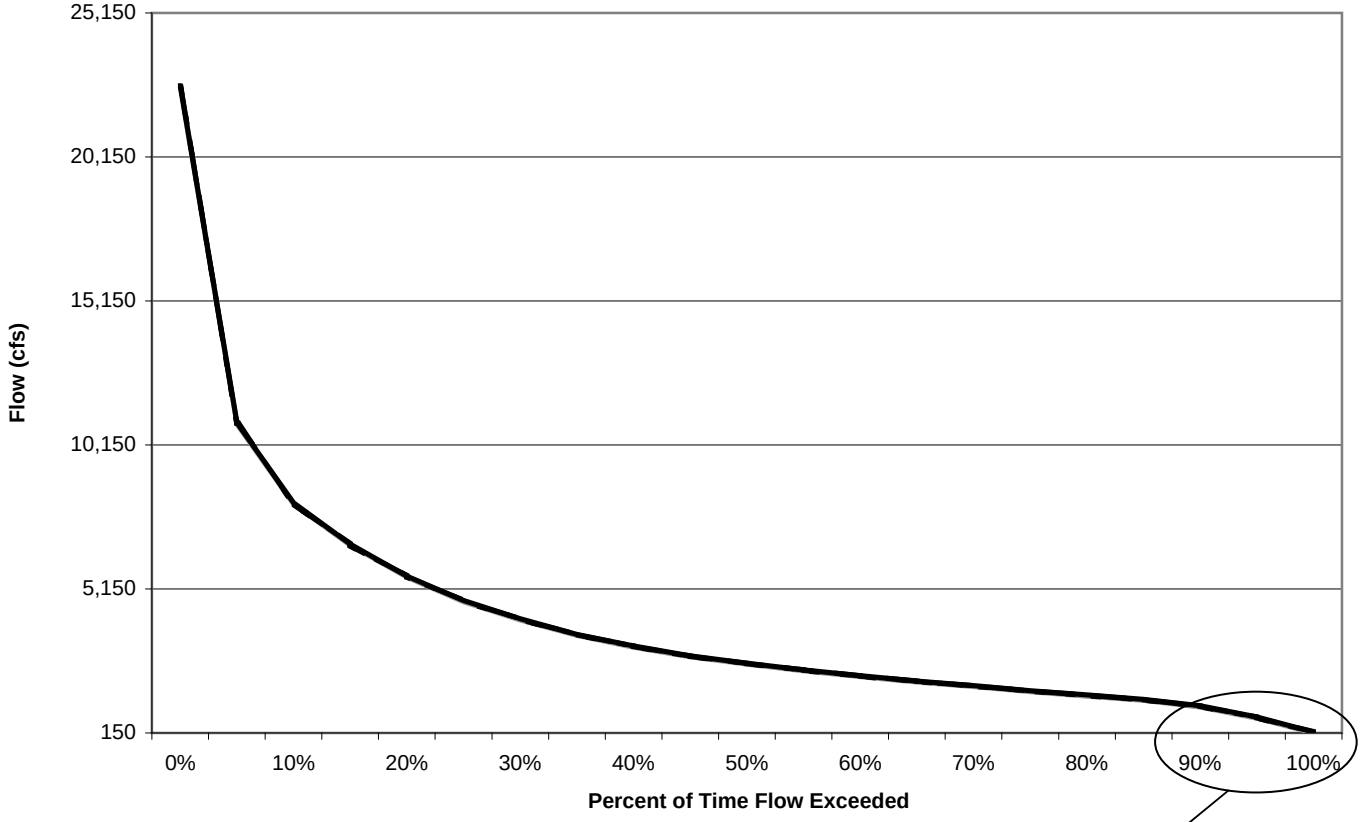
Flow Duration Curves

Below Greenville WWTP - Future Scenarios

January



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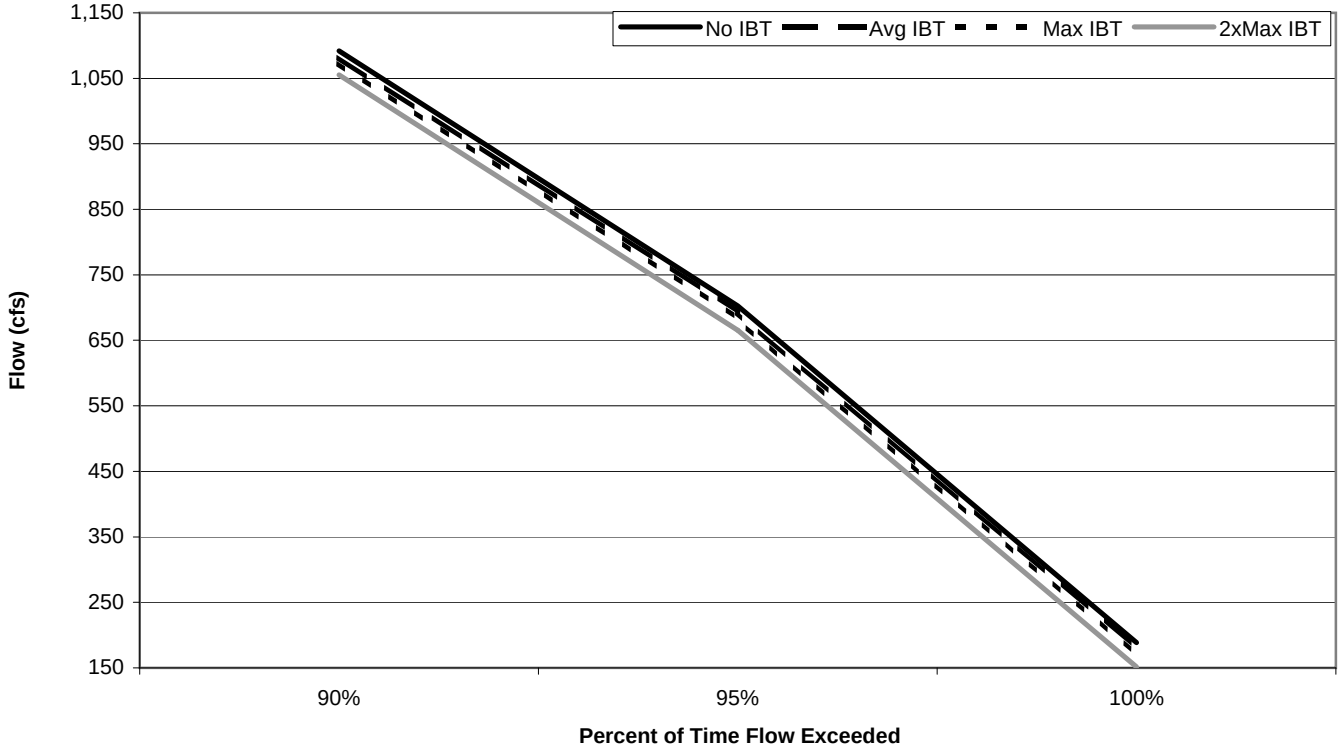

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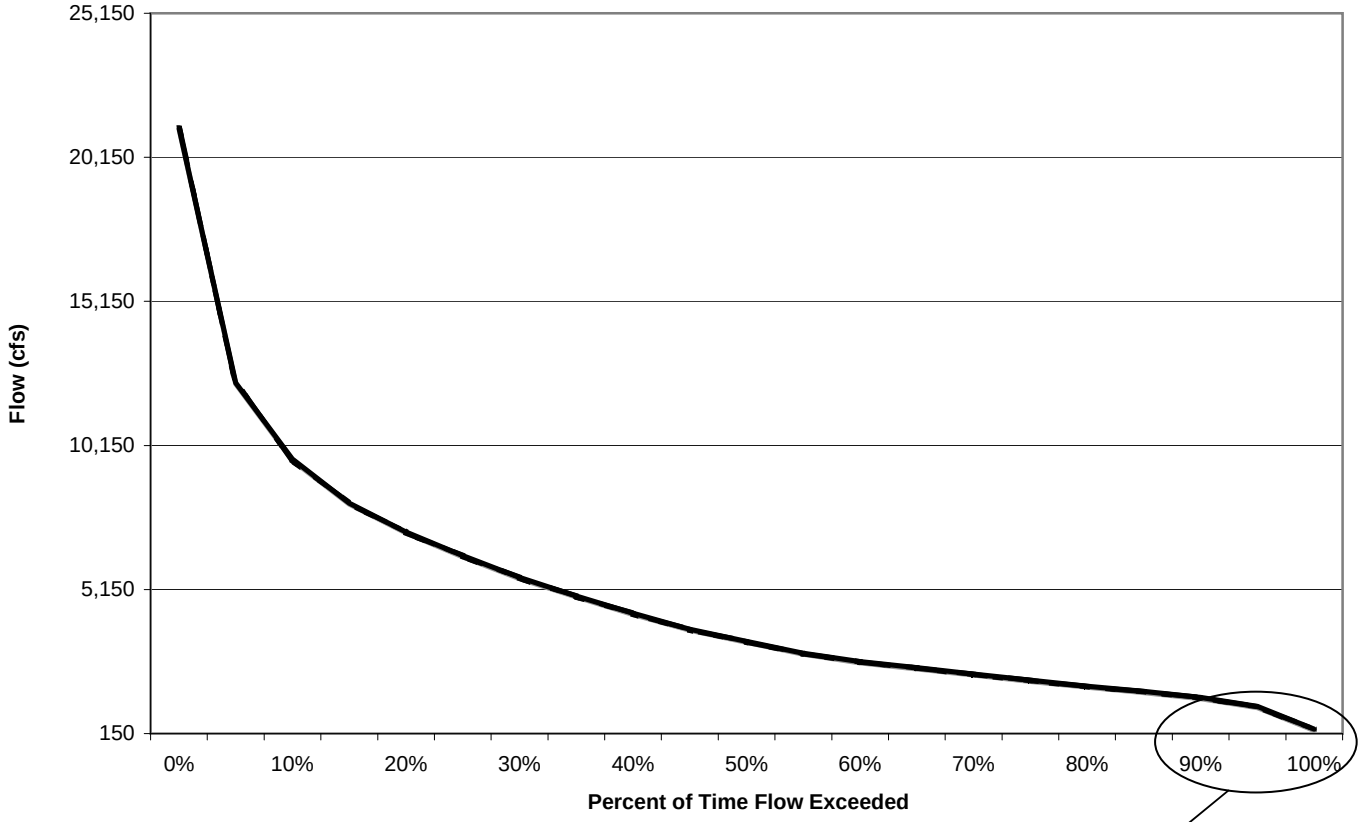
Below Greenville WWTP - Future Scenarios

February



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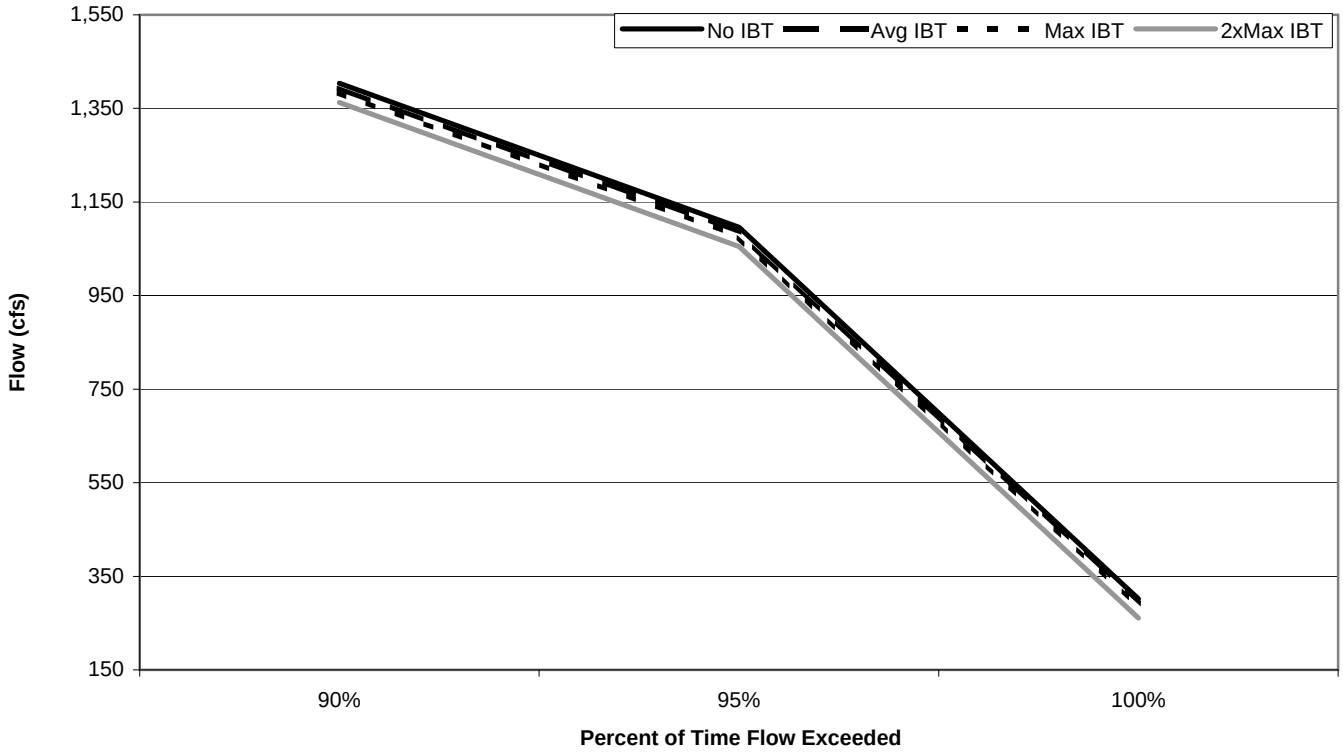

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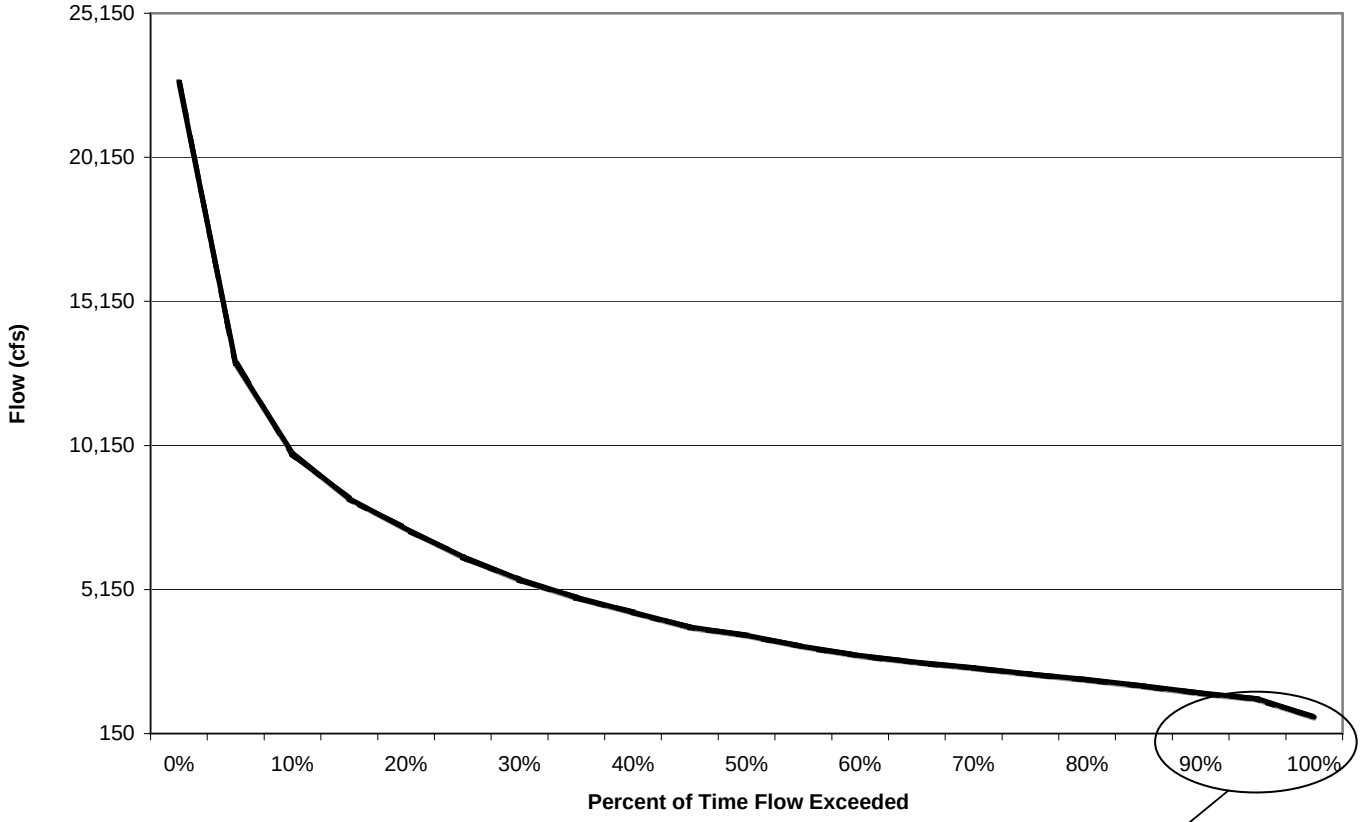
Below Greenville WWTP - Future Scenarios

March



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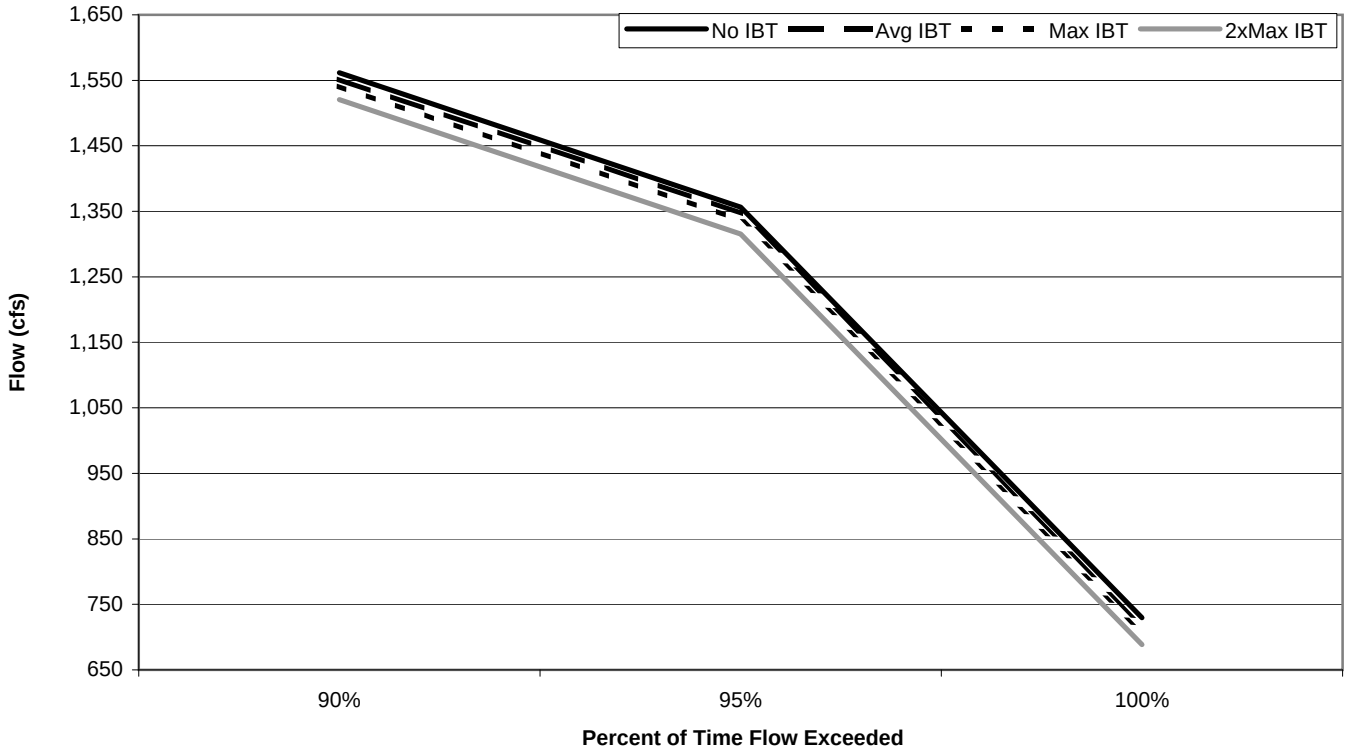

