TRIANGLE REGIONAL WATER SUPPLY PLAN

VOLUME I – REGIONAL NEEDS ASSESSMENT

Collaboration for Sustainable and Secure Water Supply for the Triangle Region

Prepared For:

Jordan Lake Partners

Prepared By:

Triangle J Council of Governments

February 20, 2012

(Corrected: March 8, 2012)

Acknowledgments

This document was produced through the collaborative effort of staff from the Triangle J Council of Governments, Fountainworks, LLC and the members of the Jordan Lake Partnership, who demonstrated a remarkable commitment to working together to produce the best possible product. Never before has a water supply planning document of this kind been developed for the Triangle Region with this level of coordination, technical merit and peer-review.

Completion of this document would not have been possible without the commitment and support of the Partnership members, who engaged at multiple levels from technical staff and contractors to senior staff leaders. Partnership members each devoted time and resources throughout this iterative process.

Special thanks goes to the Jordan Lake Partnership Technical Review Team, which included representatives of each Partnership member and provided essential guidance on every aspect of the planning process. The Technical Review Team members are listed below:

Tim Donnelly, Town of Apex
John Cratch, Town of Apex
Jessica Bolin, Town of Apex
Leila Goodwin, Town of Cary
Sydney Miller, Town of Cary
David Hughes, Chatham County
Don Greeley, City of Durham
Vicki Westbrook, City of Durham
Kenny Keel, Town of Hillsborough
Stephanie Sudano, Town of Holly Springs
Amanda Boone, Town of Morrisville
Richard Cappola, Town of Morrisville
Tom Davis, Orange County
Ed Holland, Orange Water and Sewer Authority
William Terry, Town of Pittsboro
Scott Jewell, Town of Pittsboro
Becky Smith, Hydrostructures, PA (Consultant for the Town of Pittsboro)
Kenneth Waldroup, City of Raleigh
Victor Czar, City of Sanford
Paul Weeks, City of Sanford
John Roberson, Wake County
Warren Miller, Fountainworks, LLC
Lars Hanson, Triangle J Council of Governments
Mike Schlegel, Triangle J Council of Governments

Additional thanks goes to the City of Durham, which serves as the Lead Agency and fiscal and contracting agent for the Jordan Lake Partnership. Theodore Voorhees serves as the Chairman of the Jordan Lake Partnership. Funding for this project was provided by the members of the Jordan Lake Partnership through a shared cost structure.

Table of Contents

SECTION I. BACKGROUND AND PURPOSE 1
BACKGROUND 1
PURPOSE 1
PROCESS 2

SECTION II. JORDAN LAKE PARTNERSHIP 3

SECTION III. WATER SYSTEMS INCLUDED IN THIS REPORT 5
TOWN OF APEX 6
TOWN OF CARY 6
CHATHAM COUNTY – NORTH 6
CITY OF DURHAM 7
TOWN OF HILLSBOROUGH 7
TOWN OF HOLLY SPRINGS 7
TOWN OF MORRISVILLE 7
ORANGE COUNTY 8
ORANGE WATER AND SEWER AUTHORITY 8
TOWN OF PITTSBORO 8
CITY OF RALEIGH AND MERGER PARTNERS 8
CITY OF SANFORD 9
WAKE COUNTY – RESEARCH TRIANGLE PARK (RTP) SOUTH 9

SECTION IV. SYSTEM SERVICE AREAS 11
METHODS 11
DISCUSSION 11

SECTION V. SYSTEM INTERCONNECTIONS 13

SECTION VI. SERVICE AREA POPULATION ESTIMATES 19

SECTION VII. HISTORICAL FINISHED WATER USE 23

SECTION VIII. WATER DEMAND PROJECTIONS 25
DEMAND PROJECTION METHODOLOGIES AND PEER REVIEW PROCESS 25
WATER DEMAND PROJECTIONS 25
DEMAND PROJECTIONS BY SECTOR 28

SECTION IX. WATER SUPPLY SOURCES 31
CURRENT WATER SUPPLY SOURCES 31

SECTION X. FUTURE WATER SUPPLY NEEDS 33

SECTION XI. INDIVIDUAL SYSTEM SUMMARIES 35
TOWN OF APEX 37
TOWN OF CARY 41
CHATHAM COUNTY – NORTH 55
CITY OF DURHAM 59
TOWN OF HILLSBOROUGH 65
TOWN OF HOLLY SPRINGS 69

TOWN OF MORRISVILLE (PART OF THE TOWN OF CARY'S SERVICE AREA)....75
ORANGE COUNTY....78
ORANGE WATER AND SEWER AUTHORITY (OWASA)....81
TOWN OF PITTSBORO....87
CITY OF RALEIGH AND MERGER PARTNERS....93
CITY OF SANFORD....99
WAKE COUNTY – RTP SOUTH....103

List of Tables

Table 1. Current Jordan Lake Allocations (Shares, approximately equal to MGD) 5
Table 2. Preliminary Interconnection Water Transfer Capacities between Partners and with other utilities in the Region (MGD). 17
Table 3. Triangle Area Water Systems – Future Service Area Population Estimates. 19
Table 4. Triangle Area Water Systems - Future Service Area Population Estimates by County. 21
Table 5. Triangle Area Water Systems – Historical Finished Water Use/Production. 23
Table 6. Triangle Area Water Systems – Total Projected Future Water Demand. (MGD) 26
Table 7. Average day raw water supply capacity of water sources used by Partnership members (MGD). 31
Table 8. Triangle Area Water Systems -Future Water Supply Needs (MGD). 33
Table 9. Apex Historical Finished Water Production. 37
Table 10. Apex Future Demand Projections (MGD). 38
Table 11. Apex Future Demand Projections (percent of total demand). 38
Table 12. Apex Water Supply (MGD). 40
Table 13. Apex Future Water Supply Need (MGD). 40
Table 14. Cary Historical Finished Water Production. 41
Table 15. Cary Future Projected Demand (MGD). 42
Table 16. Cary Future Projected Demand (percent of total demand). 42
Table 17. Town of Cary Water Demand Unit Factors. 45
Table 18. Town of Morrisville Water Demand Unit Factors (from CH2M Hill, 2011). 45
Table 19. Town of Cary Water System Non-Revenue Data Analysis, Jan 2001- Dec 2010 (MGD). 47
Table 20. Cary/Apex WTP Raw Water Demand to Finished Water Produced Ratio. 47
Table 21. Water Service Connection Categories, Description, and Method of Determination. 48
Table 22. Water Service Connection Category Parcel Build-out Rates. 50
Table 23. Cary Water Supply (MGD). 54
Table 24. Cary Future Water Supply Need (MGD). 54
Table 25. Chatham County – North Historical Finished Water Production. 55
Table 26. Chatham County - North Future Projected Demand (MGD). 56
Table 27. Chatham County- North Future Projected Demand (percent of total demand). 56
Table 28. Chatham County – North Water Supply (MGD). 58
Table 29. Chatham County North Future Water Supply Need (MGD). 58
Table 30. Durham Historical Finished Water Production. 59
Table 31. Durham Future Projected Demand (MGD). 60
Table 32. Durham Future Projected Demand (percent of total demand). 60
Table 33. Durham Water Supply (MGD). 62
Table 34. Durham Future Water Supply Need (MGD). 63
Table 35. Hillsborough Historical Finished Water Production. 65
Table 36. Hillsborough Future Projected Demand (MGD). 66
Table 37. Hillsborough Future Projected Demand (percent of total demand). 66
Table 38. Hillsborough Water Supply (MGD). 68
Table 39. Hillsborough Future Water Supply Need (MGD). 68

Table 40. Holly Springs Historical Finished Water Use (finished water purchased from Harnett County). 69
Table 41. Holly Springs Future Projected Demand (MGD).....70
Table 42. Holly Springs Future Projected Demand (percent of total water demand). 70
Table 43. Three-Year Highest Average Daily Water Usage by Water Type (adapted from CDM, 2011). 72
Table 44. Holly Springs Future Water Account Distribution Scenario (from CDM, 2011). 72
Table 45. Holly Springs Water Supply (MGD).....73
Table 46. Holly Springs Future Water Supply Need (MGD).....73
Table 47. Morrisville Historical Finished Water Use.....75
Table 48. Morrisville Future Projected Demand (MGD).....76
Table 49. Morrisville Future Projected Demand (percent of total demand).....76
Table 50. Morrisville Water Supply (MGD).....77
Table 51. Morrisville Future Water Supply Need (MGD). 77
Table 52. Orange County Future Demand Projections (MGD).....78
Table 53. Orange County Future Demand Projections (percent of total demand). 78
Table 54. Orange County Water Supply (MGD). 80
Table 55. Orange County Future Water Supply Need (MGD).....80
Table 56. OWASA Historical Finished Water Production.....81
Table 57. OWASA Future Water Demand Projections (MGD).....82
Table 58. OWASA Future Water Demand Projections (percent of total demand). 82
Table 59. OWASA Water Supply (MGD). 85
Table 60. OWASA Future Water Supply Need (MGD).....86
Table 61. Pittsboro Historical Finished Water Production.....87
Table 62. Pittsboro Future Water Demand Projection (MGD).....88
Table 63. Pittsboro Future Water Demand Projection (percent of total demand). 88
Table 64. Pittsboro Water Supply (MGD).....91
Table 65. Pittsboro Future Water Supply Need (MGD).* 91
Table 66. Raleigh Historical Finished Water Production.....93
Table 67. Raleigh Future Water Demand Projection (MGD).....94
Table 68. Raleigh Future Water Demand Projection (percent of total demand). 94
Table 69. CORPUD rate tiers.....96
Table 70. Raleigh Existing Water Supply (MGD). 96
Table 71. Raleigh Future Water Supply Need (MGD).....97
Table 72. Sanford Historical Finished Water Production.....99
Table 73. Sanford Future Water Demand Projection (MGD). 100
Table 74. Sanford Future Water Demand Projection (percent of total demand).....100
Table 75. Sanford Water Supply (MGD). 102
Table 76. Sanford Future Water Supply Need (MGD). 102
Table 77. Wake County – RTP South Historical Finished Water Production.....103
Table 78. Wake County – RTP South Future Projected Demand (MGD). 104
Table 79. Wake County – RTP South Future Projected Demand (percent of total demand).....104
Table 80. Wake County – RTP South Water Supply (MGD). 107
Table 81. Wake County – RTP South Future Water Supply Need (MGD).....107