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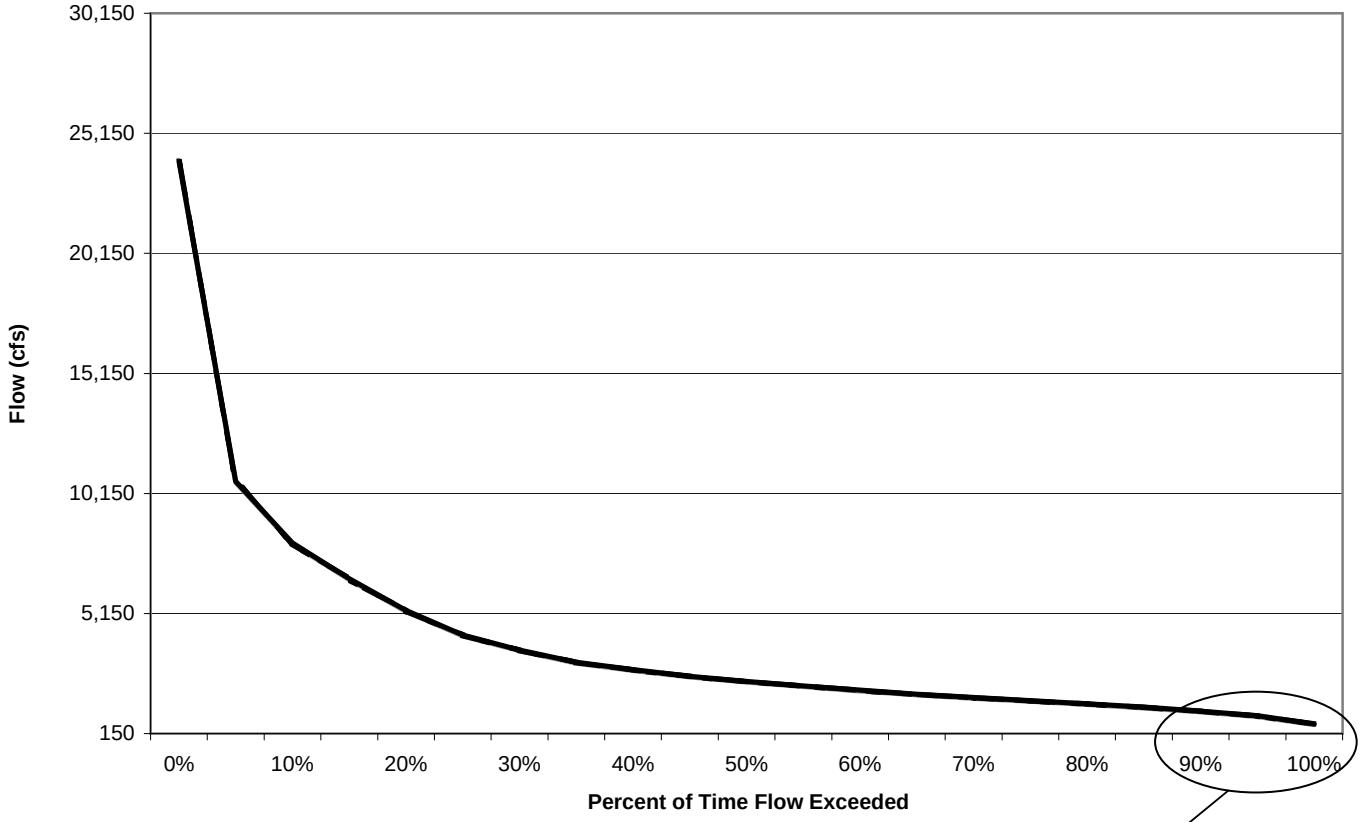
April



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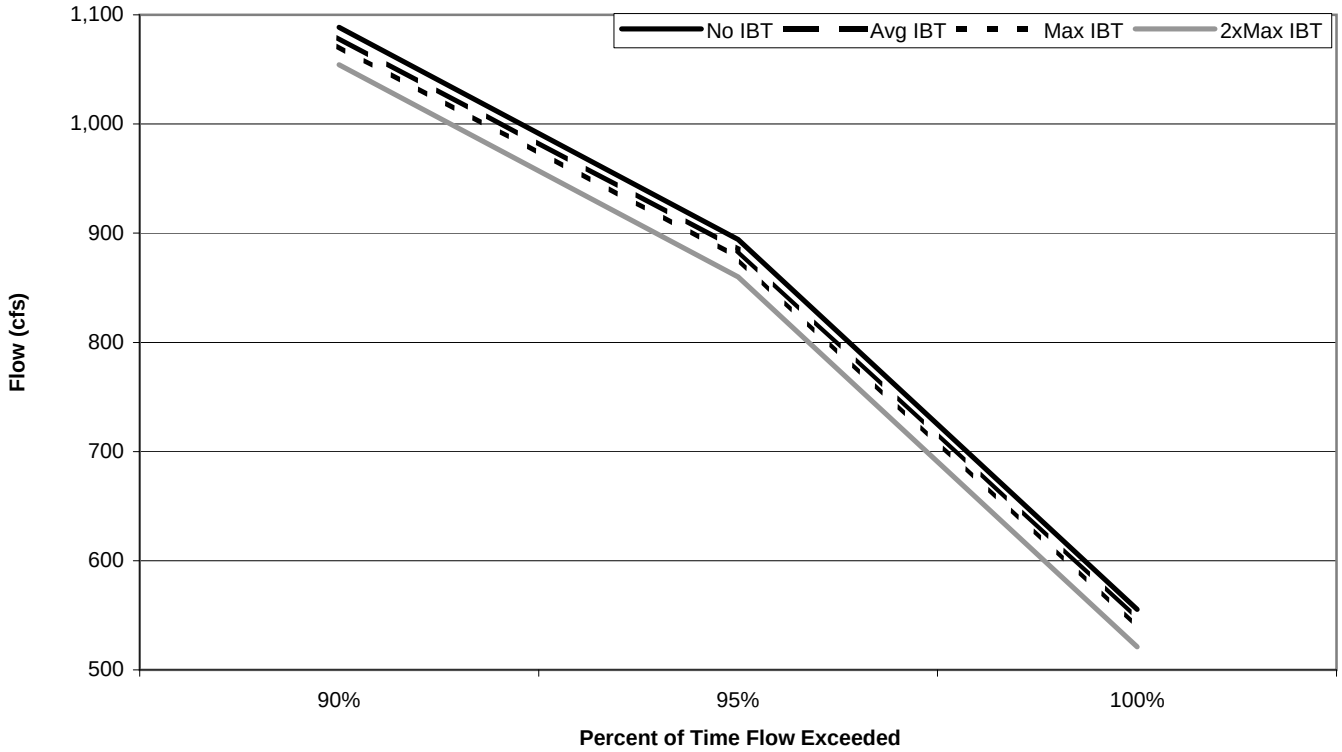

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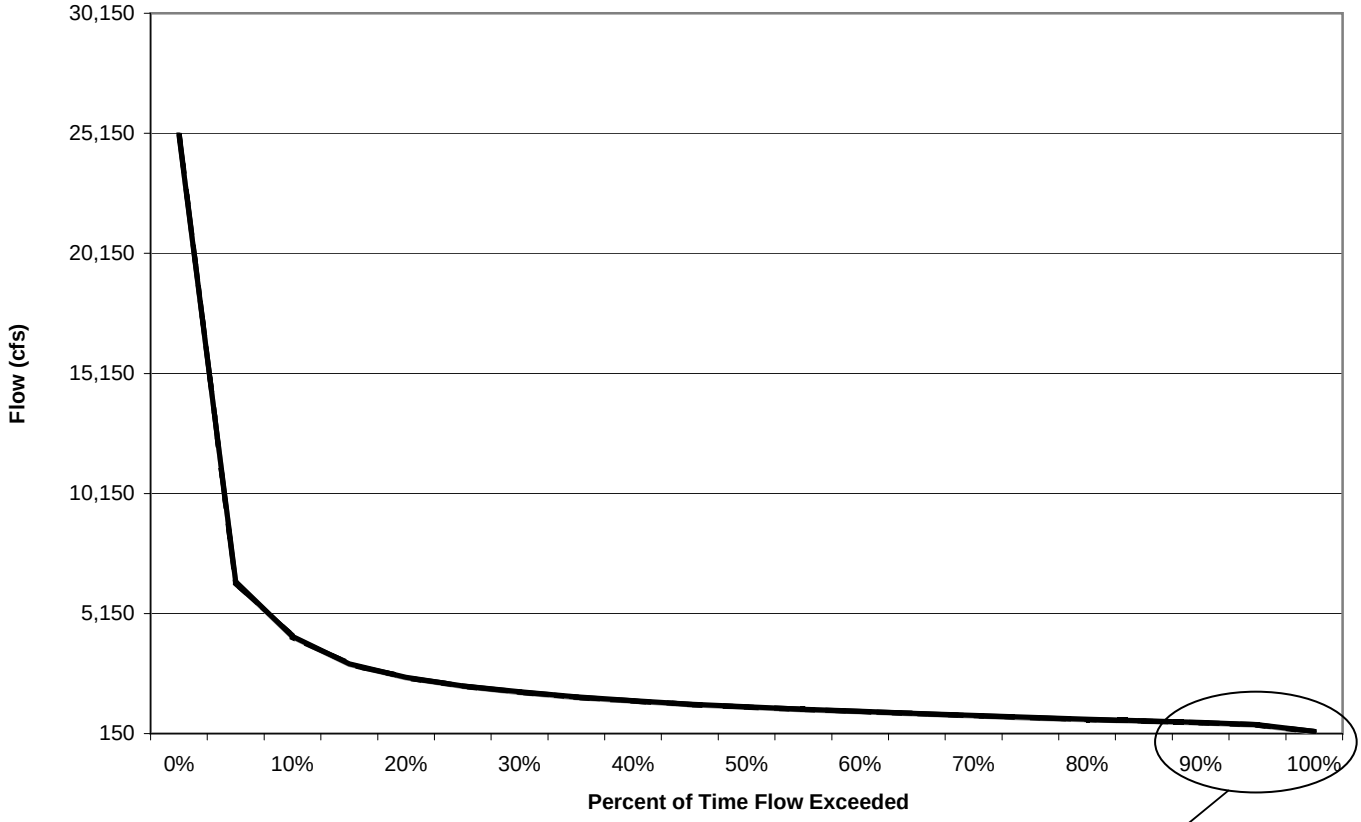
Below Greenville WWTP - Future Scenarios

May



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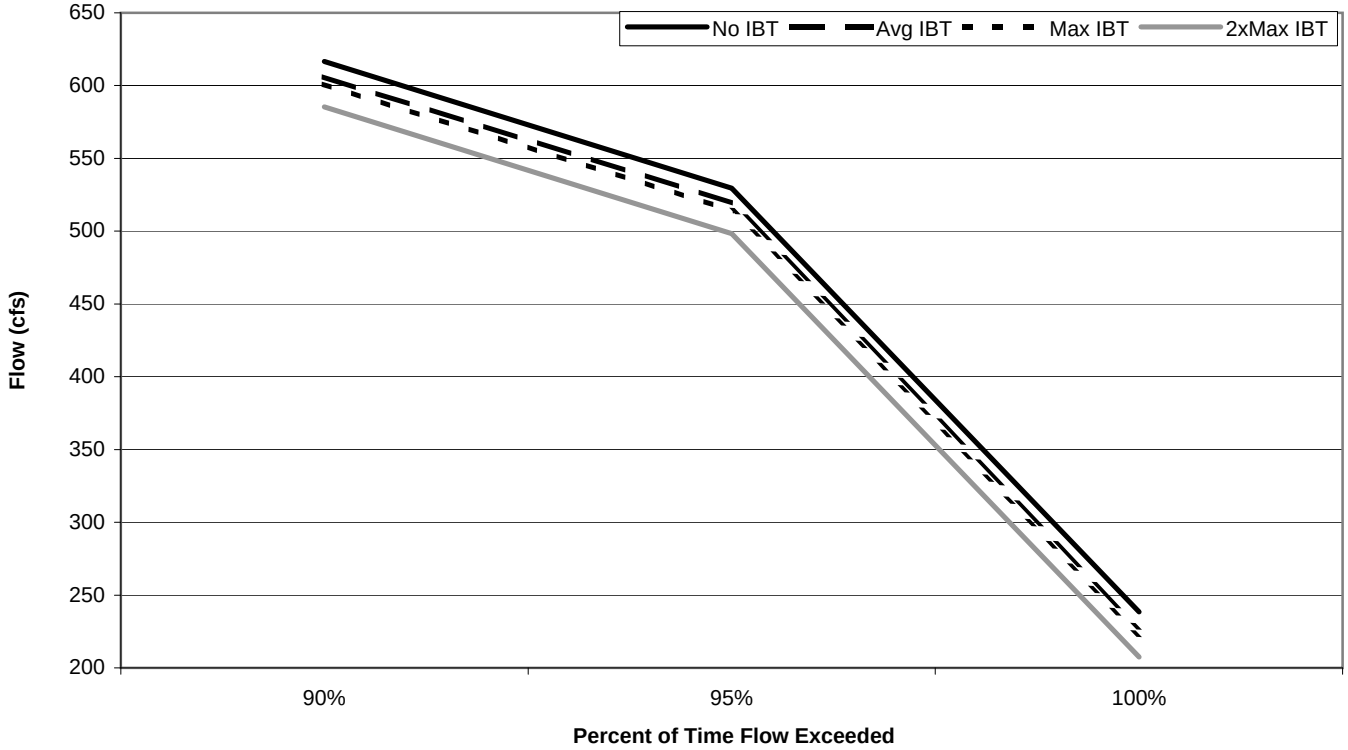

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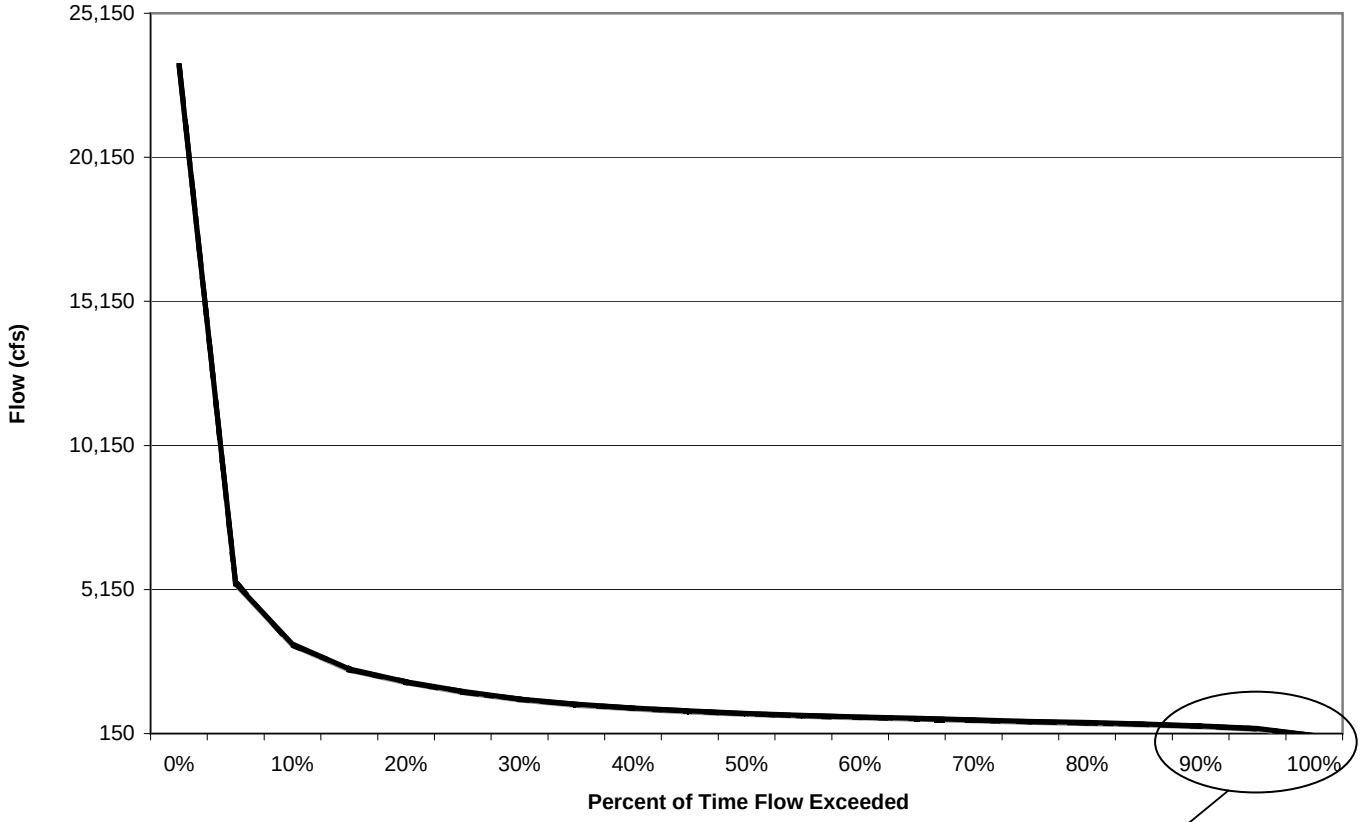
Flow Duration Curves

Below Greenville WWTP - Future Scenarios

June



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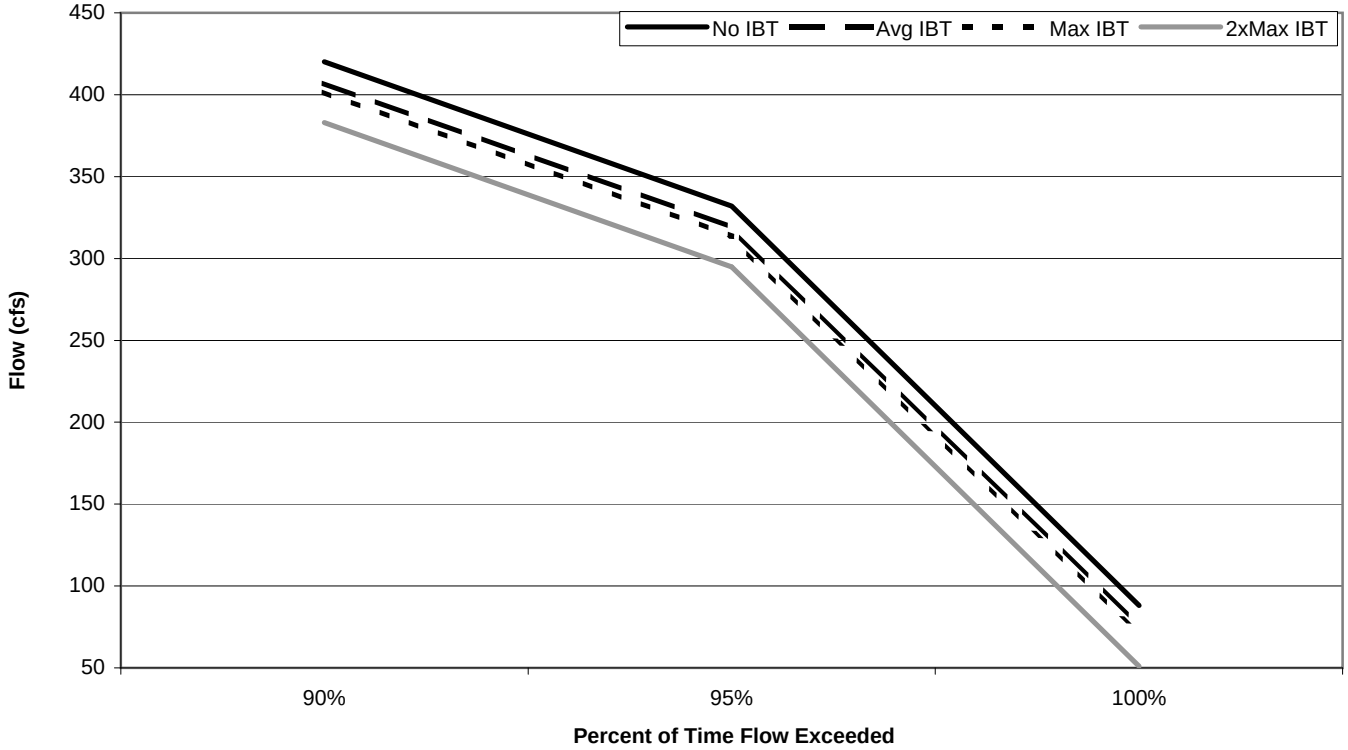

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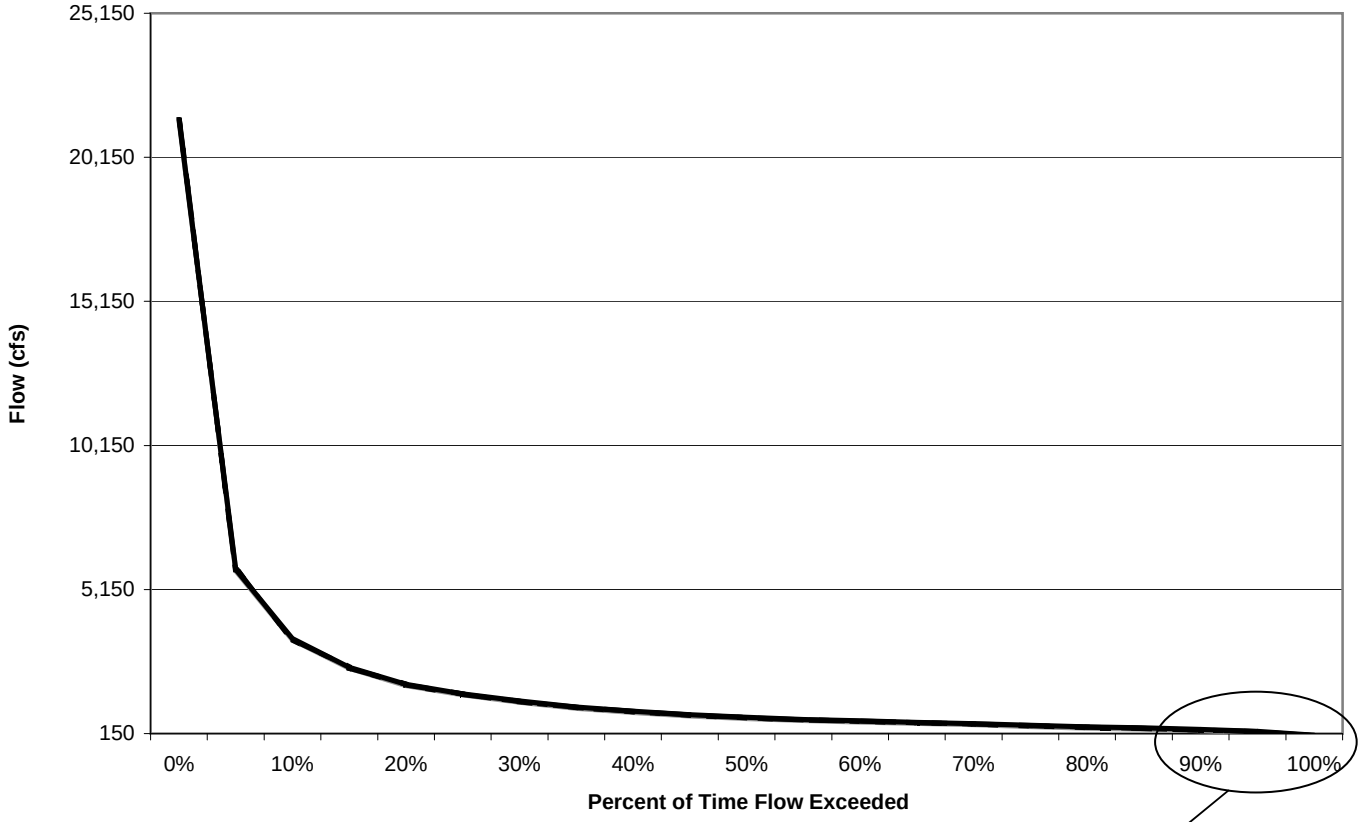
Flow Duration Curves

Below Greenville WWTP - Future Scenarios

July



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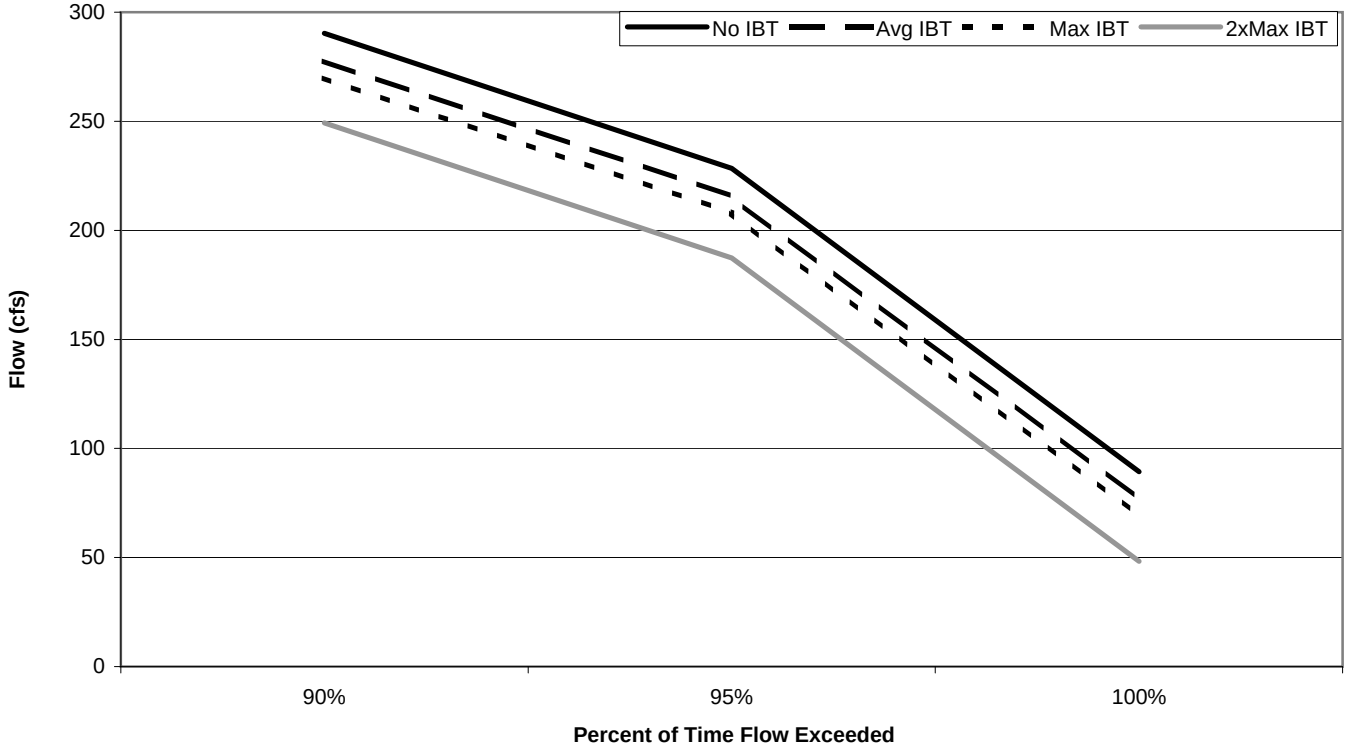

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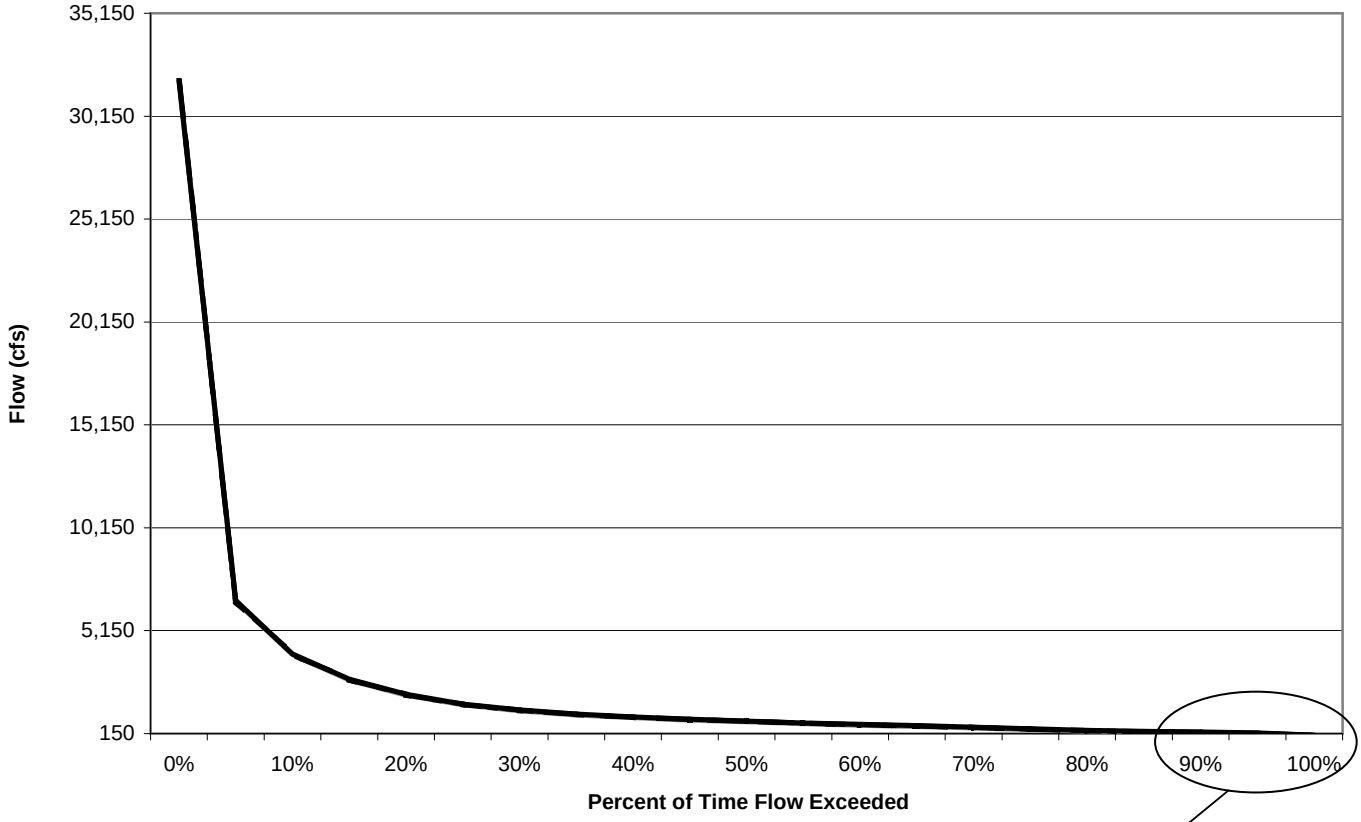
Below Greenville WWTP - Future Scenarios

August



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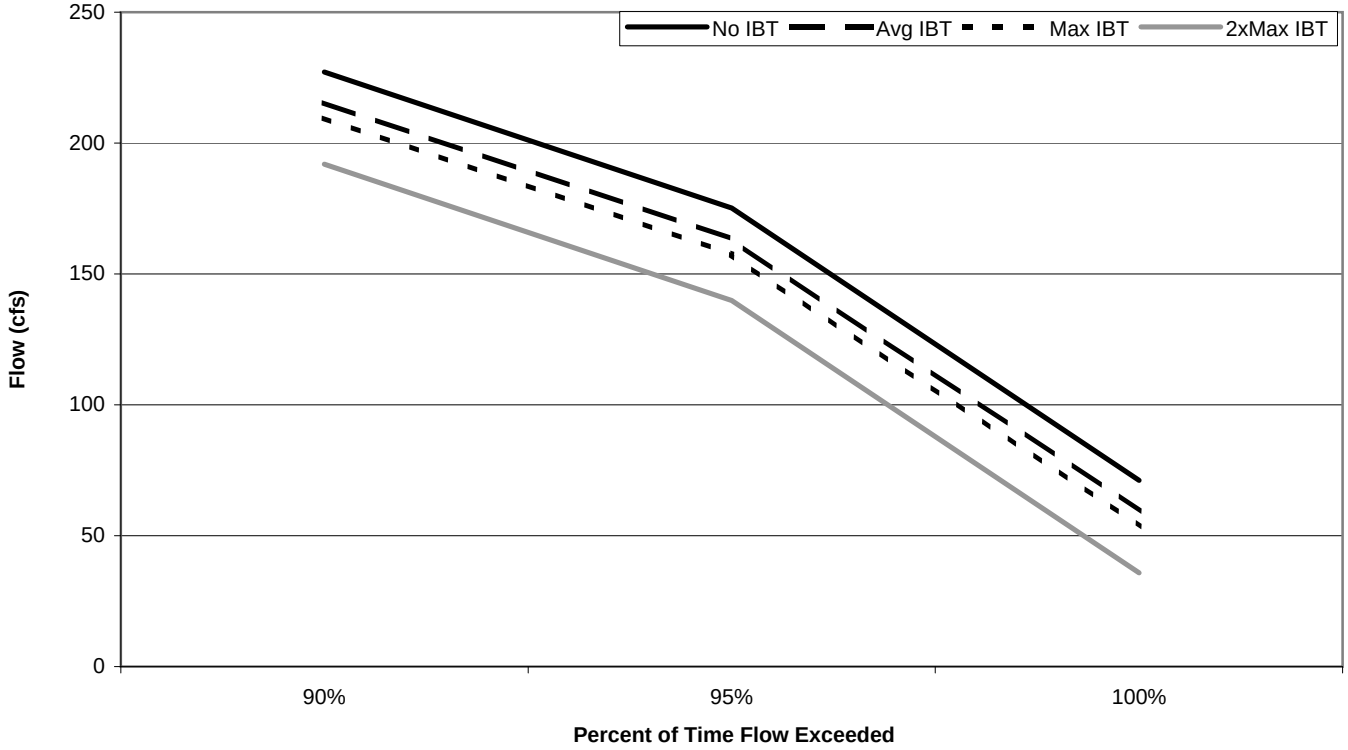

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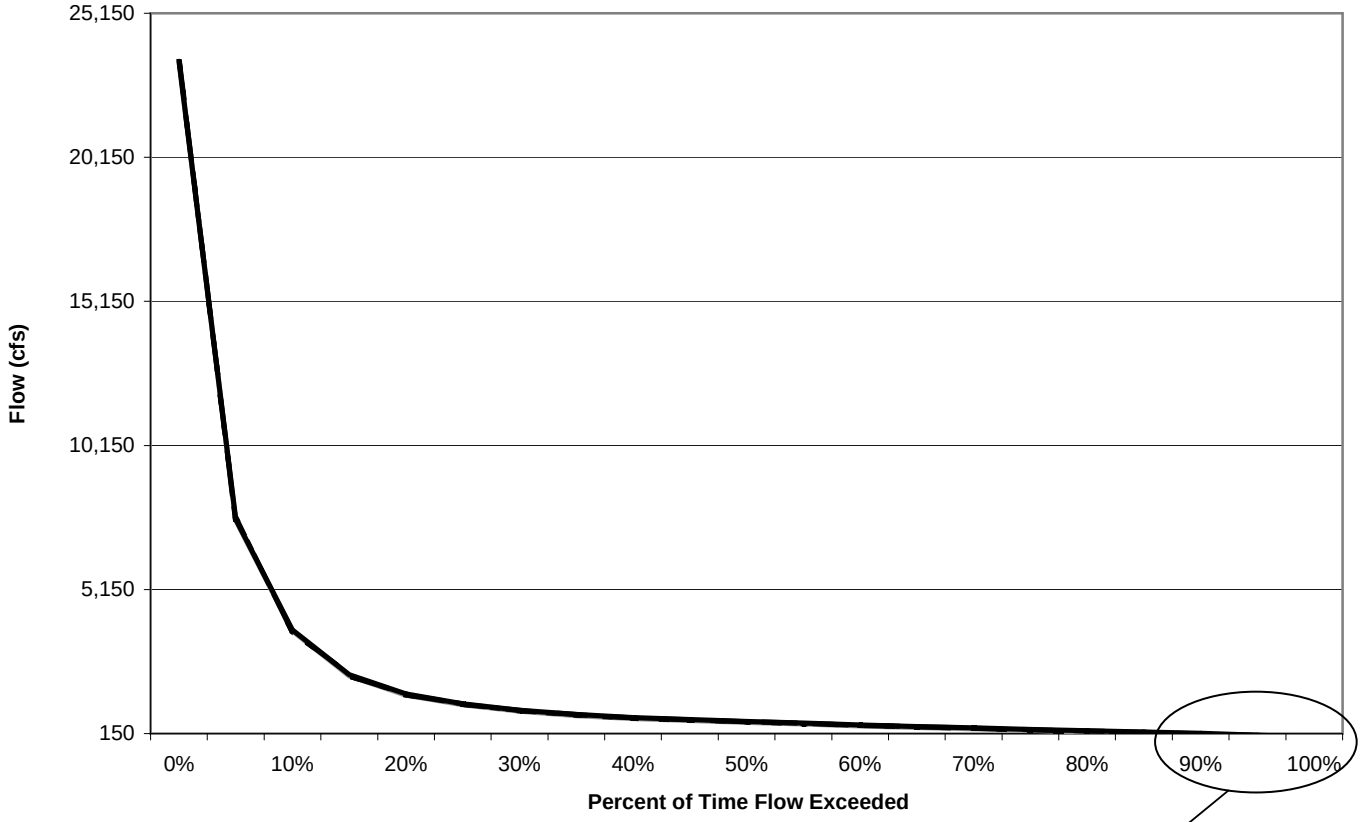
September



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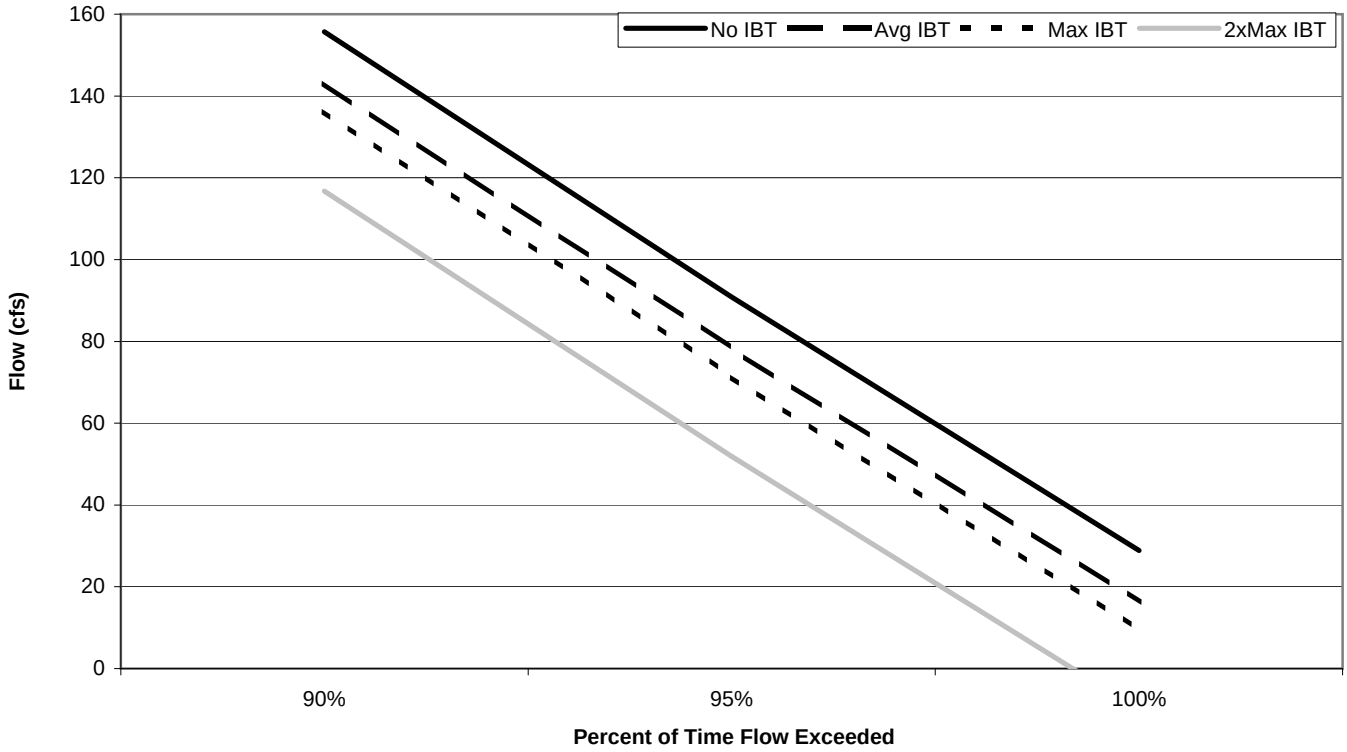