List of Figures

Figure 1. Triangle Area Water Systems – Future Service Areas.....12
Figure 2. Triangle Area Water Sharing Agreements.....14
Figure 3. Map of Interconnections between Triangle Area water systems. 15
Figure 4. Graphical summary of physical interconnections between the water systems in the region *(information from Hazen and Sawyer, 2011).* 16
Figure 5. Triangle Area Water Systems – Future Service Area Population Estimates. 20

Figure 6. Triangle Area Water Systems – Historical Finished Water Production/Use. 24
Figure 7. Triangle Area Water Systems – Total Projected Demands. (MGD). 26
Figure 8. Triangle Area Water Systems – Projected Water Demand in 2010, 2040 and 2060. 27
Figure 9. Relative Sector Demand as Percent of Total Demand in 2010, 2040 and 2060. 29
Figure 10. Apex Historical Finished Water Use (MGD).....38
Figure 11. Cary Historical Finished Water Use (MGD).....42
Figure 12. Cary residential per capita demand, 1995-2010.....53
Figure 13. Cary total water use per capita, 1995-2010.....53
Figure 14. Chatham County – North Historical Finished Water Use (MGD).....56
Figure 15. Durham Historical Finished Water Use (MGD). 60
Figure 16. Hillsborough Historical Finished Water Use (MGD). 66
Figure 17. Holly Springs Historical Finished Water Use/Purchase (MGD). 70
Figure 18. Holly Springs historic population data and future population estimates (from CDM, 2011). 71
Figure 19. Morrisville Historical Finished Water Use/Purchase (MGD).....76
Figure 20. OWASA Historical Finished Water Production (MGD). 82
Figure 21. OWASA historical and Projected Raw Water Demands (from OWASA, 2010). 85
Figure 22. Pittsboro Historical Finished Water Production (MGD).....88
Figure 23. Raleigh Historical Finished Water Production (MGD).....94
Figure 24. Sanford Historical Finished Water Use (MGD).....100
Figure 25. Wake County – RTP South Historical Finished Water Use/Purchase (MGD). 104
Figure 26. Wake County – RTP South Future Demand Projections. 106

Appendices

Appendix A – Town of Apex Supporting Documents
Appendix B – Town of Cary Supporting Documents
Appendix C – Chatham County – North Supporting Documents
Appendix D – City of Durham Supporting Documents
Appendix E – Town of Hillsborough Supporting Documents
Appendix F – Town of Holly Springs Supporting Documents
Appendix G – Town of Morrisville Supporting Documents
Appendix H – Orange County Supporting Documents
Appendix I – OWASA Supporting Documents
Appendix J – Town of Pittsboro Supporting Documents
Appendix K – City of Raleigh and Merger Partners Supporting Documents
Appendix L – City of Sanford Supporting Documents
Appendix M – Wake County – RTP South Supporting Documents

List of Abbreviations and Acronyms

TRWSP	-	Triangle Regional Water Supply Plan
DENR	-	Department of Environment and Natural Resources
DWR	-	Division of Water Resources
EMC	-	Environmental Management Commission
JLP	-	Jordan Lake Partnership
OWASA	-	Orange Water and Sewer Authority
TJCOG	-	Triangle J Council of Governments
RTP	-	Research Triangle Park
RTF	-	Research Triangle Foundation
CAWTP	-	Cary Apex Water Treatment Plant
USACE	-	United States Army Corps of Engineers
CORPUD	-	City of Raleigh Public Utilities Department
TAZ	-	Traffic Analysis Zones
EDD	-	economic development district
ETJ	-	extra-territorial jurisdiction
gpd	-	gallons per day
gpcd	-	gallons per capita per day
gphd	-	gallons per household per day
IBT	-	inter basin transfer
MGD	-	million gallons per day
pph	-	persons per household
SFR	-	single family residential
USA	-	urban services area
WTP	-	water treatment plant
WWTP	-	wastewater treatment plant
WRF	-	water reclamation facility

This page left intentionally blank.

SECTION I. BACKGROUND AND PURPOSE

Background

During the past 10 years, the Research Triangle Region (Region) has experienced two historic droughts that highlighted the need for a cooperative approach to water supply planning. In addition, the Region continues to grow and serve as one of North Carolina's premier economic engines. It is estimated that over the next 50 years, the population in the Region will grow by nearly 1.8 million residents.

The local government jurisdictions in the Region each have land use plans to guide how they will accommodate the projected growth. Further, these jurisdictions and constituent drinking water utilities (water systems) are also responsible for providing for the publicly-managed water supply, which has been a critical driver of economic growth in the Region. As such, the leaders from the Region's jurisdictions and water systems identified a need to work together collaboratively to enhance the sustainability and security of the Region's water supply through coordinated planning and development.

In 2009, the Region's local governments and public water systems formed the Jordan Lake Regional Water Supply Partnership (Jordan Lake Partnership, Partnership, or JLP) to jointly plan for meeting the Region's water resource needs, including the expanded use of the Jordan Lake water supply. A total of 13 local governments and public bodies have joined the Jordan Lake Partnership. Membership in the Partnership is voluntary. The members include the Town of Apex, Town of Cary, Chatham County, City of Durham, Town of Hillsborough, Town of Holly Springs, Town of Morrisville, Orange County, Orange Water and Sewer Authority (OWASA), Town of Pittsboro, City of Raleigh and its Merger Partners, City of Sanford, and Wake County. The Jordan Lake Partnership contracted with Triangle J Council of Governments (TJCOG) to develop this Triangle Regional Water Supply Plan (TRWSP). Project management support for the Partnership is provided through Fountainworks, LLC.

Purpose

The purpose of the *Triangle Regional Water Supply Plan* is to support efforts to provide for long-term, sustainable and reliable water supplies for the communities in the Region.

The goals of this regional water supply planning effort are to:

1. identify the future service areas of the Region's water systems,
2. determine and verify the future water supply demand projections provided by the systems,
3. examine current water supply sources and estimated yields, and
4. identify future water supply needs, and
5. present an array of potential strategies for meeting those future needs.

Additionally, this plan may be used to support potential Jordan Lake allocation requests by providing a common framework for analyzing the future needs and documenting a suite of available options for the partner systems, particularly those demands that are anticipated within the next 30 years.

The TRWSP is divided into two volumes. This document, *Volume I: Regional Needs Assessment*, addresses the first four goals above, and presents the projected future water demands along with the future water supply needs for each water system, and for the Region as a whole. *Volume II: Regional Supply Options* will address the last goal and present potential options for meeting the future water supply needs.

This two-volume TRWSP is the first document of its kind for the Triangle Region that aims to create a long-range, 50-year cooperative water supply plan at a regional scale. This plan was prepared by TJCOG for the Jordan Lake Partnership and relies in large part on data provided by Partnership members. The focus of this document is on *average daily demand* of raw, untreated source water. This document does not directly address

infrastructure issues or the ability of facilities and distribution systems to treat, store and deliver water to water utility customers. Where applicable, relevant treatment capacity, interconnection capacity, and other values are noted for informational purposes. This document is not intended to replace the Cape Fear Basin or Neuse River Basin Water Supply Plans developed by the NC Department of Environment and Natural Resources (DENR) Division of Water Resources (DWR), but rather to support those plans by providing a focused analysis of the systems in the Triangle Region.

Process

The process used in developing this *Triangle Regional Water Supply Plan* was collaborative. The Jordan Lake Partnership engaged in a thorough, technical, peer-reviewed regional planning process to create the water supply demand projections. From the initial data requests, through the production of this report, and well into the next phase of the planning process, the Partnership members demonstrate a remarkable commitment to working together to produce the best information possible. Many Partnership members contracted specialized assistance in developing and refining their water demand projections. In addition, Partnership members engaged at multiple levels from technical staff and contractors to senior staff leaders. Partnership members each devoted time and resources throughout this iterative, peer-reviewed process. Much credit for the quality of the report goes to the Technical Review Team, which included every Partnership member and provided essential guidance on every aspect of the planning process.