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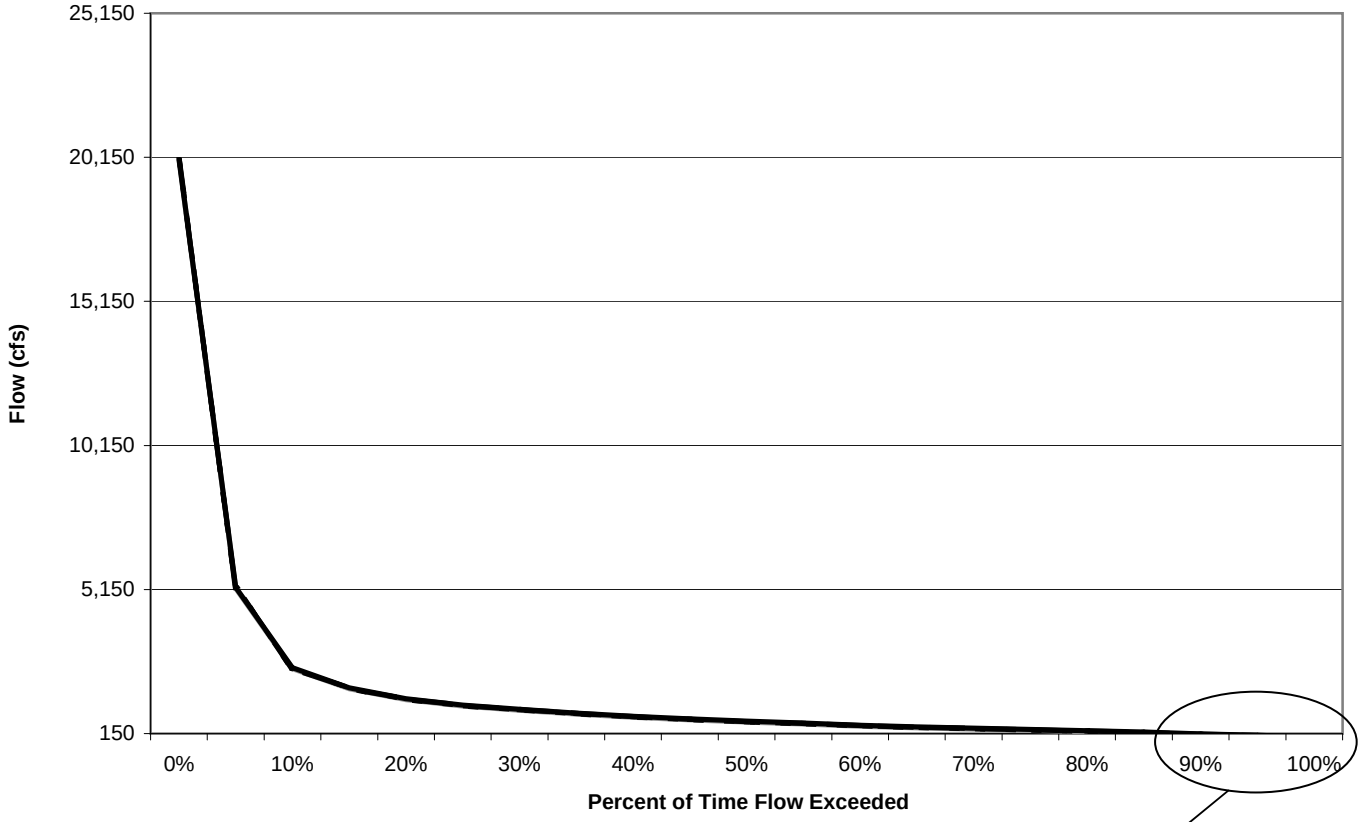
October



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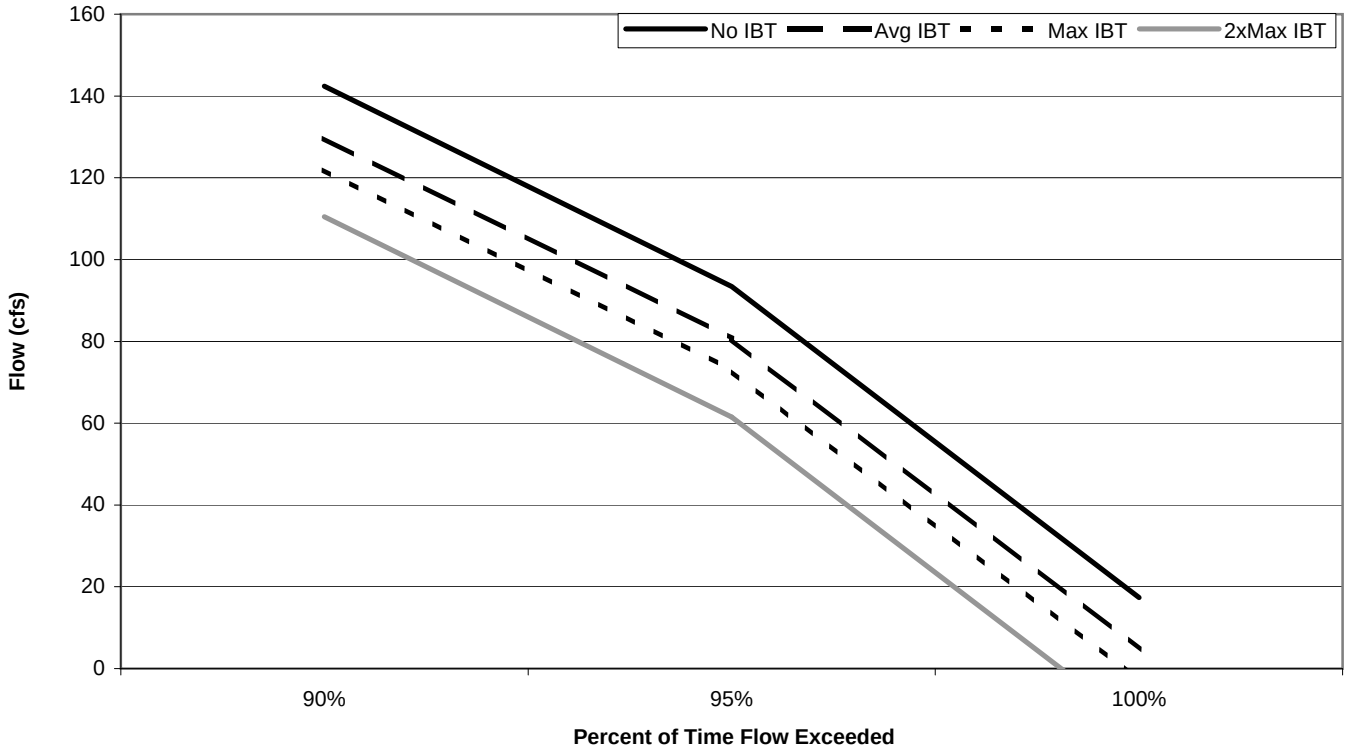

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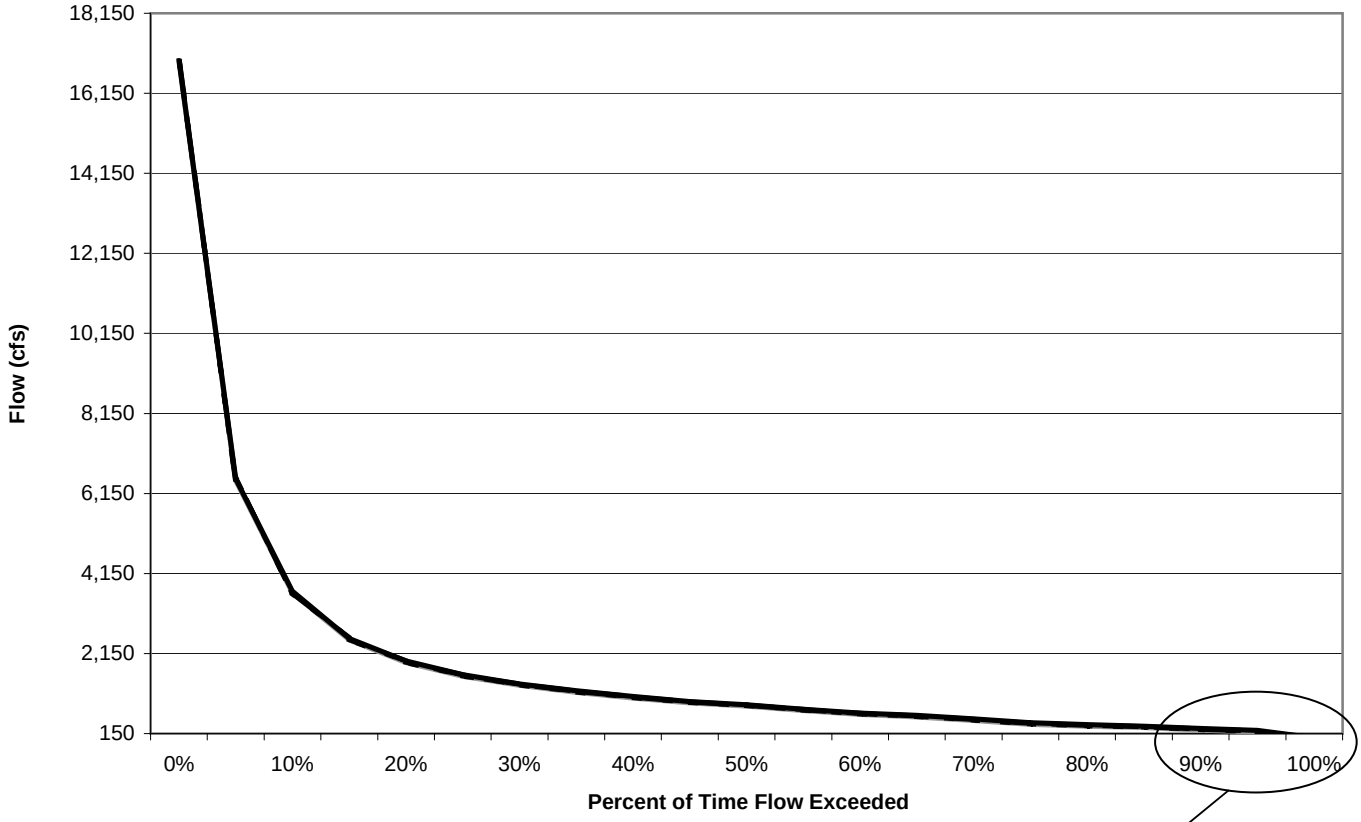

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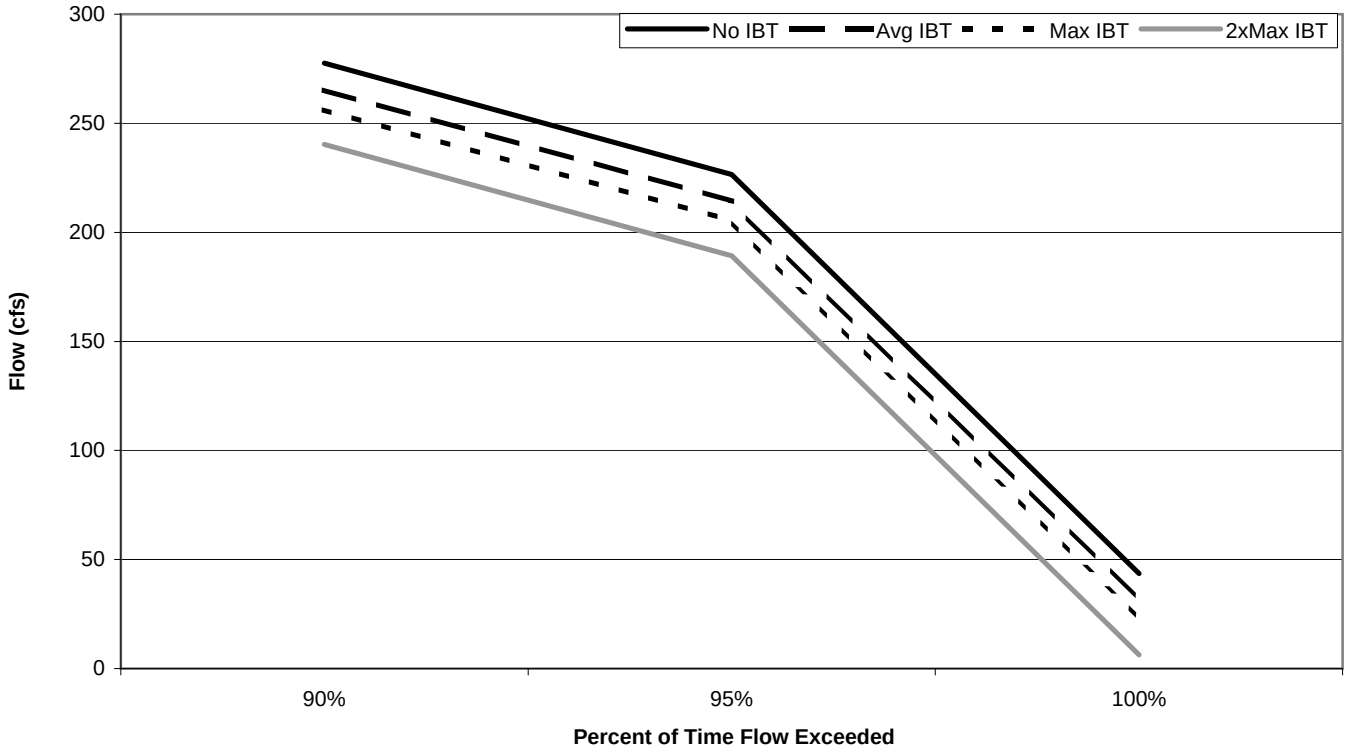

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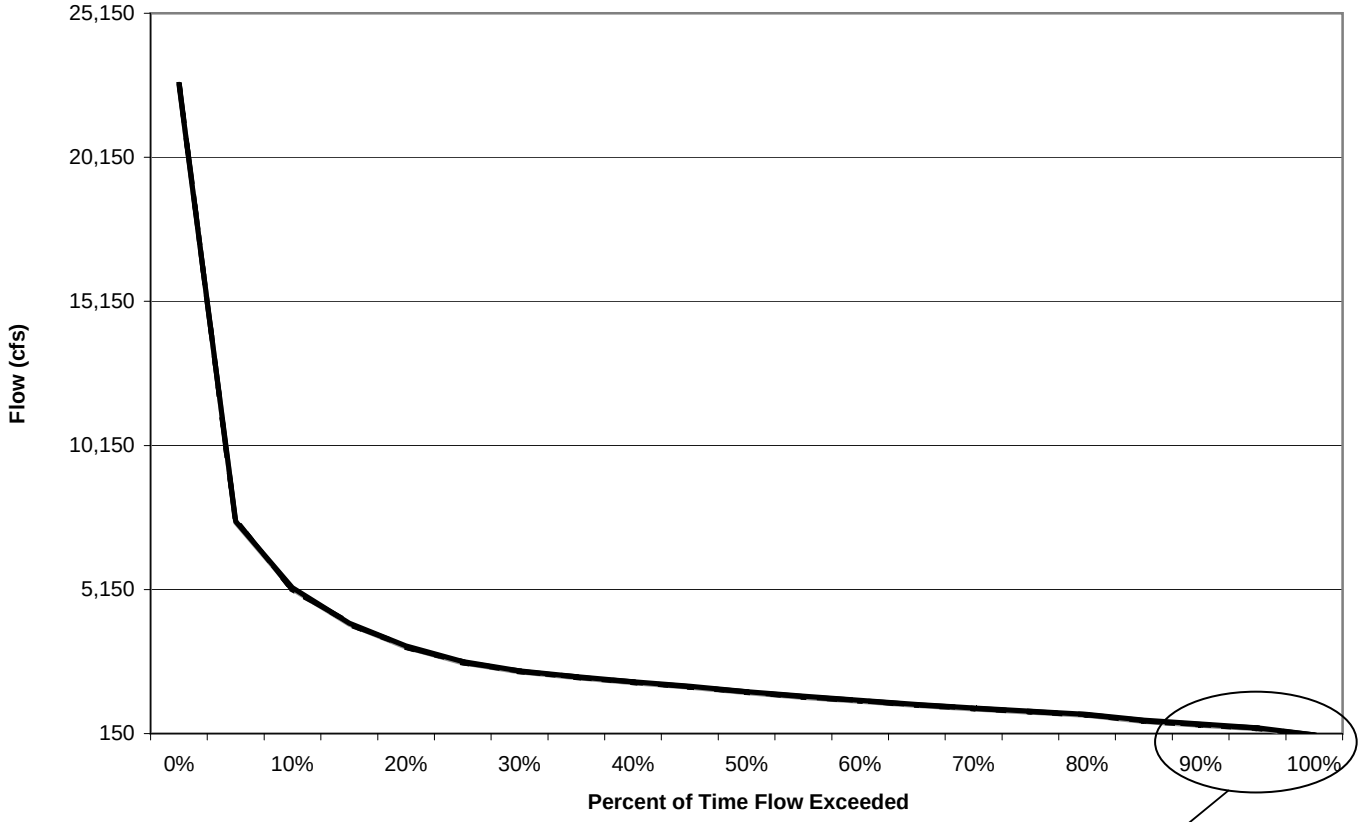

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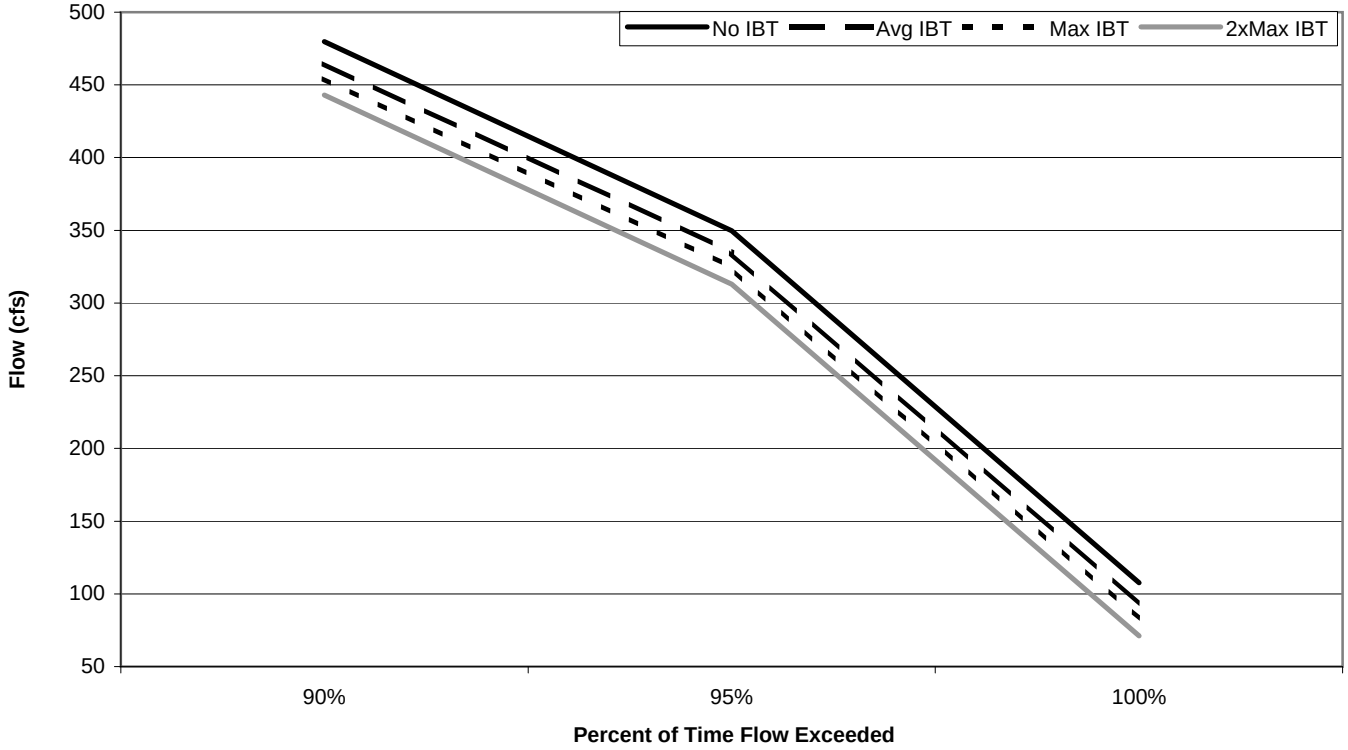

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ARCADIS

Final Environmental Assessment – Greenville Utilities Commission Interbasin Transfer

Appendix C

Response to Division of Water Resources Completeness Review Comments

ARCADIS
Infrastructure, environment, facilities

ARCADIS G&M of North Carolina, Inc.
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Raleigh
North Carolina 27607
Tel 919.854.1282
Fax 919.854.5448
www.arcadis-us.com

Messrs. Tom Fransen and Phil Fragapane
North Carolina Division of Water Resources
1611 Mail Service Center
Raleigh, NC 27699-1611

WATER RESOURCES

Subject:
Response to Completeness Review Comments
Draft Environmental Assessment for Interbasin Transfer
Greenville Utilities Commission

Date:
February 1, 2008

Contact:
Mary Sadler

Phone:
919-854-1282

Email:
mary.sadler@arcadis-us.com

Our ref:
NC706015.0010

Dear Mr. Fransen and Mr. Fragapane:

The following are our responses to your completeness review comments. The Draft EA or the Hydrologic Analysis on the Tar River has been modified where appropriate.