The elements of the process in developing this *Volume I: Regional Needs Assessment* report included:

- collecting information on current water service areas, and future areas to be served;
- collecting information on current water supply capabilities and limitations including water source yields, withdrawal limitations, permits and inter-basin transfer (IBT) limitations, water treatment capacities, and alternative supplies such as reclaimed water systems;
- studying interconnections between partners both from infrastructure and contractual perspectives;
- open presentation and sharing of water demand projection methodology (including primary data upon which projections were based, commentary about population, caveats, assumptions, etc.);
- peer review of partner's demand projections to assess base data and assumptions, projection methodology, and overall credibility of demand projections;
- regional context/perspective for reviewing and comparing future demand projections with an individual partner's recent performance to those of other partners;
- discussion of how to handle and disaggregate non-revenue water in projections; and,
- discussion of partners' water efficiency and conservation efforts to date; whether, how, and to what extent water efficiency changes are included in the demand projections.

SECTION II. JORDAN LAKE PARTNERSHIP

The Jordan Lake Partnership was created in 2009 by local jurisdictions and water systems in the Triangle Region to jointly plan for sustainable and secure water supplies for the Region. The need to evaluate water supply planning and demand on a regional basis was accelerated by two historic droughts experienced in the Region and throughout the Southeast between 2001 and 2008.

The Partnership is committed to working collaboratively to enhance the sustainability and security of the Region's water supply resources through optimization of existing resources, conservation and efficiency, interconnections, and coordinated planning and development. The Partnership intends to demonstrate that local governments can work together in a cooperative fashion – within the Region, with constituent organizations, with upstream and downstream jurisdictions, and with regulators – to create environmentally sustainable, secure and mutually beneficial water supply strategies for the Triangle Region.

Members of the Partnership are committed to sustainability and have implemented numerous water efficiency and water conservation measures within their service areas including tiered water pricing, year-round conservation measures and a regionally-consistent drought/water shortage response framework. Building on the already robust regional efforts to coordinate water efficiency/conservation measures and water resources planning, the Jordan Lake Partnership serves as a forum to share information. The Partnership coordinates information from members that is being used in regional planning for secure water supplies and compiles common information from local governments and water systems, such as water conservation and efficiency measures, expected growth in water utility service areas and anticipated future water supply demands.

The Partnership receives administrative and technical support from Fountainworks, LLC and Triangle J Council of Governments. Fountainworks, LLC is market research and policy consulting firm and provides collaboration, communication, and administrative support for the Partnership by convening meetings of the Partnership members, facilitating discussions with the State of North Carolina, and coordinating communication with governmental contacts, regulators, organizations and stakeholders beyond the Partnership who are interested in regional water supply issues. Triangle J Council of Governments is a public organization serving municipal and county governments in the Triangle region of North Carolina. TJCOG has been contracted by the Jordan Lake Partnership to provide coordination and technical support and to develop the Triangle Regional Water Supply Plan.

As the name implies, the Jordan Lake Partnership has a strong interest in Jordan Lake, especially for issues related to water supply planning. The water supply pool of Jordan Lake is owned by the State of North Carolina and is managed and allocated by the NC Environmental Management Commission (EMC) with the support of the DWR. In the three previous rounds of Jordan Lake water supply allocations, about two-thirds of the available water supply pool has been allocated, and about half of the allocated portion is currently being used. Based on the information gleaned in this report, some members of the Partnership will make individual requests to the State of North Carolina for a portion of remaining available water supply storage in Jordan Lake.

In November 2009, the Partnership requested that DWR and the EMC initiate the Jordan Lake water allocation process, and in January 2010, the EMC formally approved initiating a fourth round of allocations. The Partnership has specified that it will not prepare individual water allocation applications for Partnership members or make policy recommendations; but, will serve only as a forum to collaboratively develop information, communicate with interested parties, and inform members.

In addition to potential Jordan Lake allocation requests, some Partnership members may explore opportunities to jointly share in the costs and development of facilities to access the Jordan Lake water supply, such as an intake near the western side of the lake. Furthermore, the Partnership has completed an interconnection study to determine the engineering capacity of water systems within the Region to move water among the individual systems. The ability to move water between and among interconnected systems greatly improves resiliency to

drought or other emergency situations and improves the security and reliability of the Region as a whole to meet the current and future water supply needs of its residents, businesses, and institutions. The Partnership may continue to serve as a forum for infrastructure planning and management coordination in the future.

SECTION III. WATER SYSTEMS INCLUDED IN THIS REPORT

The water systems included in this Triangle Regional Water Supply Plan are described below. Each Partnership member has a Jordan Lake allocation, may pursue a new or expanded Jordan Lake allocation, and/or has significant interconnections with other partners. In this section, each partner's Jordan Lake allocation, existing water supply sources, water treatment or water withdrawal permit capacity, interconnections, and if applicable, Inter-basin Transfer (IBT) certificate status are briefly described.

Jordan Lake is a multipurpose reservoir with part of its total storage capacity allocated to water supply. Water supply storage allocations provide the legal right to use a portion of Jordan Lake's water supply pool. These rights are managed by DWR through the allocation process and subsequent contracts with individual allocation holders. The available water supply yield of Jordan Lake has been previously estimated as 100 million gallons per day (MGD). From this overall quantity, the EMC allocates shares (as percentages) of the Jordan Lake water supply pool, which are currently considered to translate to 1 MGD per share. Jordan Lake's water supply yield is expected to be recalculated upon completion of the combined Neuse/Cape Fear River Basin Hydrologic Model, which is currently being updated by DWR.

Jordan Lake water supply storage is available either as a Level I or Level II allocation. Level I allocations are granted for near-term use (within five years), and Level II allocations are granted for longer term future needs.

In the third round of Jordan Lake allocations, 63 out of 100 shares of Jordan Lake's water supply pool were allocated. All of the third round allocations are currently held by members of the Partnership, but not all of the Partners hold an allocation. Table 1 shows the current Level I and Level II Jordan Lake Allocations.

Table 1. Current Jordan Lake Allocations (Shares, approximately equal to MGD)

Allocation Holder	Level I Allocation	Level II Allocation
Apex*	8.5	
Cary*	23.5	
Chatham County – North	6.0	
Durham	10.0	
Holly Springs		2.0
Morrisville	3.5	
Orange County		1.0
OWASA		5.0
Wake County – RTP South	3.5	
Total	**55**	**8**
Combined Total	**63**	

*Apex and Cary have a combined 32 MGD Level I Allocation.

The Partners utilize a variety of other raw water supply sources in addition to Jordan Lake. These include individual reservoirs, run-of-river intakes or stream withdrawals, and quarry reservoirs. These sources can provide a finite quantity of water as determined by their hydrology (e.g. "yield") and/or by withdrawal conditions. In addition to these supply sources, all water providers require extensive treatment, transmission, and distribution infrastructure to convey drinking water to their customers. Some systems rely on the purchase of treated water from other systems on a regular or special needs basis.

The Jordan Lake Partnership spans a geographic area that includes portions of two major river basins, the Neuse and Cape Fear. Transfers of water between different basins are regulated by DENR through Interbasin Transfer regulations, which limit the amount of water a system may move from one basin to another.

Town of Apex

The Town of Apex operates a public water system drawing raw water from Jordan Lake. The Towns of Apex and Cary jointly own and operate the only surface water intake structure on Jordan Lake, which provides raw water to two water treatment plants (WTPs): Chatham County's Jordan Lake WTP and the Cary-Apex WTP (CAWTP). The Cary-Apex WTP has a permitted capacity of 40 million gallons per day (MGD). Apex and Cary have a combined 32 MGD Level I allocation from Jordan Lake, of which 8.5 MGD is assigned to Apex. In addition to sharing the treatment plant, Apex and Cary's distribution systems are interconnected in several locations. Apex also has an interconnection with Holly Springs, through which it can also exchange water with Harnett County. Apex has a joint IBT Certificate with the Town of Cary. The details of this certificate are discussed in the Town of Cary section below.

Town of Cary

The Town of Cary operates a public water system drawing raw water from Jordan Lake. The Towns of Cary and Apex jointly own and operate the only surface water intake structure on Jordan Lake and an associated water treatment plant. The Cary-Apex water treatment plant has a permitted capacity of 40 MGD. Cary and Apex have a combined 32 MGD Level I allocation from Jordan Lake, of which 23.5 MGD is assigned to Cary.

In addition, the Town of Morrisville merged their water and sewer systems with the Town of Cary in April 2006. The Town of Cary supplies, administers and manages the Town of Morrisville's water system as part of the Town of Cary's system. The Town of Cary also supplies and administers the delivery of finished water to the Wake County – Research Triangle Park (RTP) South system through an interlocal agreement. While finished water is supplied by the Town of Cary, both the Town of Morrisville and Wake County – RTP South each have their own Jordan Lake allocations. As such, the systems are mainly listed separately in this document.

Cary's use of water from Jordan Lake constitutes an interbasin transfer. Water from Jordan Lake is withdrawn from the Haw River Basin (part of the Cape Fear River Basin), used in the Town, and then discharged through Cary's North and South Water Reclamation Facilities to the Neuse River Basin. Cary's service area lies predominantly in the Neuse River Basin. The amount of water consumed in the Neuse River Basin and discharged to the Neuse River Basin comprise Cary's interbasin transfer of water from the Haw River Basin to the Neuse River Basin. The EMC granted Cary, Apex, Morrisville and Wake County-RTP South an Interbasin Transfer Certificate based on the Jordan Lake allocations that were approved in 2002.

The Town of Cary, along with the Towns of Apex and Morrisville and Wake County – RTP South have a combined IBT certificate, which permits the systems to withdrawal water from the Haw River Subbasin and discharge up to a daily maximum of 24 MGD into the Neuse River Basin. The current IBT certificate was issued in 2001 and replaces a previous IBT certificate issued in 1989. Beyond the maximum daily IBT, the current IBT certificate stipulates a minimum annual volume of reclaimed water that must be returned to the Haw or Cape Fear River Subbasins. Currently, this condition is met by sending wastewater to Durham County; and in the future, this condition will be met by the Western Wake Regional Wastewater Reclamation Facility.

Chatham County – North

Chatham County operates three separate public water systems: Chatham County – North, Chatham County – East and Chatham County – Southwest. Only the Chatham County – North system is included in this planning effort, and the future water service area and future demand projections in this report were developed only for the Chatham County – North system.

Chatham County owns and operates the Jordan Lake WTP, which serves the Chatham County – North system and has a permitted capacity of 3 MGD. Raw water is pumped from Jordan Lake via the joint Cary/Apex water supply intake directly to the Jordan Lake WTP (in addition to the CAWTP). Additionally, the Chatham County – North system has interconnections with the OWASA, Town of Pittsboro, City of Sanford and City of Durham water systems. Chatham County has a 6 MGD Level I allocation from Jordan Lake.

City of Durham

The City of Durham operates a public water system drawing raw water from two primary reservoirs in the Neuse River Basin: Lake Michie on the Flat River and the Little River Reservoir. In addition, the City operates Teer Quarry as an emergency water supply source. All of these reservoirs are on different tributaries upstream of Falls Lake in the Neuse River Basin. Lake Michie and the Little River Reservoir together have been conservatively estimated to provide a water supply yield of 28.9 MGD (with 20% of their storage held in reserve). The City maintains a minimum release from the Little River Reservoir, which varies depending on the water elevation in the reservoir. The City operates two water treatment plants with a combined permitted capacity of 52 MGD. The Brown WTP has a 30 MGD capacity, and the Williams WTP has a 22 MGD capacity. Both can treat water from either of Durham's reservoirs. In addition to its reservoirs, the City has a 10 MGD Level I allocation from Jordan Lake. This allocation is accessed via interconnections with the Town of Cary. The City of Durham supplies water to the portions of Research Triangle Park located in Durham County and future water needs for this area are included in Durham's projected future water demands. Durham has additional interconnections with the OWASA, Town of Hillsborough, City of Raleigh and Chatham County – North water systems. The City has an agreement with Orange County to provide water service for a portion of the future Orange County service area. The City of Durham's service area straddles the Neuse and Haw River basin watershed divide, and the City has a Wastewater Treatment Plant (WWTP) in each basin. The City of Durham has a grandfathered IBT certificate in the amount of 40 MGD.

Town of Hillsborough

The Town of Hillsborough operates a public water system drawing raw water from Lake Ben Johnston, an impoundment of the Eno River in the Neuse River Basin, upstream of Falls Lake. The Town owns and operates the West Fork of the Eno Reservoir upstream of Lake Ben Johnston to augment the flow in the Eno River as needed to maintain adequate supply for its intake in Lake Ben Johnston and to maintain a 1 cubic foot per second (cfs) minimum release to the Eno River, which is based on the Eno River Basin Voluntary Capacity Use Agreement between Orange County, the Orange-Alamance Water System, Piedmont Minerals and the Town of Hillsborough. The water supply system consisting of Lake Orange, the West Fork of the Eno Reservoir and Lake Ben Johnston is estimated to have a yield of 2.56 MGD. The Town's withdrawal intake has a relatively small upstream watershed, so its withdrawal amount is limited by weather-dependent water levels in addition to the capacity use agreement for the Eno River. The Hillsborough WTP has a permitted capacity of 3 MGD. Hillsborough does not currently have a Jordan Lake allocation, though it previously had a Level II allocation. Hillsborough does not have an IBT certificate. The Town of Hillsborough water system has interconnections with the City of Durham, OWASA, and Orange-Alamance water systems. The Town of Hillsborough may also provide finished water in the future through bulk sales to a portion of the future Orange County service area near Hillsborough.

Town of Holly Springs

The Town of Holly Springs operates a public water system and owns 10 MGD of water treatment capacity in the Harnett County Water Supply System. The Town purchases its primary finished water supply from Harnett County, which uses surface water from the Cape Fear River as its raw water supply. The Town of Holly Springs maintains its own distribution system and customer billing functions. In addition to this primary finished water supply source, the Town also has a formal agreement for emergency supply with the City of Raleigh to provide 1.2 MGD through the year 2017, although no water has been purchased from Raleigh since July 2008. The Town also has interconnections with the Towns of Apex and Fuquay-Varina. The Town holds a 2.0 MGD Level II allocation from Jordan Lake, but does not currently receive water from this source. Finally, a new reclaimed water system was put in service in the summer of 2010 to help offset potable water demands for the Town.

Town of Morrisville

The Town of Morrisville merged its water and sewer system with the Town of Cary in April 2006. Since then, the Town's system is managed and operated as part of the Town of Cary system. The Town of Morrisville shares a combined IBT certificate with Cary, Apex, and Wake County – RTP South. Additionally, all interconnections

to the water distribution system in Morrisville are managed by the Town of Cary. As such, the Town of Cary's water system interconnections with the Cities of Durham and Raleigh and the Town of Apex are shared with the Town of Morrisville.

Though its water service is merged, the Town of Morrisville remains a separate entity from Cary for planning purposes and has a separate 3.5 MGD Level I allocation from Jordan Lake. Because the Town of Morrisville has its own Jordan Lake allocation, the system is shown separately in most places in this document. For consistency, Morrisville's water demand projections were completed in tandem with Cary's and using the same methodology, albeit with slightly different growth rates and water use characteristics.

Orange County

Orange County does not operate a water system. However, the County is committed to ensuring adequate future water supply to support development in the three economic development districts (EDDs) identified in the County's Comprehensive Plan. The Buckhorn EDD, the Hillsborough EDD and the Eno EDD are not currently fully served by public water systems. A portion of the Hillsborough EDD is currently served by the Town of Hillsborough, a portion of the Buckhorn EDD is served by the Town of Mebane, and a portion of the Eno EDD is currently served by the City of Durham. Orange County does not plan to operate their own water system in the future, but is committed to providing additional water service to these areas through agreements with other public water systems. Agreements for water provision have been finalized with the Town of Mebane and the City of Durham. Orange County has a 1 MGD Level II allocation from Jordan Lake.

Orange Water and Sewer Authority

The Orange Water and Sewer Authority (OWASA) is a community-owned, non-profit agency that provides drinking water to the Towns of Carrboro and Chapel Hill and the University of North Carolina at Chapel Hill. OWASA has three surface water impoundments in the Haw River Basin: Cane Creek Reservoir, University Lake and Quarry Reservoir. The reservoirs provide raw water to the utility's Jones Ferry Road WTP, which has a permitted capacity of 20 MGD. In addition to the reservoirs, OWASA has a 5 MGD Level II allocation from Jordan Lake. OWASA's water supply sources and wastewater discharge from the Mason Farm WWTP are all located within the Haw River basin, so OWASA does not require an IBT certificate.

Town of Pittsboro

The Town of Pittsboro operates a public water system drawing raw water from a run-of-river intake in the Haw River in the impoundment created by Bynum Dam, which DWR estimates can provide 9.8 MGD of water supply for Pittsboro (*20% of the 7Q10* as reported in the Cape Fear River Basin Water Supply Plan, Second Draft, 2002)[1]. The Town does not own or maintain the dam structure on the Haw River, upstream of Jordan Lake. The Town owns and operates a water treatment plant with a permitted capacity of 2 MGD that withdraws water from the impoundment behind Bynum Dam. The Town of Pittsboro does not currently have a Jordan Lake allocation. The Town of Pittsboro is interconnected with the Chatham County – North water system.

City of Raleigh and Merger Partners

The City of Raleigh and its Merger Partners operate a public water system that draws raw water from Falls Lake and the Lake Benson/Lake Wheeler Reservoir system in the Neuse River basin. Between 2000 and 2006, the Towns of Garner, Knightdale, Rolesville, Wake Forest, Wendell and Zebulon merged their water and wastewater utilities with the City of Raleigh, and they are considered part of the City's system and are referred to collectively as "Merger Partners." The City of Raleigh also provides water to the Town of Fuquay-Varina through a sales agreement. The City of Raleigh and Merger Partners' two water treatment plants (E.M. Johnson and D.E. Benton) are operated by the City of Raleigh Public Utilities Department (CORPUD) and have a combined

[1] DWR, 2002. *Cape Fear River Basin Water Supply Plan: Second Draft.* NC Division of Water Resources. March 2002. <http://www.ncwater.org/Reports_and_Publications/Jordan_Lake_Cape_Fear_River_Basin/CFRBWSPdraft2.pdf>

permitted capacity of 106 MGD. The combined yield of Falls Lake and the small Lake Benson/Lake Wheeler reservoir system is currently estimated to be 79.6 MGD. The City of Raleigh and its Merger Partners do not currently have a Jordan Lake allocation. The City of Raleigh water system also has interconnections with the City of Durham, Town of Cary, and Town of Holly Springs water systems. Raleigh's water sources and wastewater treatment plants are located entirely within the Neuse River Basin, so Raleigh does not require an IBT certificate.