1. *EA needs better quality maps. Figure 7.2 legend is difficult to read. Figures 7-3 to 7-4 are difficult to read.*

   Figures 7.1 through 7.6 are included as a supplement to the text as graphical documentation. Due to copyright and privilege issues, these figures (e.g. land use and zoning) will not be re-created.

2. *More detailed maps with larger scales, such as land use maps instead of Figure 5.1. Perhaps break maps into quadrates [sic].*

   Figure 5-1 is meant to provide an overall snapshot of the significant land use categories in Pitt and Greene Counties: urban, wooded/undeveloped, cultivated, and water. Figure 5-1 shows that Pitt and Greene Counties are currently not urbanized, but are mostly undeveloped and agricultural.

   Pitt County has a land use plan, as described in Section 7.2.1.1. The land use figure has been deleted from the text per the response to comment #1. The Town of Farmville is currently working on a land use plan, but this plan will not be available until late 2008. Winterville does not have a land use plan. Additionally, no land use planning exists for Greene County. Per Section 7.5 of the Draft EA, Greene County is a very rural county with many small towns and unincorporated areas. Thus, the County has not enacted zoning regulations for unincorporated areas or invested in comprehensive land use planning.

3. *Figure 1-2: Additional maps should be provided with a detailed service area for each recipient. Including those water systems in Greene County listed on page 2-6. Also need maps to provide projected service areas to 2030-40(?).*

   Figure 1-2 has been modified to show the water systems in Greene and Pitt Counties (attached to this correspondence).

   It would be difficult to estimate exactly what the 2030 service areas will look like for the small communities and unincorporated areas. However, the 2030 service areas are expected to be contained within Pitt County (Farmville, Greenville, and Winterville), and Greene County. Water is not expected to be transferred to any area outside of these two counties.

4. *There's been some preliminary discussions concerning a technique known as aquifer storage and recovery (ASR), in which treated drinking water is stored in aquifers during periods of low demand (i.e., the winter months), which may help the GUC meet peak demands prior to and beyond 2010. This document does not mention this effort. Could there be cumulative and/or secondary impacts of the IBT and ASR on the Tar River?*

   In several meetings with DWR concerning the IBT Management Strategy, the point was raised that ASR may help mitigate the interbasin transfer amount to the Neuse and Contentnea Creek subbasins, particularly during peak demands and low stream flow conditions. Therefore, ASR would be expected to have a positive effect on any potential impacts of the proposed IBT. We agreed with DWR on this assessment. However, GUC's ASR project has not been fully tested and implemented, so the recovery rate for the ASR water is not known. Therefore, it was decided to exclude ASR from consideration to avoid the risk of underestimating projected IBT amounts.

5. *No literature cited section [sic] in the Entrix report in Appendix B. Some of the citations are not in the lit.cit. of the main document.*

   The literature citations in the Draft EA have been corrected.

6. *The document dismisses cumulative and secondary impacts associated with growth by repeatedly stating that the project is primarily a water replacement project and significant growth is not a component of this project or a reason for developing the IBT request. It is true that they are being forced to switch to surface water and that initially the volume of surface water matches the volume of ground water; however, over time the volume of water increases due to growth projections that the communities would have supported with an untapped volume of ground water. On page 4-2 it states that "these communities will be unable to compensate for the reduced groundwater withdrawals for predicted growth to 2030". There appear to be pockets of significant growth and, without the additional water, this growth could not be supported. The Executive Summary states that growth is modest at 1 to 3 percent in some communities (GUC {GUC*

is NOT a community}, Greene Co. {Greene Co. is NOT a community}, Farmville) and slightly higher in others (Winterville). However, Section 2.2 gives growth rates of from 11 to 50 percent for Winterville. Greene County had a 25 percent growth rate from '90 to '06; although the overall growth rate of the county may be 1 percent, pockets of higher growth may occur, e.g. near the Global Transpark. The document does not provide the percent growth for Greenville, but from the numbers provided it could be 45 percent from '05 to '30.

The Draft EA does not dismiss the secondary and cumulative impact issue. This project is a water replacement project and significant growth is not a reason for requesting this IBT. In fact, the Capacity Use rules are the only factor limiting the water supply in lower Cretaceous aquifers. Small pockets of growth do exist in several areas, but this growth would have most likely been supported by additional groundwater supply in absence of Capacity Use rules or the purchase of water via the Neuse Regional Water and Sewer Authority. In other words, the current predicted growth would happen regardless of the IBT.

Section 2.2 gives an annual growth rate of 2.65 to 21.25 percent for the Town of Winterville (in 2001), not as high as 50 percent. If the number of people added to Winterville per year is examined closely, the 21.25 percent growth rate translates to 942 people moving to Winterville between 2000 and 2001, for a total of 4,921 persons. In Greene County, the *average* annual growth rate between 1990 and 2006 is 1.4 percent. Growth rates are not typically reported as a percentage over a sixteen year time span. Growth rates are typically reported on an annual basis. Over a sixteen year period, it is expected that a community would increase in population. The Draft EA does provide growth rates for Greenville via the GUC numbers, since GUC currently serves the City of Greenville.

The term "community" in the Draft EA is used for ease of reading. Greene County is not a "community", per se, but is acting on behalf of the smaller communities in the County. GUC represents the community of the City of Greenville.

7. *In general, service areas and the areas to evaluate impacts (study area) do not always necessarily match. Impacts travel downstream and downwind. The study area to evaluate impacts needs to be delineated around each projected 2030 service area.*

It would be difficult to estimate exactly what the 2030 service areas will look like for the small communities and unincorporated areas. However, the 2030 service areas are expected to be contained within Pitt County (Farmville, Greenville, and Winterville), and Greene County. Water is not expected to be transferred to any area outside of these two counties.

The term "study area" is not very applicable to this project, as the service area has finite boundaries. It is not expected that a finished water project would cause "downwind" impacts to neighboring counties. Downstream impacts due to the

proposed withdrawal have been addressed in the water balance model by ENTRIX.

8. *Is Greenville a recipient in this IBT? Or, are they merely the provider under GUC? If they are simply the provider, what is the rationale for including section 7.1 with Greenville's land use plan, zoning ordinances, etc.? It's informative, but will it mitigate impacts associated with the IBT?*

   The City of Greenville is a recipient of the IBT. The portion of GUC's service area in the Neuse River subbasin was estimated to be approximately 8 percent based on the number of service connections located in the Neuse River subbasin (referenced on Page 3-2 of the Draft Ea and Page 21 of the IBT Management Strategy document in Appendix A). Figure 1-2 provides an illustration of the service areas with respect to the Interbasin transfer line.

9. *If appropriate, the EA needs to consider an alternative that includes return of wastewater to the source basin.*

   Section 3.6 of the EA provides an analysis of the receiving basin that includes a return of water to the source basin. This section includes an estimation of the cost for a centralized treatment system in Greene County with a force main for the return of water to the Tar River basin. However, the costs do not include the collection system required to convey wastewater to a centralized treatment plant.

   The source basin analysis was not placed in the alternatives analysis section (Section 4), since at the time it was felt that the IBT Analysis section (Section 3) would be a more appropriate location in the text.

10. *Table 2-2 on page 2-5: Historical and projected water demands data need to explicitly show a column which is per capita water use. Projected water demands must show that GUC is using and will continue to use water efficiently.*

    Footnotes have been added to Table 2-2, "Historical and Projected Water Demands," to indicate the residential per capita water use. Per capita water use (residential, commercial, and institutional) for GUC is approximately 120 gpcd. Per capita water use for Farmville (residential) is estimated between 90 and 120 gpcd. A large percentage of Farmville's total water use is industrial (39 percent). The large industrial water use in addition to the scarcity of population data has resulted in a total per capita use values that may be misleading. Per capita water use (residential, commercial, and institutional) for Greene County is approximately 115 gpcd. Per capita water use (residential, commercial, and institutional) for Winterville is approximately 90 gpcd.

11. *Water conservation efforts should be explained somewhere in the EA to show that all water systems (GUC, Farmville, Winterville, and Greene County) have adequate conservation measures in place in order to show efficient water use.*

    Water conservation measures for GUC, Farmville, Winterville, and Greene County are explained in Section 7 of the Draft EA.

12. *Tables 3-2 and 3-3 on pp. 3-4 and 3-5: IBT quantity is the amount removed from the source river basin minus the amount returned to the source river basin. In these tables, the fourth column minus the 14th column should equal the 15th column, but it does not. Why not?*

    A minor math error was discovered in the tables. The tables have been revised accordingly.

13. *Section 3.4, page 3-6: The EA says the consumptive water use for Farmville and Greene County is assumed to be 30%. On what is this assumption based?*

    The consumptive use for GUC was determined to be 20 percent based on historical operating records. Winterville, Farmville, and the water systems in Greene County are based on groundwater use. For the groundwater systems, water use record-keeping is on a monthly basis. Also, accurate data on wastewater flow is not available. In particular, Greene County has multiple sanitary districts and a significant percentage of water users on septic systems. Therefore, reliable data was not available to compare water use and wastewater production to estimate consumptive use. Therefore, a conservative estimate of consumptive use (30 percent) was used to ensure the projected IBT amounts were not under-estimated.

14. *Table 3-4 and 3-5, pp. 3-7 and 3-8: These table [sic] needs to include a column which is "Total Withdrawal from the Tar River Basin"*

    This column was added to Tables 3-4 and 3-5.

15. *Section 7.2.7, page 7-23: This section should be titled "GUC Water Shortage Response" instead of "Water Conservation." What is GUC's "water production capacity?" Is it constant or does it depend on the Tar River flow? The water shortage response plan should include the state of the water supply (the flow in the river) rather than just being dependent on demand vs. infrastructure. Also, the plan does not include response during recovery from a drought.*

    The "Water Conservation" headings in the text of the Draft EA have been revised to read "Water Shortage Response."

    GUC is in the process of revising their Water Emergency Management Plan to include triggers for implementation of the Stage 1, 2, and 3 conservation measures. Final adoption is expected in January 2008. In lieu of river flow, the

implementation triggers are based on river level at the raw water intake or the salt wedge location from the raw water intake. Due to the tidal influence, river flow is not an appropriate trigger, since there have been many instances of net negative flow recorded but adequate water over the intake screens (indicating tidally influenced flow). A new Table 7-1 has been added to the Draft EA that provides the implementation triggers.

Table 7-1: Greenville Utilities Commission Water Shortage Response Triggers

Stage	River Level at WTP Intake [1]		Salt Wedge Location from WTP Intake
1	– 1.0 feet MSL	Or	10 miles
2	– 1.5 feet MSL	Or	7 miles
3	– 2.0 feet MSL	Or	4 miles

[1] *The top elevation of the raw water intake screens are at – 2.5 feet MSL and the mid-point of the screens are at elevation – 3.4 feet MSL. Therefore, when the river level is 1.5 feet above the top of the intake screen, Stage 1 restrictions are applied.*

In regards to the response during recovery from a drought, the appropriate stage will remain in effect until the trigger condition no longer exists.

16. *Section 7.3.7, page 7-29: This section should be titled "Farmville and Winterville Water Shortage Response" instead of "Water Conservation". The water shortage response plan should include the state of the water supply (the flow in the river) rather than just being dependent on demand vs. infrastructure.*

    The "Water Conservation" headings in the text of the Draft EA have been revised to read "Water Shortage Response."

    Refer to the response to comment #15 for more detail on the new triggers for the water shortage response plan.

17. *Does Greene County have a water shortage response plan? If so, it should be included in the EA. If they don't have one, a plan should be developed and included in the EA.*

    Greene County was required to adopt all water shortage response measures implemented by GUC as a stipulation of the Water Purchase Agreements.

ARCADIS

Mr. Fransen and
Mr. Fragapane

Appendix B

18. *Please provide a copy of the spreadsheet model.*

    A copy of the spreadsheet model is included on the enclosed CD.

19. *Introduction, page 1: The figure numbers appear to be out of order.*

    The figure numbers have been revised.

20. *Introduction, page 1: The scenarios to be studied must include maximum day IBT amounts. Please add two scenarios: current flows with maximum day IBT, predicted 2030 flows with maximum day IBT.*

    The hydrologic model evaluated the influence of no IBT, average day IBT, and the maximum possible withdrawal (23.76 mgd) on current and future instream flow. The maximum day IBT scenario was not modeled in the water balance. In the 2030 condition, both the maximum day IBT and maximum withdrawal IBT scenarios exceed the water treatment plant capacity. Therefore, the water treatment plant capacity (plus process water) was used as the worst-case (maximum withdrawal) condition. There are three reasons to support this assumption: 1) the maximum day for the Neuse River subbasin, the Contentnea subbasin, and GUC are not expected to occur on the same day, 2) GUC's water purchase agreement contracts stipulate that GUC reserves the right to curtail water to Farmville, Winterville, and Greene County given the appropriate notice, and 3) Farmville, Winterville, and Greene County expect to use their banked water during periods of high water demand.

    The following table describes the water usage scenarios evaluated in the hydrologic model. This table will be added to the Draft EA and to the text in Appendix B. Furthermore, a separate table was added to the ENTRIX hydrologic analysis that documents each model input for the flow scenarios.

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Mr. Fransen and
Mr. Fragapane

Explanation of Modeling Scenarios Used in the Tar River Water Balance

	GUC Water Demand (mgd)	Neuse River Subbasin IBT (mgd)	Contentnea Subbasin IBT (mgd)	Total Water Use (mgd) [2]	WTP Capacity (mgd) [3]	Comment
Existing Conditions [1]						
No IBT	10.91	0	0	10.91	23.76	modeling scenario
2030 Conditions [1]						
No IBT	12.83	0	0	12.83	23.76	modeling scenario
Average Day IBT	12.83	2.0	3.9	18.73	23.76	modeling scenario
Max Day IBT	18.65	3.8	8.5	30.95	23.76	[4]
Maximum Withdrawal IBT	18.65	3.9	9.6	32.15	23.76	modeling scenario

[1] The daily water withdrawal data used for each model scenario have been underlined. The model runs evaluated the influence of 2030 average day IBT and 2030 maximum withdrawal IBT on both existing flows and projected 2030 flow.

[2] The total withdrawal indicated in this column represents a yearly average. Total withdrawals were modeled by month using a composite monthly factor. The composite monthly factor was determined using six years of daily water withdrawal data from the Greenville Utilities Commission.

[3] The water treatment plant capacity of 22.5 mgd plus 8 percent process water.

[4] The maximum day IBT scenario was not modeled in the water balance. In the 2030 condition, both the maximum day IBT and maximum withdrawal IBT scenarios exceed the water treatment plant capacity. Therefore, the water treatment plant capacity (plus process water) was used as the worst-case (maximum withdrawal) condition. There are three reasons to support this assumption: 1) the maximum day for the Neuse River subbasin, the Contentnea subbasin, and GUC are not expected to occur on the same day, 2) GUC's water purchase agreement contracts stipulate that GUC reserves the right to curtail water to Farmville, Winterville, and Greene County given the appropriate notice, and 3) Farmville, Winterville, and Greene County expect to use their banked water during periods of high water demand.

21. *It would be easier to read the analysis if the tables and figures were included in the text rather than grouped at the end.*

The figures and tables were grouped at the end to improve readability. The extensive number of figures and tables resulted in the text being split up and hard to follow. The figures and tables remain grouped at the end to allow the

reader to separate the figures and tables and examine them individually while reading the more easily readable consolidated text.

22. *What is/are the operating rules for the Rocky Mount reservoir? Are they considered in the analysis? If not, it must be explained why it's appropriate not to include the RM reservoir in the analysis.*

The Rocky Mount reservoir was completed in 1969 and started operations in 1971. An 80 cfs minimum flow release was implemented. The operating rules require a minimum release of 80 cfs (refer to note at the end of response). Lower flow releases are allowed under specific drought conditions. Stage I (when the City of Wilson is purchasing water from the City of Rocky Mount) reductions allow a reduction from 80 to 75 cfs. Stage II conditions (when the reservoir elevation is at or below 120) allow a reduction from 75 to 70 cfs. Stage III (the reservoir operations model indicates for two consecutive weeks that the reservoir elevation will decrease to 115 or lower) conditions allow a reduction from 70 to 60 cfs. Different water conservation measures are associated with each Stage and get more restrictive as the stage increases. Stage III requires Rocky Mount to impose mandatory water conservation measures. The normal and low flow releases from the Rocky Mount reservoir are reflected in the historical gage data.

The Rocky Mount operating rules are considered in the hydrologic analysis and modeling. The years examined in the hydrologic modeling included 1931 to 2007, and the underlying hydrologic analysis in the hydrologic model was based on actual flows at Tarboro, reflecting the Rocky Mount operation. So, the hydrologic model reflects the Rocky Mount operating rules and minimum flows for the period since they have been in place and have been followed and modified (the past 36 years). During that period, there have been a number of very dry and drought periods that would have likely triggered the implementation of the minimum flows and low flow operating rules at Rocky Mount during the 1980s, 1990s, during 1999 to 2002, and in 2007.

There is also the period of record included in the hydrologic analysis prior to the implementation of the Rocky Mount operating rules and minimum flow, 1931 through 1971, or 40 years. Flow during these years also had a number of dry and drought years, including events during the mid 1940s and early 1950s. Reservoirs, such as Rocky Mount, typically augment low flows in rivers because they store water from higher flow periods and release it over extended lower flow periods. The period of record from 1931 until the Rocky Mount reservoir was in operation most likely included flows that were lower than would now occur with the Rocky Mount minimum flows. The pre-Rocky Mount years were included in the impact analysis, so the results probably somewhat over estimate the frequency of low-flow conditions that would now occur with the Rocky Mount operating rules and minimum flow. Thus, the hydrologic analysis and modeling results are most likely conservative with regards to predicted impacts (e.g., actual impacts would not be as much as indicated).

(Note: The permit to begin constructing or to begin filling Rocky Mount Reservoir issued in May 1969 and the Dam became operational in 1971. According to Jim Mead, the Rocky Mount Reservoir has always had a minimum release requirement of 80 cfs, and in 1993 permission was given to allow the minimum release to go to 65 cfs. In 1995 the minimum release requirement returned to 80 cfs. In 1999 Rocky Mount Reservoir was allowed to cut back releases to 60 cfs. In 2002, a letter from Rocky Mount reaffirmed the operating stages (reservoir management Stages I through III) approved in 1999. Later in 2002 and due to drought conditions, Rocky Mount was allowed to change minimum release to 50 cfs at the reservoir, but had to maintain 60 cfs at the WWTP discharge location downstream of Rocky Mount Mills dam. The Rocky Mount WWTP discharge requirements are based on a minimum river flow of 60 cfs. In 2007, Rocky Mount was allowed to reduce reservoir releases to the point that minimum flows at the WWTP discharge point are 40 cfs and flows at this point actually got down to 20 cfs in the fall of 2007.)

23. *The modeling must explain the expected impacts of the IBT on the Rocky Mount reservoir or show that there are no impacts.*

    The hydrologic analysis and modeling assumed that interbasin transfers at Greenville would have no impact on the operations of the Rocky Mount reservoir 70 river miles upstream. The only way that the IBT could affect upstream operations would be if there were to be an approved change in Rocky Mount's permitted withdrawal and operating conditions. GUC has not made such a request and such as operational change has not been assumed in the hydrologic analysis and modeling.