City of Sanford

The City of Sanford operates a public water system that draws raw water from a run-of-river intake in the Cape Fear River in the impoundment created by Buckhorn Dam. The water is treated at their Sanford water treatment plant, which has a permitted capacity of 12 MGD. The City also provides finished water and system administration to the Lee County Water and Sewer District #1 and finished water to the East Chatham County water system. In addition, the City provides finished water to the Town of Broadway to meet their demands that are in excess of their water supply capacity, which is provided by a series of groundwater wells. The City of Sanford does not currently have a Jordan Lake allocation. Sanford does not require an IBT certificate because its water withdrawal and wastewater discharge are both in the Cape Fear Basin, though the wastewater discharge is upstream of its water intake in the Deep River Subbasin.

Wake County – Research Triangle Park (RTP) South

The Wake County – RTP South water system is supplied and administered by the Town of Cary through an interlocal agreement. Wake County has a 3.5 MGD Level I allocation from Jordan Lake for the portion of RTP located in Wake County. Wake County does not operate its own water sources, but receives treated Jordan Lake water as finished water from the Cary/Apex WTP. Wake County – RTP South shares a combined IBT certificate with the Towns of Cary and Apex. Wake County – RTP South is interconnected to other partners through the Cary/Apex interconnections.

This page left intentionally blank.

SECTION IV. SYSTEM SERVICE AREAS

As part of the regional water supply planning process, GIS data was collected from each of the Partnership systems to depict the anticipated future (2060) water service areas as shown in Figure 1 on the next page. These data are also useful for identifying areas in which the future service areas of two or more systems may overlap, thus representing potential sources of error in projecting future region-wide water demands.

Methods

Several water systems provided georeferenced data depicting their future water service areas directly. These included the Towns of Cary, Hillsborough and Morrisville, as well as Orange County, OWASA and Wake County-RTP South. For the City of Durham, the Urban Growth Area (UGA) boundary within Durham County was used to depict the future service area, which includes the portion of RTP in Durham County (but excluding the portion of the Durham UGA boundary within Orange County's Eno EDD). For municipalities in Wake County, including the Towns of Apex and Holly Springs, as well as the City of Raleigh and its Merger Partners, data were downloaded from the Wake County GIS department. The future service areas for these systems were created by integrating the corporate limits, the short-term urban service area and the long-term urban service area. The future service area for the Town of Pittsboro includes the area within Pittsboro's extraterritorial jurisdiction (ETJ). The City of Sanford considers its future service area to be all of Lee County. The Chatham County--North future service area is bounded by the Haw River Basin boundary and the Alamance, Orange, Durham, and Wake County boundaries, but excludes the Town of Pittsboro's ETJ and the critical watershed area around Jordan Lake.

Discussion

This planning effort identified two overlapping service areas that required attention and these are coded as "unresolved" on Figure 1. The first is the unresolved planning area between the Towns of Apex and Holly Springs. In this report, TJCOG includes the future water demand projections provided by Apex and Holly Springs. Because of the restricted developable area around the Shearon Harris Nuclear Power Plant as well as the future expanded impoundment of Harris Lake, there is little development and subsequent water demand projected for the unresolved planning area between Apex and Holly Springs so any potential overlap or "double-counting" of projected future water demand is minimal.

The second unresolved area is in Orange County near the Town of Hillsborough. Orange County includes Proposed Orange County Urbanizing Areas within the Hillsborough EDD as part of its future water demand projections. Portions of these areas within the Hillsborough EDD are also within the future service area delineation provided by the Town of Hillsborough. Orange County is primarily interested in ensuring that a water supply will be available to support development in this area and intends to work with the Town of Hillsborough to reach agreement on the service area. The County is committed to working with cooperating water systems (like the City of Durham, the Town of Hillsborough and the City of Mebane) to provide future water service to the EDD areas included in Orange County's Comprehensive Plan but outside of existing water service areas. The overlapping area around the Town of Hillsborough is very small, and any potential "double-counting" of future water demand would be expected to have minimal consequences to either system's future water projections.

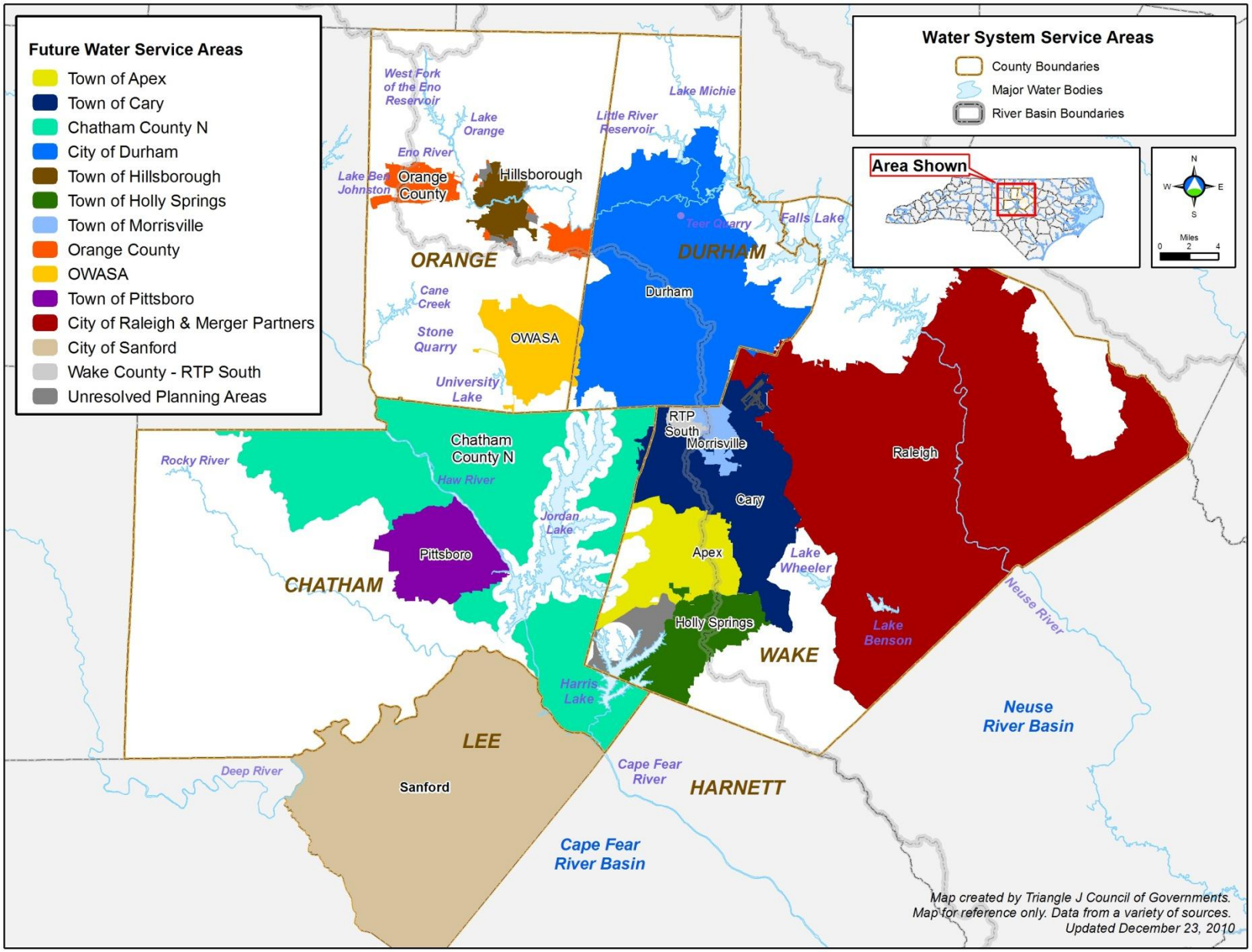

Figure 1. Triangle Area Water Systems – Future Service Areas.

SECTION V. SYSTEM INTERCONNECTIONS

A network of water system interconnections in the Region provides advantages for both long-term reliability and short-term emergency response by allowing the movement of treated drinking water among various systems in the Region. Many systems have written agreements to provide water under special circumstances (e.g., emergencies). Some agreements provide for regular (non-emergency) bulk sales of treated water.