24. *The EA must better justify the assumption of 4.69 mgd for agricultural use. If this is based on the water withdrawal registration, this may not be a complete estimate of agricultural use from the Tar River.*

    The estimate of 4.69 mgd for agricultural use is based upon the best available data from DWR, and a very conservative buffer was added by assuming that all of these withdrawals would occur continuously, when in fact they would not.

    According to Pitt County Soil and Water Conservation District and Natural Resource Conservation Service staff, there is no current accounting system for agricultural surface water use (conversation with staff, September 2007). The estimate of 4.69 mgd is based on the registered water withdrawal data available from DWR (from Wayne Howard with DWR on September 12th), which is the only known source of reliable data on agricultural withdrawals. In order to account for some of the water use that may not be effectively included in the DWR data, the estimate was increased substantially by a very conservative estimate that water would be withdrawn by these registered agricultural users every day for the entire growing period.

25. *Table 6, page 13: This table shows that the discharges for Greenville and Bethel were greater in November and December of 2002 than the withdrawals for the same months shown in Table 4. Is this accurate? It could possibly be explained by Bethel's groundwater use.*

    The withdrawal and discharge data come from different sources. The discharge data was determined from DMR data and the water use and withdrawal data came from local water supply plans. It is possible that both groundwater use and infiltration and inflow (I/I) into the collection system may explain this discrepancy between withdrawal and discharge.

26. *Table 7, page 13: The monthly variability for discharges for 2030 seem to be very small compared to the monthly variability for 2002 (Table 6). Why? It seems there should also be monthly variability in the 2030 assumed discharges.*

    There are two reasons why the monthly variability is different between the 2002 effluent data and the 2030 predicted data. First, variability in wastewater flow is difficult to predict. The 2030 effluent projections were based on a linear projection analysis for each community. Despite using 6.5 years of effluent data (as reported in the DMRs), the R^2 values on the linear projections were very low due to the fact that 1) these plants are small and 2) the collection system infrastructures are aging. A smaller plant or aging infrastructure results in more influence of I/I (more I/I into the system and less storage in the collection system prior to reaching the plant). The effect of I/I causes difficult up and down trends in the DMR data, resulting in a low rate of projection, and thus over time, only minor differences in variability.

    Second, the 2002 effluent data is stated exactly as reported on the DMRs, variability included. A linear projection analysis will have the effect of smoothing out any variability.

27. *The modeling results must be better presented. Currently, they are mostly presented using tables. Flow duration curves should be presented which compare the different scenarios studied.*

    Flow duration curves have been added to the results and we have retained the tables, which are helpful to ascertain the actual values, which cannot be accurately obtained from the graphs.

28. *Tables 4-7, pp. 12-13: It appears that the titles should include "with No IBT".*

    Additional clarification was added to the tables. These tables present the water use and discharges that were entered in to the model. The Greenville numbers do not include any IBT flows.

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Mr. Fransen and
Mr. Fragapane

29. *Table 9, page 15: Another column must be added showing "Maximum Day IBT." This is true of all tables that present the average and emergency case, but not the max day case.*

    Since the emergency IBT and maximum day IBT are both limited to the permitted WTP capacity of 23.76 mgd, the column has been re-labeled "maximum withdrawal" for clarity. Please see the response to comment #20 for further details.

30. *It's not clear how the flow thresholds were chosen, i.e. 25, 50 cfs. Were these just chosen somewhat arbitrarily as low flow comparison points below the 7Q10?*

    These points were chosen because 50 cfs is approximately one-half (50 percent) of the 7Q10 flow and 25 cfs is approximately one-quarter (25 percent) of the 7Q10 flow.

If you have any questions, please do not hesitate to call.

Sincerely,

ARCADIS G&M of North Carolina, Inc.

Mary E. Sadler, PE
Associate Project Manager

Copies:
David Briley
Richard Wyche
Lauren Elmore
Paul Leonard

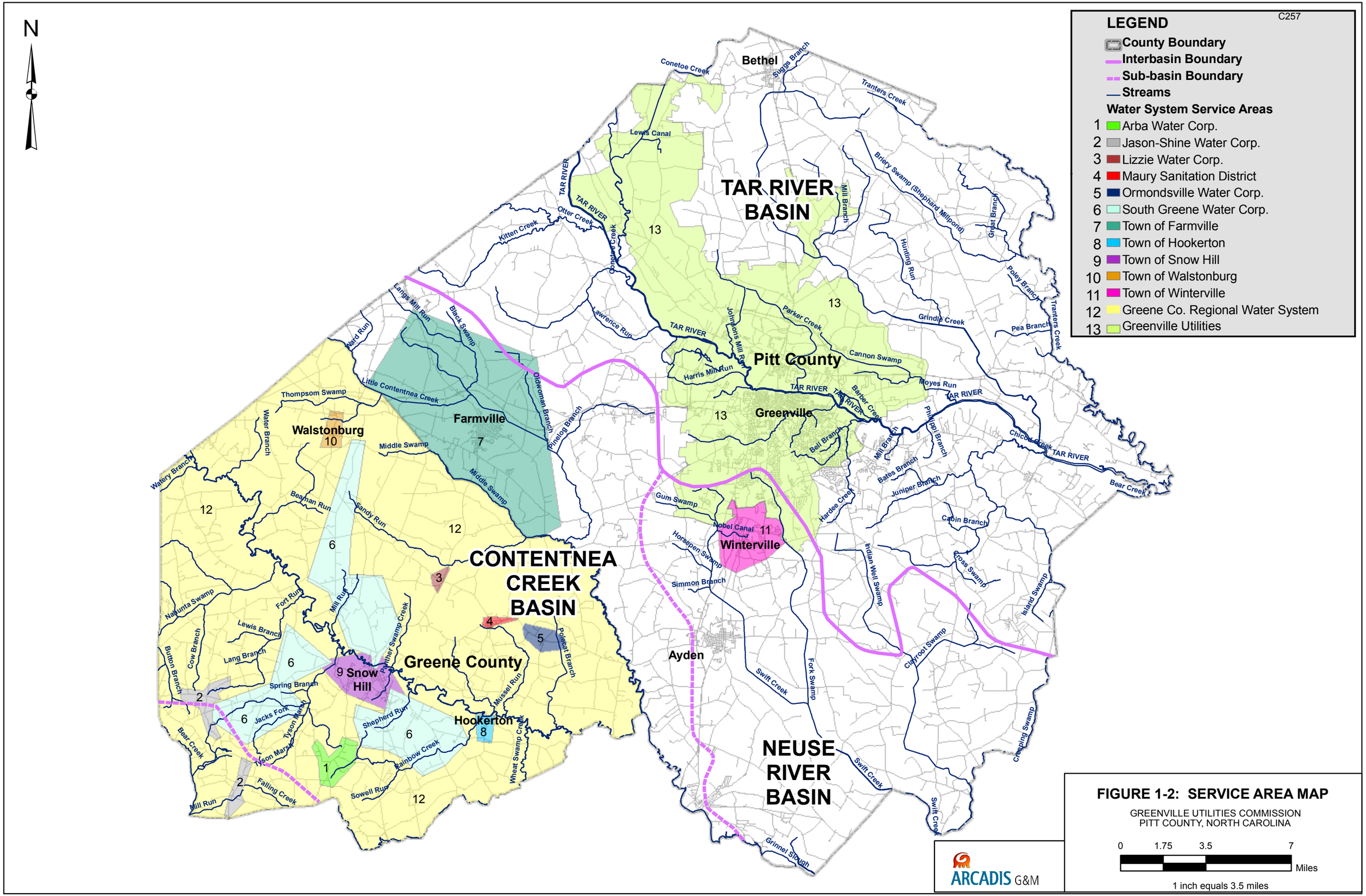

FIGURE 1-2: SERVICE AREA MAP

GREENVILLE UTILITIES COMMISSION
PITT COUNTY, NORTH CAROLINA

ARCADIS

Final Environmental Assessment – Greenville Utilities Commission Interbasin Transfer

Appendix D

Response to DENR Comments

C259

NCDENR

North Carolina Department of Environment and Natural Resources

William G. Ross Jr., Secretary

Michael F. Easley, Governor

Post-it® Fax Note 7671	Date 10/14/08	# of pages ▶ 1
To MARY SADLER	From MELBA MCGEE	
Co./Dept.	Co.	
Phone # 854-5448	Phone #	
Fax #	Fax #	

MEMORANDUM

TO: Tom Fransen
Division of Water Resources

FROM: Melba McGee
Environmental Review Coordinator

RE: #1456 Greenville Utilities Commission Interbasin Transfer Pitt and Greene Counties

DATE: October 13, 2008

We appreciate the effectiveness in addressing agency comments that were received during the department's internal review. The Environmental Assessment and Finding of No Significant Impact can be forwarded to the State Clearinghouse for further state review.

Thank you for your assistance.

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ FAX: 919-715-3060 \ Internet: www.enr.state.nc.us/ENR/

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www.arcadis-us.com

Mr. Randy Sipe, Regional Aquifer Protection - Washington
North Carolina Division of Water Quality
943 Washington Square Mall
Washington, NC 27889

WATER RESOURCES

Subject:
Follow-up Clarification to Response to Internal Review Comments
Draft Environmental Assessment for Interbasin Transfer
Greenville Utilities Commission

Date:
September 29, 2008

Contact:
Mary Sadler

Phone:
919-854-1282

Email:
mary.sadler@arcadis-us.com

Our ref:
NC706015.0010

Dear Mr. Sipe:

The Aquifer Protection Section Washington Regional Office reviewed the responses in our September 4, 2008 letter for the Draft Environmental Assessment (EA) for Greenville Utilities Commission (GUC) Interbasin Transfer (IBT). In a September 11, 2008 memorandum, the Division stated that all of the responses were adequate with the exception of response #4. Our original response did not address why costs were not estimated for connection to the Town of Farmville or how the construction of 10 miles of pipeline would provide water for all of Greene County.

The proposed construction for the interconnection between GUC and the Town of Farmville and Greene County will occur in three phases. Phase 1A is the 10 miles of pipeline from the Frog Level area to Lang's Crossroads in Pitt County. Phase 1A also includes two new elevated storage tanks and two booster pump stations. The original construction estimate was $25 million (originally provided in the Draft EA). This project has been recently bid for $17,195,417.00. Phase 1B of the project is Farmville's water distribution system tie in at Lang's Crossroads. This project has not yet been bid; however, the engineer's estimate for this phase is $4.9 million. Phase 1C of the project is Greene County's water distribution system tie in at Lang's Crossroads. Approximately 12 miles of 16-inch pipe will tie in the Phase 1A project at Lang's Crossroad to Greene County's water distribution system in Murray via an existing elevated water storage tank. This project has not been bid; however, the engineer's estimate for this phase is $8.6 million. The total cost of the proposed IBT project is $30.7 million. The Draft EA will be revised to reflect this change.

If you have any questions, please do not hesitate to call. We hope that our responses to the Division's comments have clarified the points in the Division's September 11, 2008 memorandum. We would ask that the Division respond in writing affirming that this comment has been adequately addressed so that the document can move forward to the State Clearinghouse.

ARCADIS

Mr. Randy Sipe

Sincerely,

ARCADIS G&M of North Carolina, Inc.

Mary E. Sadler, PE
Associate Project Manager

Copies:
Phil Fragapane
Steve Porter, PE
Barrett Lasater
Randy Emory, PE
David Briley, PE
Richard Wyche, PE
Lauren Elmore
Paul Leonard

RECEIVED
SEP 17 2008
ARCADIS G & M
of North Carolina, Inc.

C262

MEMORANDUM

TO: Melba McGee – Environmental Coordinator – Office of Legislative & Intergovernmental Affairs

THROUGH: David May – Regional Supervisor – Aquifer Protection – Washingt6on DLM

FROM: Randy Sipe – Regional Aquifer Protection – Washington DRS

SUBJECT: Greenville Utilities Commission Interbasin Transfer
Pitt and Greene Counties
Project 1456
Comment Responses

DATE: September 11, 2008

The Aquifer Protection Section Washington Regional Office received responses to our comments on the draft environmental assessment for the above referenced project in the form of a letter from ARCADIS G&M of North Carolina, Inc. dated September 4, 2008 (attached). This memo is being provided to your office in response to the letter to be included with any other additional comments the Department may have concerning the draft environmental assessment. We have not had any direct discussions or contact with ARCADIS concerning their comment responses.

This office believes letter adequately addresses our comments with the exception of the response to Comment #4. The response did not address why no costs were estimated for connection of the Town of Farmville to GUC or explain how the construction of only 10 miles of pipeline would provide water for all of Greene County. Our office agrees that the proposed alternative is probably the best choice to address the problem, but we believe that an accurate cost estimate for implementing the alternative should be provided to the existing and future water users.

Please contact me at 252-948-3849 should you have any questions regarding this matter.

ARCADIS
Infrastructure, environment, facilities

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Fax 919.854.5448
www.arcadis-us.com

Mr. Randy Sipe, Regional Aquifer Protection - Washington
North Carolina Division of Water Quality
943 Washington Square Mall
Washington, NC 27889

WATER RESOURCES

Subject:
Response to Internal Review Comments
Draft Environmental Assessment for Interbasin Transfer
Greenville Utilities Commission

Date:
September 4, 2008

Contact:
Mary Sadler

Phone:
919-854-1282

Email:
mary.sadler@arcadis-us.com

Our ref:
NC706015.0010

Dear Mr. Sipe:

The following are our responses to your internal review comments. The Draft EA has been modified where appropriate.

1. *The project description in Section 1.1 states that Greene County and the Town of Farmville are in the Contentnea Creek Sub-basin; however, on Figures 1-1 and 1-2 another sub-basin boundary is shown in the southwestern portion of Greene County. Also, it is stated in Section 3.4 that Greene County is entirely in the Contentnea Creek Sub-basin, which is not consistent with the information presented on Figures 1-1 and 1-2. This additional sub-basin should be identified in the document and factored into the environmental assessment of the Interbasin Transfer.*

   The southwestern portion of Greene County is located within the Neuse River subbasin. Approximately 5 percent of Greene County is estimated to be within the Neuse River subbasin. The remaining 95 percent is within the Contentnea Creek subbasin. Sections 1.1 and 3.4 of the EA has been updated accordingly. The total IBT request from the Tar River subbasin to the Contentnea Creek subbasin decreased from 8.5 mgd to 8.3 mgd, and the total IBT request from the Tar River subbasin to the Neuse River subbasin increased from 3.8 to 4.0 mgd. Figures 1-1 and 1-2 have been updated to identify this area as Neuse River subbasin.

2. *Did the current and projected water demand estimates for Greene County and the Towns of Farmville and Winterville used in the document take into account the current and future use of private water wells in these areas? The document appears to assume that all water in these areas is supplied by public water systems. The use of private water wells in the area should be included in the evaluation of water demand.*

   The IBT calculations do not take into account the current and future use of private wells. The IBT rules only apply to public water systems that exceed the minimum requirements for a water transfer. These communities would not have been able to justify their water demand projections based on private well water use, since those people are not currently served.

Personal communication with the Greene County Director of Public Utilities and the Farmville Town Manager (August 2008) revealed that over the last decade, the majority of new development has historically connected to the public water system, and would most likely continue to do so. Therefore, it follows that the rate of new private well construction is negligible compared to the rate of public utility connection.

3. *Justification for the cost estimates used in the alternative analysis presented in Section 4 should be provided.*

   The cost estimates in the Draft EA are conceptual engineering estimates based on a dollar per gallon treatment or conveyance capacity. This method is consistent with accepted engineering practice at the highest planning level. The dollar per gallon cost figures are based on recent certified bid tabulations for similar technology projects in the southeast. For example, in Section 4.2, a new 13.5 mgd nanofiltration plant and well field would cost between $5.0 and $6.0 per gallon. We rounded to $70 million. The estimated construction costs elsewhere in Section 4 were tabulated using the dollar per gallon method for similar treatment technology.

4. *In Section 4.5 it is implied that the only cost associated with the selected alternative of purchasing water from GUC would be $25 million for construction of 10 miles of 24 inch pipeline and a booster pump station. Can the water supply needs of all of Greene County and the Town of Farmville be met by just the construction of this pipeline? Would any other infrastructure improvements be required to implement this alternative? If so, these additional costs should be presented in the evaluation of the various alternatives.*

   The construction of the pipeline and booster pump station (FONSI, 2006) will meet the needs of Greene County until well past 2015. The booster pump station was designed to pump at a maximum rate of 4,200 gpd (5 mgd) for 20 hours, or 6 mgd in a 24-hour period. Replacing the pumps could provide up to 20 percent more capacity. It is possible that a second pipeline and booster pump station may be needed; however, it is unknown at this time where a second pipeline might be located (as water distribution systems are pressure dependent) and in what year a second pipeline might be installed. Given the uncertainties surrounding the need and timing of a second line, it would difficult to estimate a cost.

5. *It is stated in Section 6.3.1 that the project will not negatively affect either groundwater quality or quantity. Has the potential for future increased use of private water wells in the study area in response to increases in public water supply costs been evaluated?*

   The increased use of private water wells with respect to public water supply costs has not been specifically evaluated in the EA. The IBT rules only apply to public water systems that exceed the minimum requirements for a water transfer. Per our response to Question #2, new development has historically connected to the public water system in both Greene County and Farmville. It follows that the

rate of new private well construction is negligible compared to the rate of public utility connection.

Each community has already evaluated the impact of this project relative to other water treatment and distribution alternatives (Section 4 of the EA). The selected alternative is the most cost effective for current users, and was selected so as to not raise utility fees significantly.

If you have any questions, please do not hesitate to call. We hope that our responses to the Division's comments have clarified the points in the EA. As stated in the above responses, the EA has been modified to clarify and/or address the Division's comments. We respectfully request that DWR respond in writing stating that the Division's comments have been adequately addressed and the Final EA can be circulated through the Department of Administration Clearinghouse.

Sincerely,

ARCADIS G&M of North Carolina, Inc.

Mary E. Sadler, PE
Associate Project Manager

Copies:
Phil Fragapane
Steve Porter, PE
Barrett Lasater
Randy Emory, PE
David Briley, PE
Richard Wyche, PE
Lauren Elmore
Paul Leonard

Spencer, Miranda

From: Hannah Stallings [Hannah.Stallings@ncmail.net]
Sent: Thursday, September 04, 2008 1:44 PM
To: Sadler, Mary
Cc: Phil Fragapane
Subject: Re: Greenville Utility Commission IBT EA - Response to DWQ Comments

Mary -
Thank you very much for your responses.
DWQ appreciates the time and care taken to respond to and address all of our concerns. DWQ will not object to a FNSI being issued for the project as explained to us.
The only recommendation that I would have has to do with comment 20/section 6.3.2 - I would suggest that the last sentence be changed to "It follows that water quality will not be significantly negatively impacted."
Thanks.

Hannah Stallings

Sadler, Mary wrote:

> Hi Hannah and Phil,
> Attached is our letter responding to DWQ's review comments. Please
> call if you have any questions. Per Melba's cover letter, we will need
> something in writing from you before we can proceed to Clearinghouse.
> Thanks!
>
> ----------
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Ms. Hannah Stallings, SEPA Coordinator
North Carolina Division of Water Quality, Planning Section
1617 Mail Service Center
Raleigh, NC 27699-1617

WATER RESOURCES

Subject:
Response to Internal Review Comments
Draft Environmental Assessment for Interbasin Transfer
Greenville Utilities Commission

Date:
September 4, 2008

Contact:
Mary Sadler

Phone:
919-854-1282

Email:
mary.sadler@arcadis-us.com

Our ref:
NC706015.0010

Dear Ms. Stallings:

The following are our responses to your the Division of Water Quality (DWQ) review comments. The Draft EA has been modified where appropriate.

1. *Pages i and 1-1 state that the Central Coastal Plain Capacity Use Area (CCPCUA) rules will only be effective over a ten-year period.*
   a. *If the CCPCUA rules are only effective until 2018, please explain why the IBT planning period is until 2030.*

      The CCPCUA rules were effective in 2001. The year 2018 is the last required reduction in groundwater withdrawal, for a total of a 75 percent reduction in total withdrawal. Page 1-1 of the Draft EA explains in detail the phasing requirements of the CCPCUA rule.

      The planning period of 2030 is based on the permitted withdrawal of the Greenville Utilities Commission (GUC) Water Treatment Plant (WTP).

   b. *Does this mean that the utility of this project will cease after 2018?*

      No, the communities will have to maintain a 75 percent reduction in total groundwater withdrawal indefinitely.

2. *Please clarify which entity/entities are covered under the FONSI mentioned in the first paragraph of page ii.*

   The FONSI for the booster pump station and finished water line (McDavid and Associates, 2006) covers service to Greene County and the Town of Farmville. Page ii of the Draft EA has been modified for this clarification.

3. *Page 2-1, Section 2.2.1: Please clarify why Greene County is only expected to grow 1% in the next 20 years when its population increased by 25% between 1990 and 2006.*

   Greene County is expected to grow one percent per year, not a total of one percent over the next 20 years. Growth rates are not typically reported or evaluated as a percentage over a long span of time. Growth rates are typically reported on an annual basis as a "per year" percentage. In Greene County, the *average* annual growth rate between 1990 and 2006 is 1.4 percent. Over a sixteen year period, it is expected that a community would increase in population.

4. *Page 2-2, Section 2.2.3, Page 2-4, Section 2.3, and Section 3.3: DWQ recommends that this EA be contingent on the completion of Winterville's water system master plan to better ensure that capacity planning is more accurate.*

   The Town of Winterville's Water System Master Plan was completed in the spring of 2008. Water demand projections for the Town of Winterville presented in the EA were based on the bulk sales agreement between GUC and the Town of Winterville, and are consistent with the Master Plan.

5. *Page 2-7, Sections 2.3.2 and 2.3.3: Please clarify when Farmville and Winterville will determine whether they plan to pursue water banking.*

   In a letter dated July 6, 2004 (located in Appendix A of the Draft EA), the Town of Farmville has already received permission from the Division of Water Resources to use the water banking concept. The Town of Farmville has not decided on a definitive plan for managing the banking concept, but it is suspected that the Town will follow the lead of Greene County.

   The Town of Winterville submitted a letter of intent to the Division of Water Resources on August 12, 2008 requesting that a banked water account be established for the Town, effective August 12, 2008. It is suspected that the Town will follow the lead of Greene County for managing the banking concept.

6. *Page 2-11, Section 2.4.1: Please clarify whether Greenville will have to reduce and/or stop pumping from its groundwater wells. Please address this issue in Sections 5.3.4 and 6.3.1.*

   GUC's groundwater wells are subject to CCPCUA regulations and reduced pumping is required. GUC has used the wells on an emergency only basis since December 2002 when the disinfectant at the water treatment plant (WTP) was switched from free chlorine to chloramine. This policy was implemented in response to advice from the Washington Regional Office of the Division of Environmental Health, Public Water Supply Section, who was concerned that mixing surface and well water with different disinfectants would lead to water quality problems in the distribution system.

GUC is currently involved in a capital project that will add ammonia feed to all groundwater wells, in addition to the existing chlorine disinfectant systems. When this project is completed in February 2009, GUC will request that the wells be allowed to operate on an as needed basis. The long-term plan for the wells is to operate them primarily in conjunction with the Aquifer Storage and Recovery (ASR) wells to meet peak demands. The wells may also be operated periodically during WTP maintenance shut downs or when WTP raw water quality is poor.

Although it is possible that well use may increase after addition of ammonia feed is completed, utilizing the wells on an intermittent basis in response to short-term situations will allow GUC to meet the annualized groundwater withdrawal reduction requirements of the CCPCUA regulations. GUC's groundwater wells will be operated only to meet peak demands, not as a primary water supply source. The proposed IBT project is not dependent on use of these wells and will not significantly affect future well use. Section 2.4.1 has been updated to include this information.

Sections 5.3.4 and 6.3.1 have not been revised, as it is our policy to separate technical components in our environmental documents, such as existing facilities, from the more general discussions of environmental impacts.

7. *Section 2.4.4: DWQ recommends that treatment facilities for each of the 10 entities in Greene County be detailed as was done for the plants in Greenville, Farmville, and Winterville.*

   Section 4.4 of the Draft EA provides a detailed breakdown of the wastewater treatment facilities in Greene County. Table 4-2 provides the NPDES permit number, the receiving stream, the river basin, the county location, the permitted flow, the 12-month average flow, the percent plant capacity in use, and the projected 2030 wastewater flow. To avoid repetition in the EA, a comment will be added in Section 2.4 to refer the reader to Section 4.4 for a detailed analysis.

8. *Section 3.1: Please add that Greenville has eight groundwater wells.*

   Per our response to Question #6, GUC's groundwater wells are currently used only for emergency situations and will be used in the future in association with ASR wells to meet peak demands. At these times, GUC may limit distribution to Winterville, Farmville, and Greene County. GUS's groundwater wells will not be used as a water supply source for the proposed IBT project. Section 2.4 of the EA in lieu of Section 3.1 has been revised to clarify the use of GUC's wells.

9. *Section 3.1: Please stay abreast of the developments on Senate Bill 1879/House Bill 2499, which will require a municipality to begin planning for expansion when 80 percent of its water system's available water supply based on average daily demand has been allocated to current or prospective water users or the seasonal demand exceeds 90 percent.*

   Comment noted. GUC is in the process of planning an Instream Flow Analysis in the Tar River in anticipation of a future expansion of the WTP.

10. *Section 3.4: Please clarify why Greenville is planning to pump more water to customers in the proposed expanded service area during times of drought. It would seem that during times of water shortage that GUC would implement conservation measures that would reduce water use. In fact, page 3-9 states that "When GUC experiences peak demands [as in times of drought], GUC may limit distribution to the wholesale customers as necessary.*

    It seems that there are two separate issues that need explanation. First, GUC has required Farmville, Winterville, and Greene County to adopt the same water conservation measures (also termed Water Shortage Response) as GUC. The Water Shortage Response is codified in GUC's utility ordinance, and written into to each Water Purchase Agreement. Section 7-11 of the Draft EA provides information related to water shortage response. The response triggers are implemented based on river level stage at the WTP intake.

    The intent of the Water Purchase Agreement contract language is to provide the best possible terms for GUC and its wholesale customers. GUC intends to sell water to its wholesale customers beyond the minimum purchase so that their customers can bank water for use at other times. A purchase of water beyond the minimum purchase agreement does not have to correlate with a peak day demand. GUC has reserved the right to limit its wholesale customers if GUC is experiencing a peak event, whereby GUC's wholesale customers would rely on banked water, if necessary.

    Additionally, the emergency IBT condition was a request from DWR in the planning phase of the project, and was based on DWR's experience with Rocky Mount in the 2007 drought. An emergency would be if GUC's wholesale customer's wells ran dry or a major power outage occurred whereby the use of wells was no longer feasible. The IBT certificate would be written such that the emergency condition would only be triggered with permission of DWR.

11. *Section 3.5: Please explain why the contracts between GUC and the three municipal governments are valid for 40 years when the CCPCUA rules will only be in effect for 10 years and this EA is for a 20-year period. Please address this issue in Section 7, also.*

    The CCPCUA rules were effective in 2001 and will be in effect indefinitely, per page 1-1 of the Draft EA. The EA is written for a 20-year planning period based on the current permitted water treatment capacity of the GUC WTP. GUC is

currently pursuing the initial scoping process for the Instream Flow Analysis in the Tar River in anticipation of the next WTP expansion. This process is expected to take several years, so GUC is planning this environmental study well in advance of the next WTP expansion.

12. *Section 4.1:*
    a. *Please clarify whether Winterville would still receive up to 2 MGD of water from GUC if the no action alternative were selected.*

       Under the current IBT rule, GUC can sell up to 2 mgd of water to Winterville without an IBT certificate. However, this scenario is not a feasible long-term water supply solution.

    b. *The text states that "Average day demands will exceed the allowable groundwater well pumping rate in 2008 for Farmville, Winterville, and Greene County." What are their plans for water supply until this EA receives a FONSI and the EMC issues an IBT Certificate?*

       Under the current IBT rule, GUC can sell up to 2 mgd of water to Farmville, Winterville, and Greene County.

13. *Section 4.5:*
    a. *Please include that GUC has eight groundwater wells.*

       Per our response to Question #6, GUC's groundwater wells are currently used only for emergency situations and will be used in the future in association with ASR wells to meet peak demands. The groundwater wells will not be used as a water supply source for the proposed IBT project. Section 2.4 in lieu of Section 4.5 has been updated.

    b. *Please address the implications of passage of Senate Bill 1879/House Bill 2499 on the need for expanding GUC's treatment facility in the last sentence of this section.*

       Regardless of Senate Bill 1879/House Bill 2499, GUC is currently pursuing the initial scoping process for the Instream Flow Analysis in the Tar River in anticipation of the next WTP expansion. This process is expected to take several years, so GUC is planning this environmental study well in advance of the next WTP expansion.

14. *Section 5.2: Please note that DWQ prefers regional wastewater treatment systems to individual package plants serving individual communities.*

    A sentence was added to the second paragraph of Section 5.3 with the comment that DWQ prefers regional wastewater treatment systems in lieu of individual package plants.

15. *Section 5.3.3:*
    a. *Please update information in this section based on the draft version of the 2008 Neuse River Basinwide Water Quality Plan (http://h2o.enr.state.nc.us/basinwide/Neuse/2008/NeuseRiverBasinPlanDRAFT.htm).*

       Section 5.3.3 of the Draft EA was updated as requested. Table 5-1 was revised to include additional waterbodies and revised bioclassifications and use support ratings.

    b. *Please update information on impaired waters using the draft 2008 303(d) list (http://h2o.enr.state.nc.us/tmdl/documents/B.Draft2008303dList.pdf).*

       Section 5.3.3 of the Draft EA was updated as requested.

16. *Section 5.3.4: DWQ recommends that this EA be contingent on the completion of Pitt County's Comprehensive Water Resources Management Plan to better ensure that capacity planning is more accurate.*

    The Pitt County Comprehensive Water Resources Management Plan was completed in 2002 (literature citation).

17. *Section 6.1 mentions installation of ancillary water lines associated with this project. If these lines are necessary for the success of this project, then the projected impacts of their installation should be covered in section 6. If the construction of lines is integral to the project, please amend text in section 6 that say "No construction activities will occur relative to the proposed project."*

    Section 6.1 was amended to read "No other construction activities relative to the proposed IBT are proposed at this time."

18. *Please address whether GUC will continue pumping from its groundwater wells in section 6.3.1.*

    Per our detailed response to Question #6, GUC's groundwater wells are currently used only in emergency situations and will be used in the future in association with ASR wells to meet peak demands. Section 2.4 of the EA has been updated in lieu of Section 6.3.1. It is our policy to separate technical components in our environmental documents, such as existing facilities, from the more general discussions of environmental impacts.

19. *Page 6-3:*
    a. *Please clarify the year in the 5th bullet.*

       The year has been revised to "2030" in the fifth bullet.

b. *Please clarify the year in the 5th sentence of the last paragraph.*

The year in the 5th sentence of the last paragraph has been revised to "2002."

20. *Please add discussion of expected impacts to water quality in section 6.3.2.*

The Draft EA has been revised to add a section 6.3.3 Water Quality, as follows:

> *"Impacts to water quality as a result of the proposed project are not anticipated. The NPDES permit for the GUC WWTP is not being modified as a result of the proposed IBT. Additionally, the results of the hydrologic modeling (Section 6.3.2) indicate that the proposed interbasin transfer from the Tar River to the Neuse and Contentnea Creek subbasins will have minimal impact on the existing stream flow at Greenville. It follows that water quality will also be minimally impacted."*

21. *Section 7.1.8: Please clarify whether Greenville has implemented/formulated Stage 1, 2, and 3 conservation measures that were expected in January 2008.*

The GUC Water Emergency Management regulations (Utility Regulations Part C, Section 21) were amended by action of the Board of Commissioners to include supply triggers for all stages on July 29, 2008.

22. *It seems that if there are areas outside of the jurisdictions of Greenville, Winterville, and Greene County that could be served by this project, then Pitt County should be a partner in an IBT agreement. Please respond.*

Pitt County does not operate a public utility. Only public utilities are affected by the IBT rule. Any areas in Pitt County served by water would be served by an entity (GUC or Farmville) already subject to the IBT rule.

23. *Section 7.3.1: If Farmville's proposed Land Use Plan is expected to mitigate impacts from this project, DWQ recommends waiting until the Town has implemented the Plan before approving this EA and the IBT Certificate.*

The Town of Farmville adopted a Revised Land Use Plan on June 3, 2008. Details of the Land Use Plan have been added to Section 7.3.1 of the EA.

24. *Section 7.3.3.1: Please clarify whether the Pitt County Greenway Plan was passed by the county commissioners.*

The Pitt County Greenway Plan 2025 was adopted by the Farmville Board of Commissioners on January 3, 2006, the same day it was recommended for adoption. Section 7.3.3.1 has been amended for clarity.

25. *Section 7.4.1.2 states that Winterville "will disapprove any new development activity proposed within [buffer zones], unless approved by DWQ." While new structures constructed in the buffer zone will require a variance from DWQ, such intrusions are not always approvable. It is recommended that the town refers to the DWQ Red Book of Rules to become familiar with buffer regulations associated with the Neuse and Tar-Pamlico Rules (http://h2o.enr.state.nc.us/admin/rules/documents/redbook_1may07_full_with_cover.pdf). Applications and further buffer information can be viewed at the following website: http://h2o.enr.state.nc.us/ncwetlands/RiparianBufferRules.htm.*

    Comment noted.

26. *DWQ recommends that ordinances affecting growth within each of the 10 areas of Greene County served by the proposed project be presented in section 7.5.*

    The ten communities within Greene County are small enough that they follow the County ordinances. Very small communities do not have the resources to staff planning and engineering departments.

27. *It appears that the municipalities involved in this project have floodplain regulations that are designed to protect property owners from damage and to allow them to purchase insurance protection against losses from flooding, not for the protection of natural resources. DWQ recommends that development not be allowed within the 100-year floodplain. Undeveloped floodplains strongly influence aquatic systems by providing and important sediment trapping function. The filling of floodplains increases the potential for flooding of adjacent properties and interferes with the natural hydrologic process of the waterways.*

    Comment noted. However, a one to three percent growth rate will not directly affect development in the 100-year floodplain. Floodplain development is also considered in the City of Greenville's Horizon's Plan. Specific implementation strategies include discouraging improvements of any kind in undisturbed areas within the 100-year floodplain, and encouraging recreational, agricultural, or other low-intensity uses within the floodplain. Pitt County has designated many areas within the floodplain as Agricultural/Open/Natural Resource to further limit development.

28. *DWQ recommends year-round water conservation to preserve this vital resource. Winterville, Farmville, and Greene County should develop new ordinances that require measures such as reclaimed water systems and low flow devices for all new development and redevelopment.*

    GUC and their wholesale customers have implemented year-round water conservation measures, termed "Water Shortage Response." The development of a reclaimed water system will be difficult given that centralized and regional wastewater treatment in these rural areas is non-existent, thus making reclaimed water physically unavailable.

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GUC and its wholesale customers strongly encourage the use of water saving devices. GUC is a licensed member of the national "Water Use it Wisely" campaign. The Energy Services and Public Information Offices incorporate water conservation messages into all communications. This includes preparation of fact sheets, television and radio advertisements, print ads, and billboards to provide local citizens with water conservation tips. This information was added to Section 7.1.8.

If you have any questions, please do not hesitate to call. We hope that our responses to the Division's comments have clarified the points in the EA. As stated in the above responses, the EA has been modified to clarify and/or address the Division's comments. We respectfully request that DWQ respond in writing stating that the Division's comments have been adequately addressed and the Final EA can be circulated through the Department of Administration Clearinghouse.

Sincerely,

ARCADIS G&M of North Carolina, Inc.

Mary E. Sadler, PE
Associate Project Manager

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Phil Fragapane
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Mr. Phil Fragapane
North Carolina Division of Water Resources
1611 Mail Service Center
Raleigh, NC 27699-1611

WATER RESOURCES

Subject:
Response to Internal Review Comments
Draft Environmental Assessment for Interbasin Transfer
Greenville Utilities Commission

Date:
September 26, 2008

Contact:
Mary Sadler

Phone:
919-854-1282

Email:
mary.sadler@arcadis-us.com

Our ref:
NC706015.0010

Dear Mr. Fragapane:

The following are our responses to the Division of Water Resources (DWR) review comments. The Draft EA has been modified where appropriate.

1. *EA needs better quality maps. Figure 7.2 legend is difficult to read. Figures 7-3 to 7-4 are difficult to read.*

   Ms. Sadler states, in her 2-1-08 letter, that figures will not be re-created due to "copyright and privilege issues." I believe that land-use and zoning ordinances and the maps created from this information would be public record information. If the maps that ARCADIS created are privileged, we should be able to get them from the applicant.

   Our February 1, 2008 response to this question included in the Division's completeness review comments did state that these figures would not be re-created. The information contained in the maps is public information, and is readily available for download at www.co.pitt.nc.us/depts/planning/ordinances/landuseindex.shtml and www.greenvillenc.gov/departments/community_development/information. The maps that are included in the EA were obtained from these websites. Since we did not produce the original maps for Pitt County nor have access to their GIS database, we are not able to improve the resolution of the maps. We have reproduced larger copies of these maps, attached to this letter.

2. *More detailed maps with larger scales, such as land use maps instead of Figure 5.1. Perhaps break maps into quadrates [sic].*

   Ms. Sadler states, in her 2-1-08 letter, that the "land use figure has been deleted from the text per the response to comment #1." I am confused by this response. In comparing the new and old drafts, I cannot locate the figure that was deleted. Her response also goes back to the issue in #1 above.

   Also, Ms. Sadler states that "Greene County is a very rural county with many small towns and unincorporated areas. Thus, the county has not enacted zoning

regulations for unincorporated areas or invested in comprehensive land use planning."

What about small towns or incorporated areas? Do they have zoning or land use plans? Also, just because a county is rural doesn't mean that growth will not occur and planning should exist to guide this growth.

It was ultimately decided to leave the land use maps in the Draft EA for informational purposes. We apologize for the confusion. Please refer to our response to Question #1. We have attached larger maps to this correspondence.

As stated our February 1, 2008 letter, in addition to Greene County, the small towns and incorporated areas in Greene County do not have land use plans or zoning. The County does have a Code of Ordinances developed by their Planning and Economic Development Department that guides building regulations and subdivision approval.

3. *The document dismisses cumulative and secondary impacts associated with growth by repeatedly stating that the project is primarily a water replacement project and significant growth is not a component of this project or a reason for developing the IBT request. It is true that they are being forced to switch to surface water and that initially the volume of surface water matches the volume of ground water; however, over time the volume of water increases due to growth projections that the communities would have supported with an untapped volume of ground water.*

   Ms. Sadler states, in her 2-1-08 letter, that this is a water replacement project and significant growth is not a reason for requesting the IBT. However, the last paragraph on page 4-1 of the document, under no-action alternative, states that these communities will be unable to compensate for the reduced groundwater withdrawals for predicted growth to 2030. This additional growth and associated impacts, are reflected in Section 4.2 (Independent water supply).

   Section 4.1 states that "Without provisions for an additional water supply, the Town of Farmville, Town of Winterville, and Greene County will not be able to meet the needs of their existing customers. Additionally, these communities will be unable to compensate for the reduced groundwater withdrawals for predicted growth to 2030." The required reductions in groundwater withdrawal result in a net loss of water supply such that the water supply needs for existing customers as well as for future customers will not be met.

   Section 4.2 is a hypothetical analysis of groundwater and surface water supply options (other than the Tar River via the Greenville Utilities Commission) as an alternative to the proposed IBT.

   The Draft EA does not dismiss the secondary and cumulative impact issue, as stated in our February 1, 2008 response letter. The IBT will not induce growth as this project is not being pursued to encourage growth. This project is being requested to replace a water supply that has been curtailed by the Division's capacity use regulations. We agree with the Division that if the capacity use rules

were not in effect, groundwater would continue to be used as the sole water supply source. The growth rate remains the same regardless of whether groundwater or another water supply option, such as the proposed IBT, would be used. It is expected that a community will grow at some rate, and it is our opinion that 1.4% annual growth rate does not qualify as induced. A 1.4% annual growth rate is low, and is consistent with growth rates in other similar rural counties.

4. *In general, service areas and the areas to evaluate impacts (study area) do not always necessarily match. Impacts travel downstream and downwind. The study area to evaluate impacts needs to be delineated around each projected 2030 service area.*

   Ms. Sadler states, in her 2-1-08 letter, that "downstream impacts due to the proposed withdrawal have been addressed in the water balance model by ENTRIX." Direct, secondary and cumulative impacts are not limited to the withdrawal from the Tar River, but include water features that drain those areas served by the IBT.