The ability and willingness to move water among interconnected systems greatly improves resiliency to drought or other emergency situations and can significantly improve the security and reliability of the Region as a whole to meet its future water supply needs. Figure 2 is a diagrammatic representation of "regular" and "emergency" water sharing agreements among the systems included in this Triangle Regional Water Supply Plan. Additionally, the Towns of Cary and Morrisville are shown as a combined system, because their two water systems are operated as a single merged system. It should be noted that Figure 2 includes only those systems in this Triangle Regional Water Supply Plan, but some of these have additional sharing agreements with other systems that are not included in this planning effort. The one exception is Harnett County, which, although it is not a member of the Partnership, is shown because it serves as the primary water source for a Partnership member (Holly Springs). Cells highlighted in yellow with a red arrow indicate an "emergency" agreement; those highlighted in blue with a white arrow indicate the "regular" purchase/sale of finished water. Arrows indicate the direction of finished water movement between the two systems. Also, see Figure 3 and Figure 4 for a geographic illustration of water supply sources and system interconnections.

The Jordan Lake Partnership initiated a study of the water system interconnections in the Region to document the physical capacity to move treated water among the systems. This study, *Technical Memorandum: Jordan Lake Potable Water Interconnection Study*[2], was completed by Hazen and Sawyer in 2011 and catalogs the physical interconnections in the region. It includes all existing, planned, and abandoned (but still in place) interconnections. Figure 2. Triangle Area Water Sharing Agreements.

shows these interconnections on a map of the region with current municipal boundaries. Figure 4 shows the same interconnections in graphical format, and includes several water systems not in the Partnership. Note that the connections are shown as physical interconnections only, and do not indicate the status of any contractual agreements or ability to transfer water in either direction. Table 2, which shows the capacity of the interconnections between systems, is also adapted from information in the interconnection study Technical Memorandum. The water transfer capacities of those interconnections are not always the same in either direction due to pressure differences between systems. The table, therefore, represents outgoing capacity to transfer water by starting at the left, and incoming capacity to receive water by starting at the top. The interconnection study's presentation of capacities includes many important caveats including that the capacity shown may be a summation of multiple physical interconnections between two systems, but there is no guarantee that any given system can move the maximum amount through all of its connections simultaneously. Additionally, these capacities are reported from a variety of sources, and have not all been calculated and independently verified.

[2] Hazen and Sawyer, 2011. *Technical Memorandum: Jordan Lake Potable Water Interconnection Study*. *Phase I.* Prepared for the Jordan Lake Partnership by Hazen Sawyer, P.C. October, 2011.

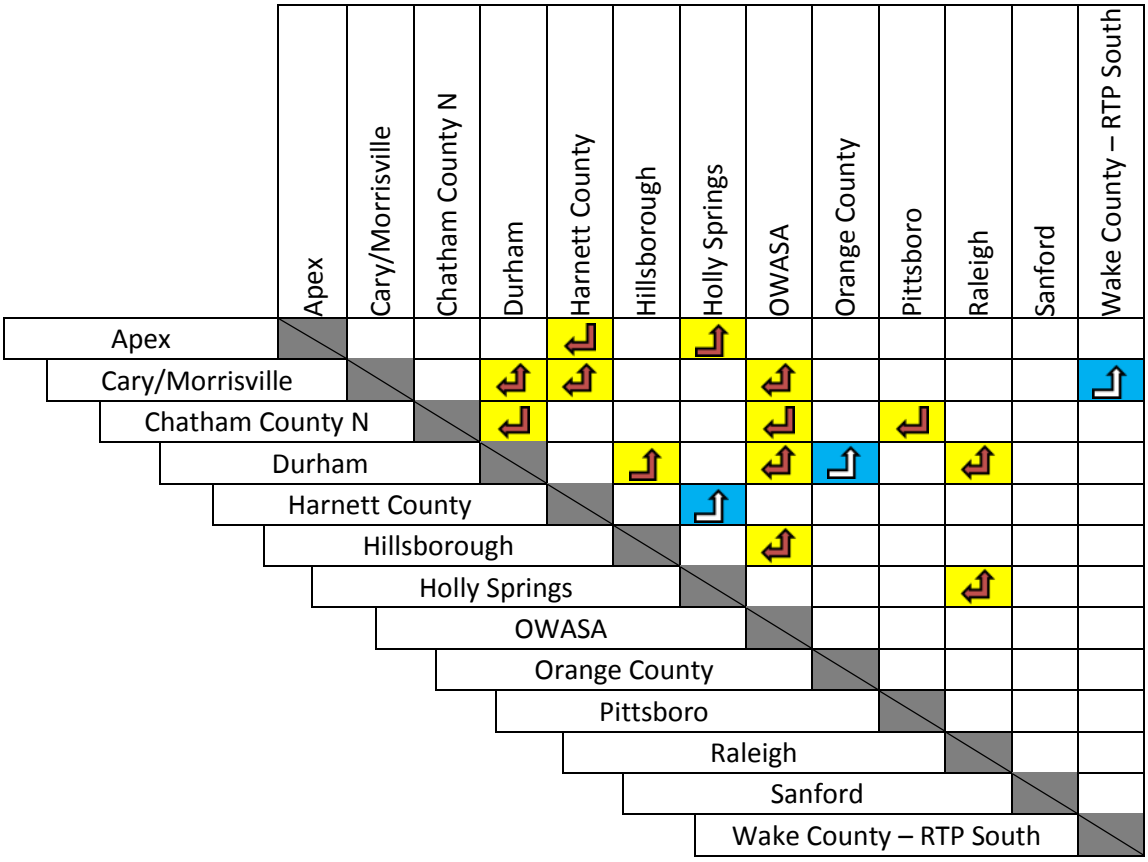

Figure 2. Triangle Area Water Sharing Agreements.

* Arrows indicate the direction of water purchase/sale provided in each agreement. Yellow cells with red arrows indicate "emergency" agreements; blue cells with white arrows indicate "regular" sales. Durham and Orange County have finalized an agreement, but water is not yet being delivered regularly.

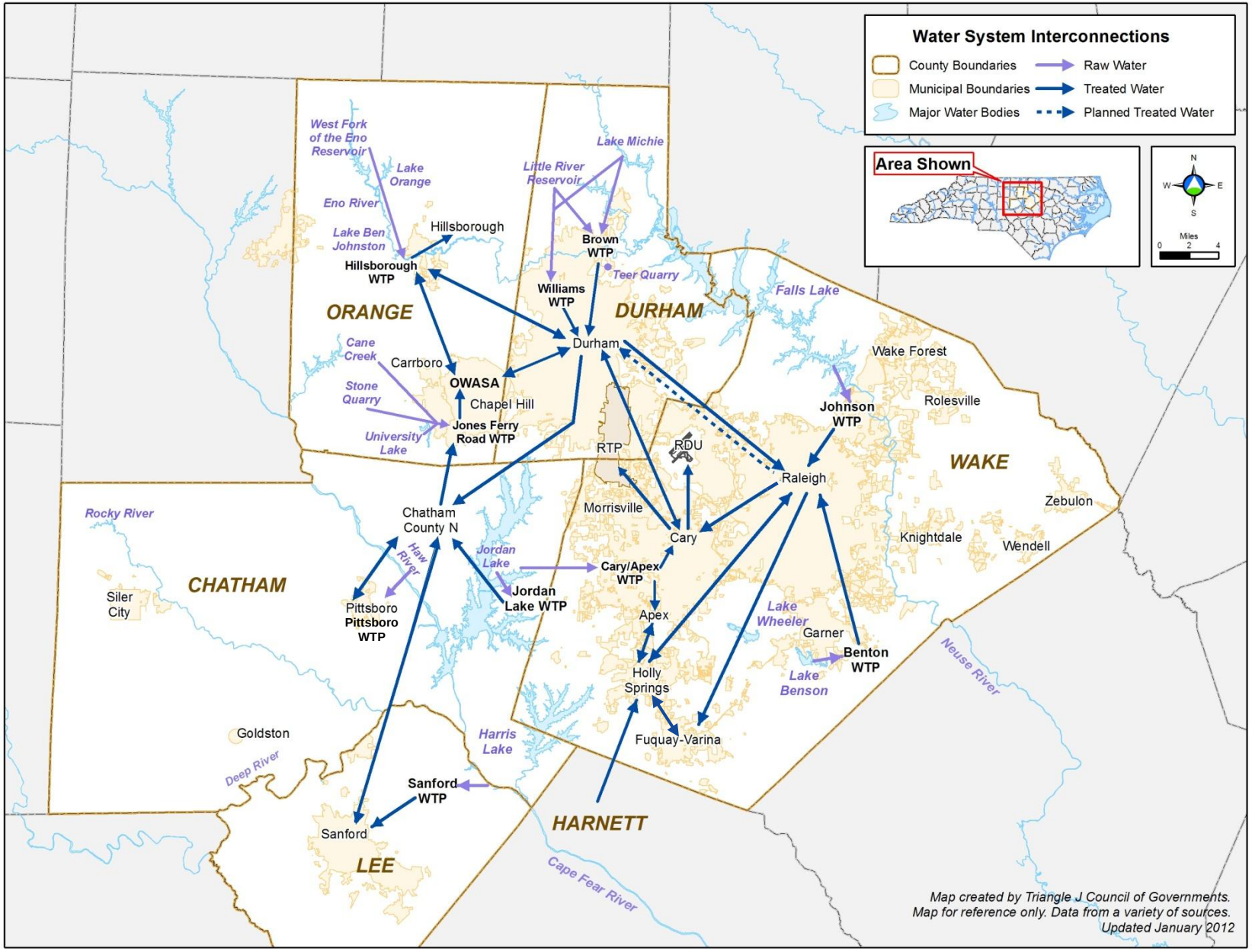

Figure 3. Map of Interconnections between Triangle Area water systems.