   We stated in our February 1, 2008 letter that we expected the growth to occur entirely within Greene County. Greene County is essentially the service area for this project. The replacement water supply to account for the capacity use rules and the additional water to account for the community growth will not occur outside Greene County.

   The Division's second comment is duly noted. However, we feel that a slow growth rate of 1.4% should not significantly affect water features drained by the areas served by the IBT.

5. *Regarding the project description and executive summary, please state that the CCPCUA rules were enacted on August 1, 2002. Also, there are 3 aquifers that are in the Cretaceous aquifer system that face reductions from 2008 to 2018.*

   Comment noted. The requested changes were made to the Draft EA.

6. *The following is an incorrect statement: "The rules will be effective over a ten year period."*

   This statement has been modified to read: "The rules will be implemented over a ten year period." We apologize for the confusion of the wording of that sentence.

7. *Please revise the word "consumption" to "withdrawals" in the last sentence of the first paragraph.*

   The Draft EA was modified as requested.

8. *Page 2-4: Winterville does have approval to bank.*

   Comment noted. The EA has been modified.

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Mr. Phil Fragapane

9. *Tables 2-2 and 2-4 need to be updated with data off of the DWR webpage.*

   Tables 2-2 through 2-4 have been updated with the most recent data.

10. *In the third paragraph of Section 2.3.1, Greene County's ABR needs to be revised to 1079.8 million gallons per year (mgy) (2.96 mgd). Also, the average annual pumping in 2018 is 0.740 mgd.*

    Values reported in the Draft EA were based on GUC's Water Purchase Agreement with Greene County, which was completed before final ABR values were received. The Draft EA has been modified to reflect the approved values.

11. *In the second paragraph of Section 2.3.2, Farmville's ABR is 574 mgy (1.572 mgd). In 2018, the annual withdrawal is 0.393 mgd.*

    Values reported in the Draft EA were based on GUC's Water Purchase Agreement with Greene County, which was completed before final ABR values were received. The Draft EA has been modified to reflect the approved values.

12. *Section 5.1.2: This is a weak description of the geology in this section.*

    Comment noted.

If you have any questions, please do not hesitate to call. We hope that our responses to the Division's comments have clarified issues that the Division raised in their completeness review letter. The EA has been modified to clarify and/or address the Division's comments. We respectfully request that a written response be provided so that the Final EA can be circulated through the Department of Administration Clearinghouse.

Sincerely,

ARCADIS G&M of North Carolina, Inc.

Mary E. Sadler, PE
Associate Project Manager

Copies:

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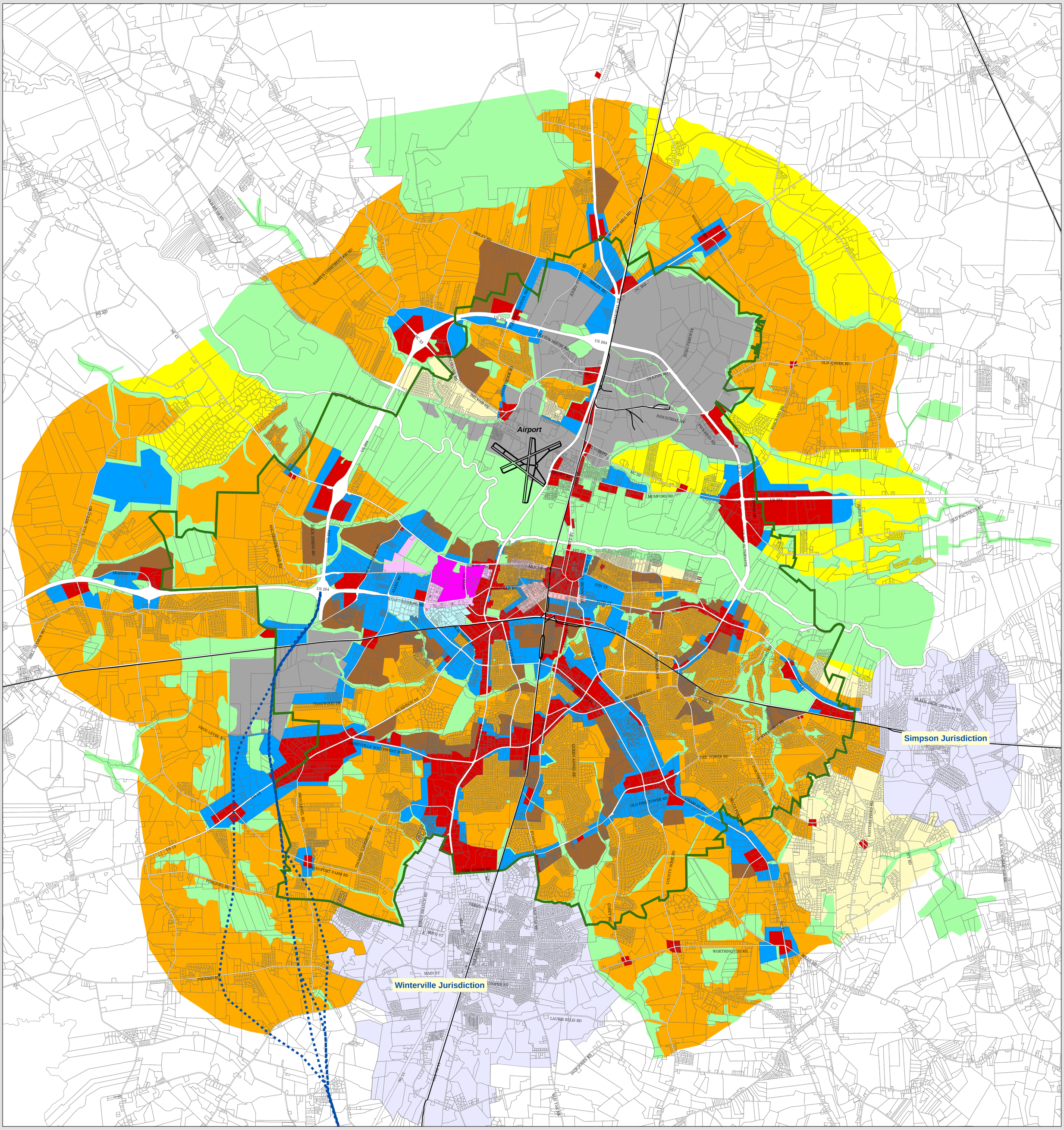
Gabrielle Cooper	Randy Emory, PE
Nat Wilson	David Briley, PE
Fred Tarver	Richard Wyche, PE
Steve Porter, PE	Lauren Elmore

Current Land Use Plan Map

City of Greenville, NC

Adopted on February 12, 2004



Map Legend

- Industrial
- Commercial
- Mixed Use / Office / Institutional
- Medical Core
- Medical Transition
- Office / Institutional / Medical
- Office / Institutional / Multi-Family
- High Density Residential
- Medium Density Residential
- Low Density Residential
- Very Low Density Residential
- Conservation / Open Space
- Land Parcels
- Greenville ETJ
- Adjoining Municipal Jurisdictions
- Southwest Bypass Options
- Railroad Tracks

N

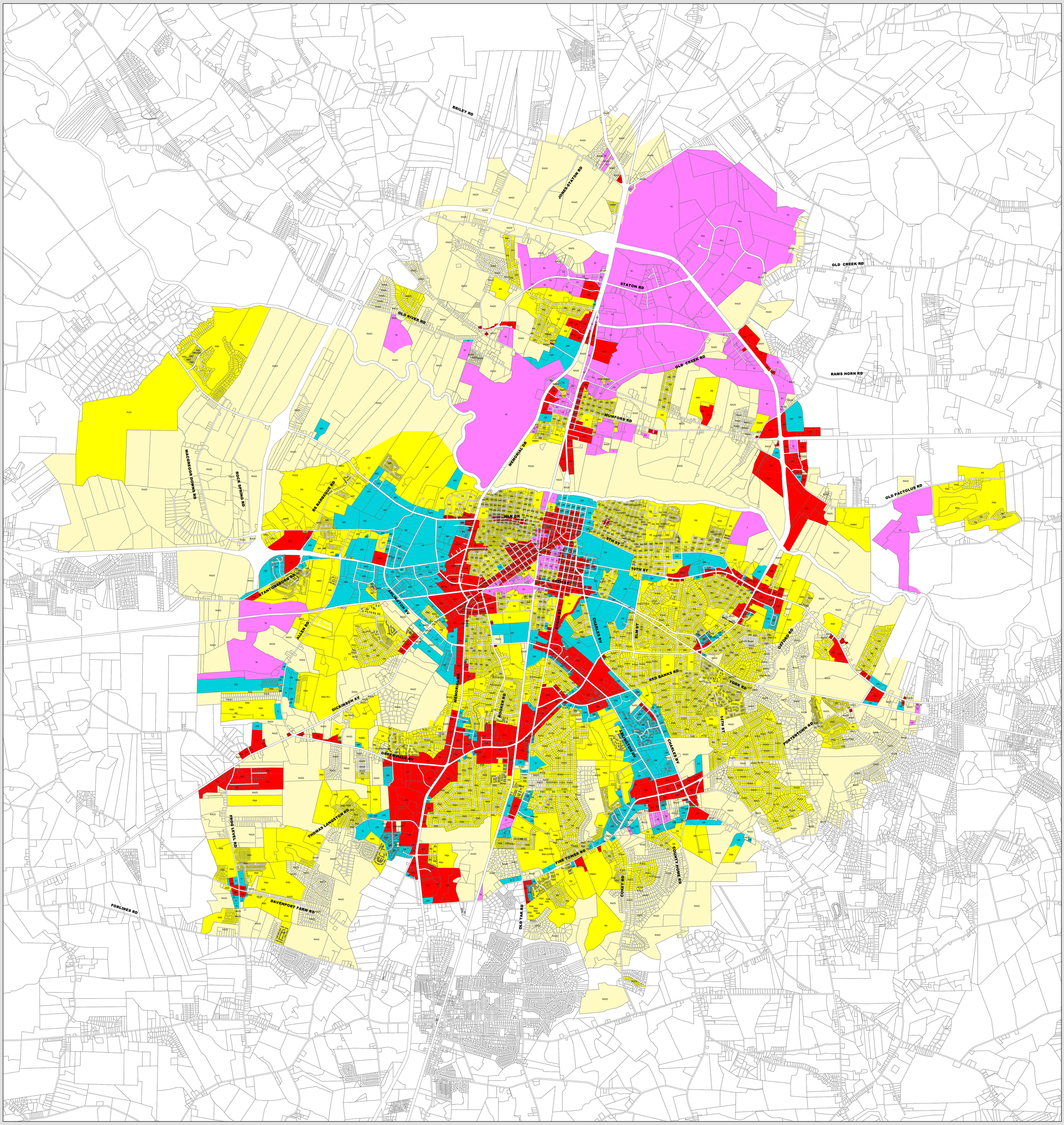
0 5,000 10,000 20,000 30,000 40,000 Feet

Scale: 1" = 2,500'

Official Zoning Map

City of Greenville, NC

April 22, 2005



Map Legend

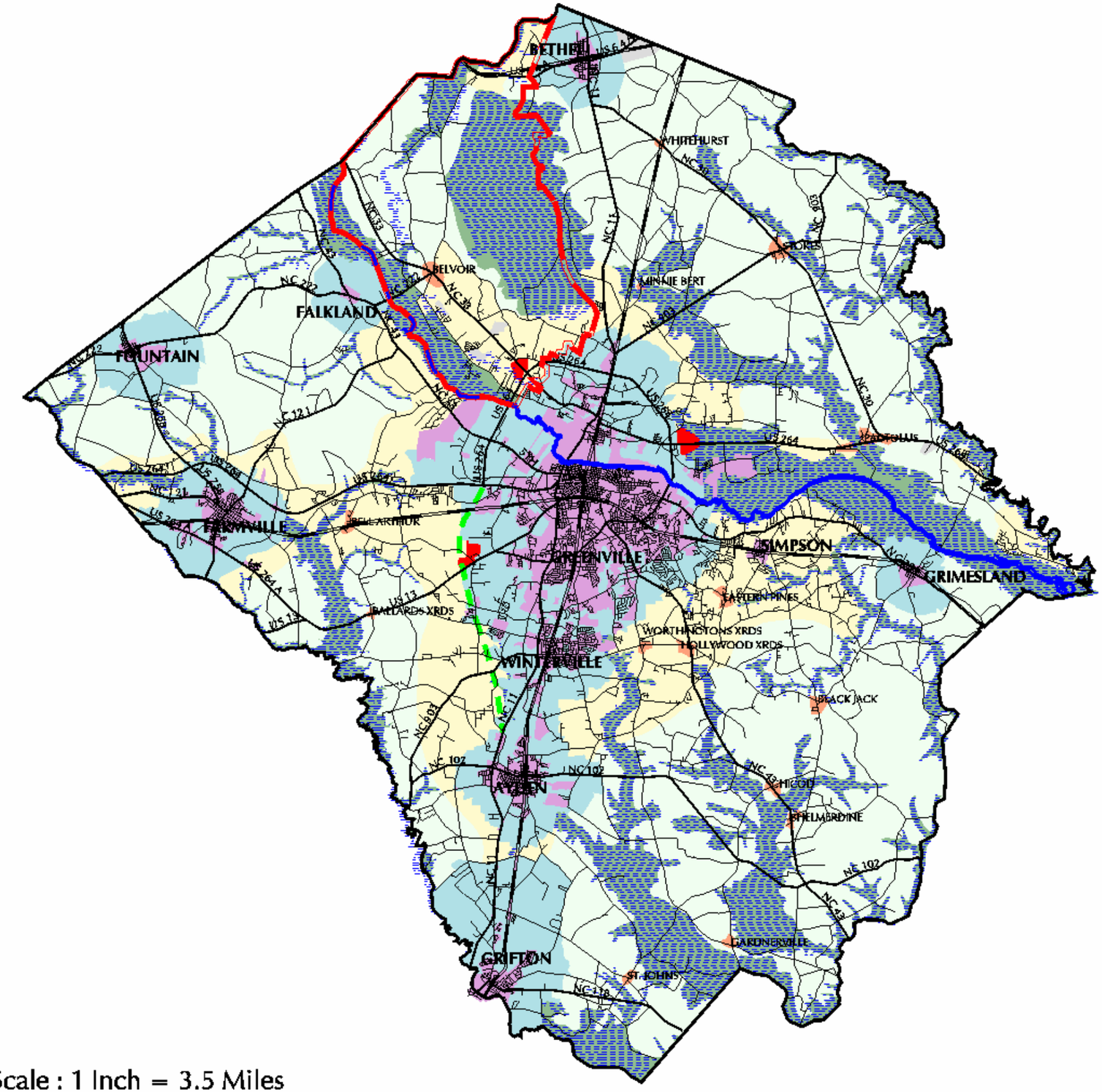
- Commercial
- Industrial
- Office & Institutional
- Residential
- Residential / Agricultural
- Land Parcels

N

0 4,350 8,700 17,400 26,100 34,800 Feet

Scale: 1" = 2,000'

Map 3-1
Future Land Use Map



AGRICULTURAL / OPEN / NATURAL RESOURCE

100 Year Floodplain

RURAL RESIDENTIAL / AGRICULTURAL

SUBURBAN RESIDENTIAL

RURAL COMMERCIAL / CROSSROAD COMMUNITY

COMMERCIAL / LIGHT INDUSTRIAL

INDUSTRIAL

City Limit

Extraterritorial Jurisdiction (ETJ)

Northwest Planning and Zoning Boundary

NC 11 (Proposed) Southwest Bypass

Tar River

Major Thoroughfares

Secondary Roads

Rail Corridors

County Line

Scale : 1 Inch = 3.5 Miles

Map Produced By :
Pitt County Planning Department

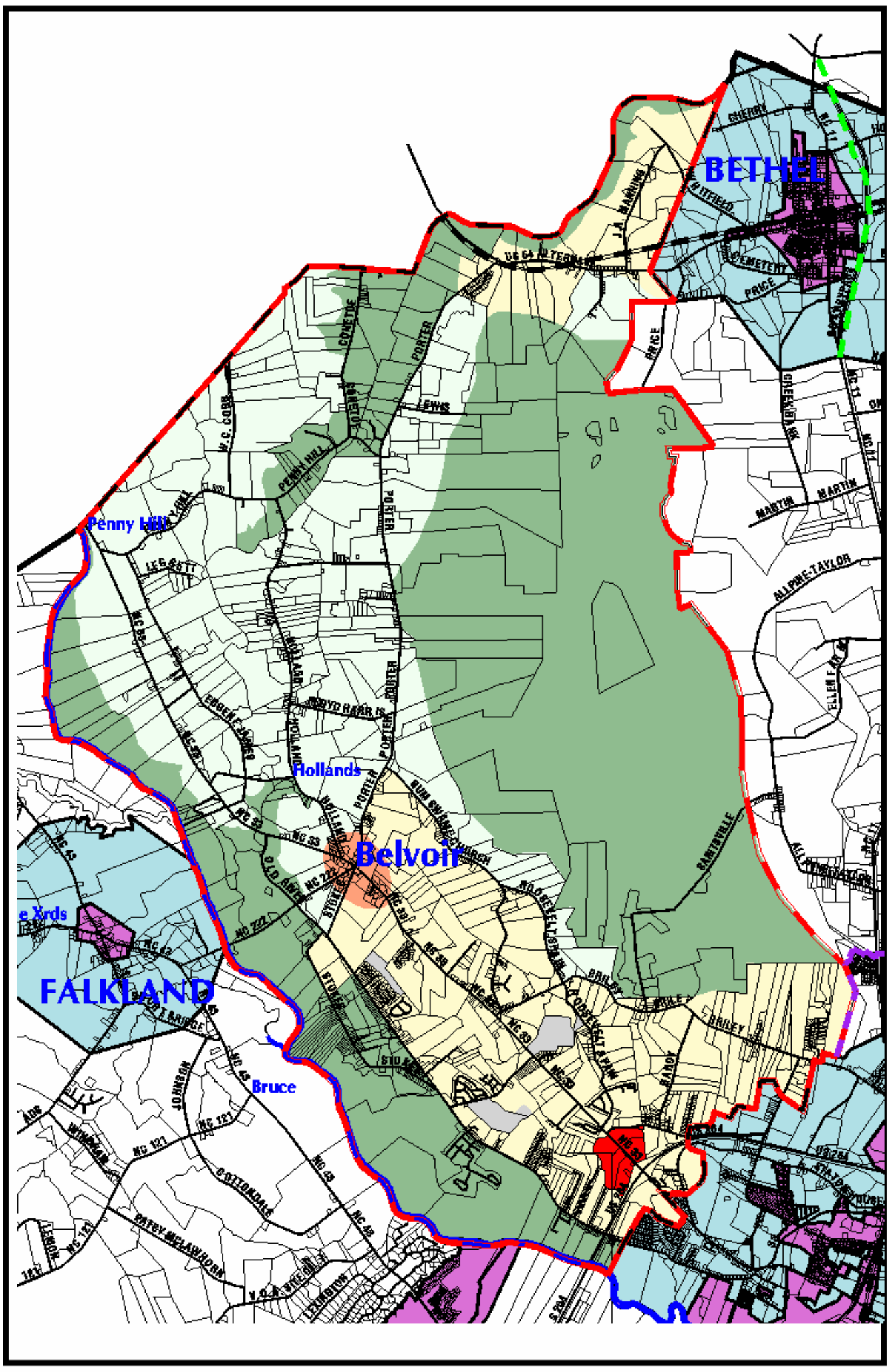
MAP 3-1 FUTURE LAND USE

ADOPTED JANUARY 8, 2001

- AGRICULTURAL/OPEN/ NATURAL RESOURCE
- RURAL RESIDENTIAL/ AGRICULTURAL
- SUBURBAN RESIDENTIAL
- RURAL COMMERCIAL/ CROSSROAD COMMUNITY
- COMMERCIAL/LIGHT INDUSTRIAL
- HEAVY INDUSTRIAL
- 100-YEAR FLOODPLAIN
- RAILROAD
- PROPOSED HIGHWAYS
- CITY LIMITS
- EXTRATERRITORIAL JURISDICTION (ETJ)
- PLANNING & ZONING AREA BOUNDARY
- PROPOSED ONE MILE EXTENSION OF GREENVILLE ETJ

SCALE: 1 INCH = 1.25 MILES

MAP PRODUCED BY
PITT COUNTY PLANNING
DEPARTMENT



MAP 3-1
FUTURE LAND USE
ADOPTED JANUARY 8, 2001