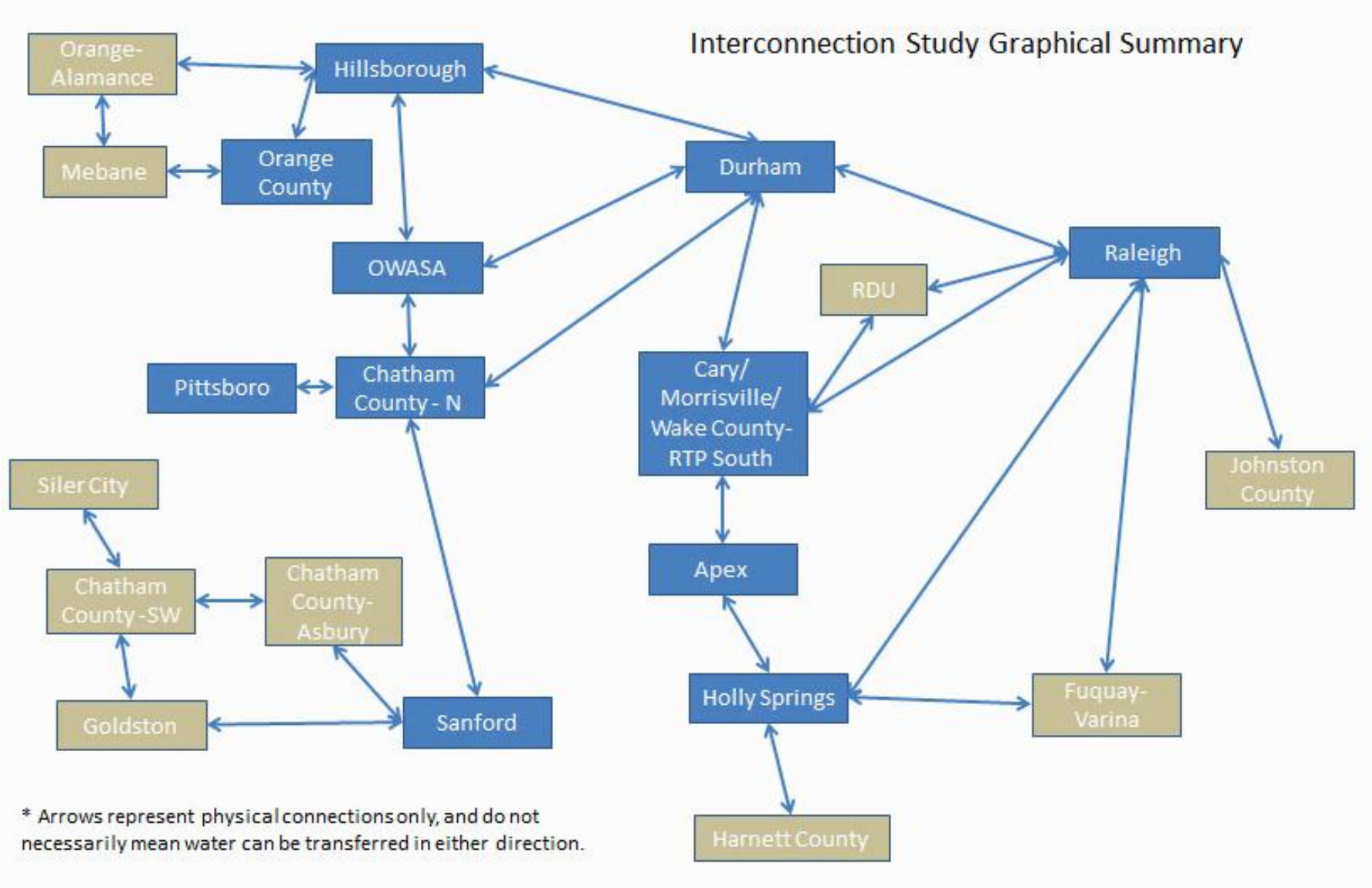

Figure 4. Graphical summary of physical interconnections between the water systems in the region *(information from Hazen and Sawyer, 2011). Water systems in the Jordan Lake Partnership are shown in blue. Others are shown in tan.*

Table 2. Preliminary Interconnection Water Transfer Capacities between Partners and with other utilities in the Region (MGD).

Partner/ Utility	Apex	Cary	Chatham County -North	Durham	Hillsborough	Holly Springs	Orange County	OWASA	Pittsboro	Raleigh	Sanford	*Partner Subtotal*	Fuquay-Varina	Harnett County	Mebane	Orange-Alamance	*Non-partner Subtotal*	*TOTAL (outgoing)*
Apex		3.4				1.0						**4.4**						**4.4**
Cary	4.4			10.0						0		**14.4**						**14.4**
Chatham County-North				1.0				1.0	0.2		0.0	**2.2**						**2.2**
Durham		7.0	2.0		3.0			7.0		11.5		**30.5**						**30.5**
Hillsborough				1.4			1.4	2.0				**4.8**				0.2	**0.2**	**5.0**
Holly Springs	0.5									2.4		**2.9**	3.0	15.0			**18.0**	**20.9**
Orange County					1.4							**1.4**			1.4		**1.4**	**2.8**
OWASA			0.0	5.2	2.0							**7.2**						**7.2**
Pittsboro			0.5									**0.5**						**0.5**
Raleigh		9.4		7.5		3.0						**19.9**	3.0				**3.0**	**22.9**
Sanford			0.5									**0.5**						**0.5**
Partner Subtotal	**4.9**	**19.8**	**3.0**	**25.1**	**6.4**	**4.0**	**1.4**	**10.0**	**0.2**	**13.9**	**0.0**	**88.8**	**6.0**	**15.0**	**1.4**	**0.2**	**22.6**	***111.4***
Fuquay-Varina																		**0.0**
Harnett County						10.0						**10.0**						**10.0**
Mebane							1.4					**1.4**				1.4	**1.4**	**2.8**
Orange-Alamance					0.2							**0.2**			1.4		**1.4**	**1.6**
Non-Partner Subtotal					**0.2**	**10.0**	**1.4**			**0.0**		**11.6**			**1.4**	**1.4**	**2.8**	***14.4***
TOTAL (receiving)	**4.9**	**19.8**	**3.0**	**25.1**	**6.6**	**14.0**	**2.8**	**10.0**	**0.2**	**13.9**	**0.0**	***100.4***	**6.0**	**15.0**	**2.8**	**1.6**	**25.4**	***125.8***

*When read from left to right, transfer capacities displayed are *outgoing* capacity. When read from the top to bottom, numbers represent *receiving* capacity. Capacities listed within a given cell may be a sum of capacities of one or more connections between the two relevant systems. Computed capacities listed likely consider connections in isolation; totals may not in fact be achievable due to hydraulic constraints, and treatment capacity limitations. Totals may not sum exactly due to rounding.

Morrisville and Wake County – RTP South are included with Cary.

This page left intentionally blank.

SECTION VI. SERVICE AREA POPULATION ESTIMATES

The Jordan Lake Partnership water systems provided population estimates for their future service areas. The data is shown in the table below. Table 3 illustrates the population estimates for each system and a total for the Region, and Figure 5 shows the same information in a stacked area chart. Table 4 is organized and summarized by county, and countywide forecasts through 2040 developed by the State Demographer's office are also shown for comparison. The totals for each county represent the projected population in the partner water system's service areas that fall within the county of interest. The 2010 values in the countywide forecast rows represent the 2010 Census population for each county. Population estimates have been rounded to the nearest hundred people in each of these tables.

Table 3. Triangle Area Water Systems – Future Service Area Population Estimates.

	Population (Service Area)					
Jurisdiction	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Apex	37,700	53,100	74,400	100,500	109,200	112,200
Cary	145,000	176,400	208,100	230,700	247,900	248,400
Chatham County - North	10,200	25,900	41,600	57,300	73,400	94,000
Durham	227,100	286,400	329,400	372,400	415,400	458,400
Hillsborough	14,000	16,800	20,100	24,200	29,000	33,800
Holly Springs	24,700	46,700	61,900	74,800	89,000	103,300
Morrisville (incl. w/ Cary)	-	-	-	-	-	-
Orange County	100	4,000	9,300	14,500	19,800	25,100
OWASA	79,400	94,300	108,600	122,800	137,100	151,300
Pittsboro	3,700	12,900	23,400	31,100	39,000	46,900
Raleigh	489,000	683,300	844,500	995,700	1,225,700	1,508,800
Sanford	40,900	56,600	76,000	92,200	111,800	135,700
Wake County-RTP South	-	-	-	-	-	-
TOTAL	***1,073,200***	***1,456,400***	***1,797,300***	***2,116,200***	***2,497,400***	***2,917,900***

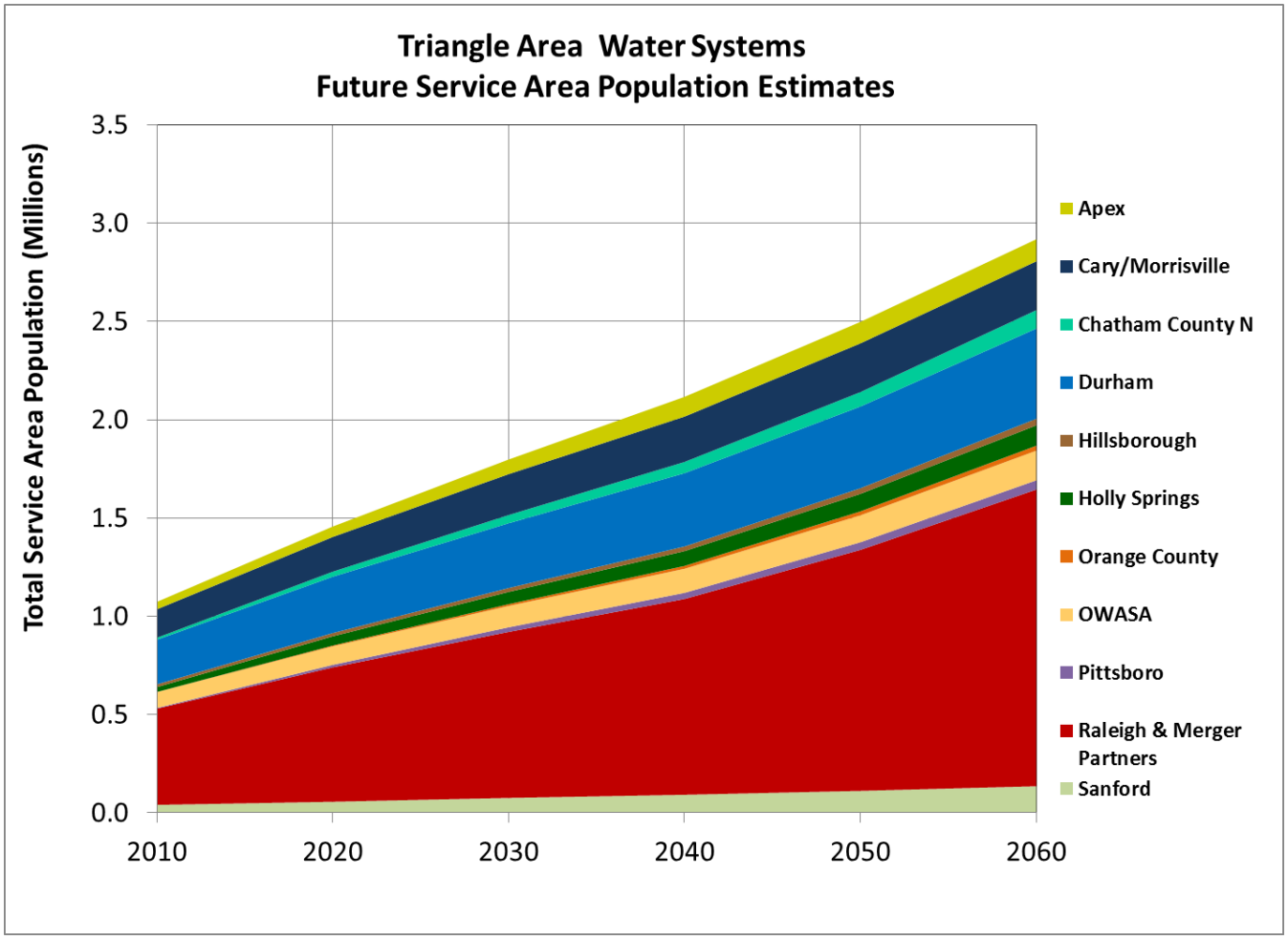

Figure 5. Triangle Area Water Systems – Future Service Area Population Estimates.

Table 4. Triangle Area Water Systems - Future Service Area Population Estimates by County.

Chatham County	2010	2020	2030	2040	2050	2060
Chatham County - North	10,200	25,900	41,600	57,300	73,400	94,000
Pittsboro	3,700	12,900	23,400	31,100	39,000	46,900
Chatham County Total	***13,300***	***38,800***	***65,000***	***88,400***	***112,400***	***140,900***
Countywide Forecast	63,505	78,237	92,604	106,973		

Durham County	2010	2020	2030	2040	2050	2060
Durham	227,100	286,400	329,400	372,400	415,400	458,400
Durham County Total	***227,100***	***286,400***	***329,400***	***372,400***	***415,400***	***458,400***
Countywide Forecast	267,587	323,474	378,024	432,575		

Lee County	2010	2020	2030	2040	2050	2060
Sanford	40,900	56,600	76,000	92,200	111,800	135,700
Lee County Total	***40,900***	***56,600***	***76,000***	***92,200***	***111,800***	***135,700***
Countywide Forecast	57,866	65,857	73,658	81,458		

Orange County	2010	2020	2030	2040	2050	2060
Orange County	100	4,000	9,300	14,500	19,800	25,100
Hillsborough	14,000	16,800	20,100	24,200	29,000	33,800
OWASA	81,000	94,300	108,600	122,800	137,100	151,300
Orange County Total	***95,100***	***115,000***	***138,000***	***161,500***	***185,900***	***210,200***
Countywide Forecast	133,801	155,442	176,560	197,675		

Wake County	2010	2020	2030	2040	2050	2060
Apex	37,700	53,100	74,400	100,500	109,200	112,200
Cary/ Morrisville	145,000	176,400	208,100	230,700	247,900	248,400
Holly Springs	24,700	46,700	61,900	74,800	89,000	103,300
Raleigh & Merger Partners	489,000	683,300	844,500	995,700	1,225,700	1,508,800
Wake County Total	***696,300***	***959,500***	***1,188,800***	***1,401,600***	***1,671,800***	***1,972,700***
Countywide Forecast	900,993	1,160,823	1,414,333	1,667,844		

This page left intentionally blank.

SECTION VII. HISTORICAL FINISHED WATER USE

This section summarizes the historical finished water production or use for each system from 1995-2009. The finished water use reported includes all uses *except* water used at the water treatment plant in the treatment process. For most systems, this finished water use is equivalent to total finished water production. In some cases, the water systems do not operate their own water treatment plant and instead purchase finished water. For these water systems (Holly Springs, Morrisville, and Wake County-RTP South) total water use is reported instead of total production. Orange County is not included in this table, because Orange County does not operate a water system and does not have any historical usage data. These water use records include water used for non-revenue uses, so the numbers are comparable between systems. Each system provided their available data on finished water production or use on a calendar year basis.

The data are shown in Table 5 and are presented as average daily finished water production or use (in MGD) for each calendar year. The same data are shown graphically in Figure 6. Data were not available from all systems for all years.

Table 5. Triangle Area Water Systems – Historical Finished Water Use/Production.

Year	Apex	Chatham County - North	Cary	Durham	Hillsborough	Holly Springs	Morrisville	OWASA	Pittsboro	Raleigh	Sanford	Wake County - RTP South	**Total**
1995	1.1	--	--	25.7	1.5	--	--	8.0	--	35.5	5.8	--	**77.6**
1996	1.2	--	--	27.0	1.5	--	--	7.9	--	36.4	5.9	--	**80.0**
1997	1.8	0.6	9.5	29.2	1.8	0.5	0.5	8.4	--	40.0	5.9	0.1	**98.2**
1998	2.2	0.7	9.7	30.7	1.8	--	0.5	8.5	--	41.6	6.2	0.1	**101.9**
1999	2.0	0.7	9.4	31.1	1.6	--	0.8	8.6	--	43.2	6.4	0.2	**103.9**
2000	2.0	0.7	9.9	31.9	1.4	--	1.0	9.2	--	44.5	6.6	0.2	**107.2**
2001	2.1	0.9	10.4	32.4	1.1	--	1.3	9.5	0.7	46.8	6.5	0.3	**112.0**
2002	2.5	0.9	10.6	27.6	0.9	1.0	1.4	9.0	0.7	45.2	7.0	0.4	**107.1**
2003	2.3	1.0	9.9	25.8	0.7	0.9	1.3	8.1	0.5	43.3	6.6	0.4	**100.8**
2004	2.6	1.2	10.5	26.8	0.9	1.1	1.4	8.5	0.5	47.2	6.6	0.4	**107.6**
2005	2.8	1.2	10.8	27.7	1.2	1.3	1.5	8.6	0.5	48.7	6.6	0.4	**111.2**
2006	2.7	1.3	10.8	27.3	1.2	1.5	1.7	8.6	0.5	48.5	6.8	0.4	**111.2**
2007	3.0	1.6	12.5	28.6	1.2	2.0	1.8	8.6	0.5	50.8	6.6	0.5	**117.7**
2008	2.7	1.5	11.8	24.1	1.1	1.7	1.1	7.7	0.5	45.3	6.2	0.5	**104.2**
2009	2.9	1.7	11.7	26.1	1.1	1.8	1.0	7.9	0.5	47.8	6.2	0.5	**109.3**
2010	3.1	2.0	11.9	25.2	1.1	1.3	1.9	7.9	0.6	51.9	6.5	0.4	**113.8**

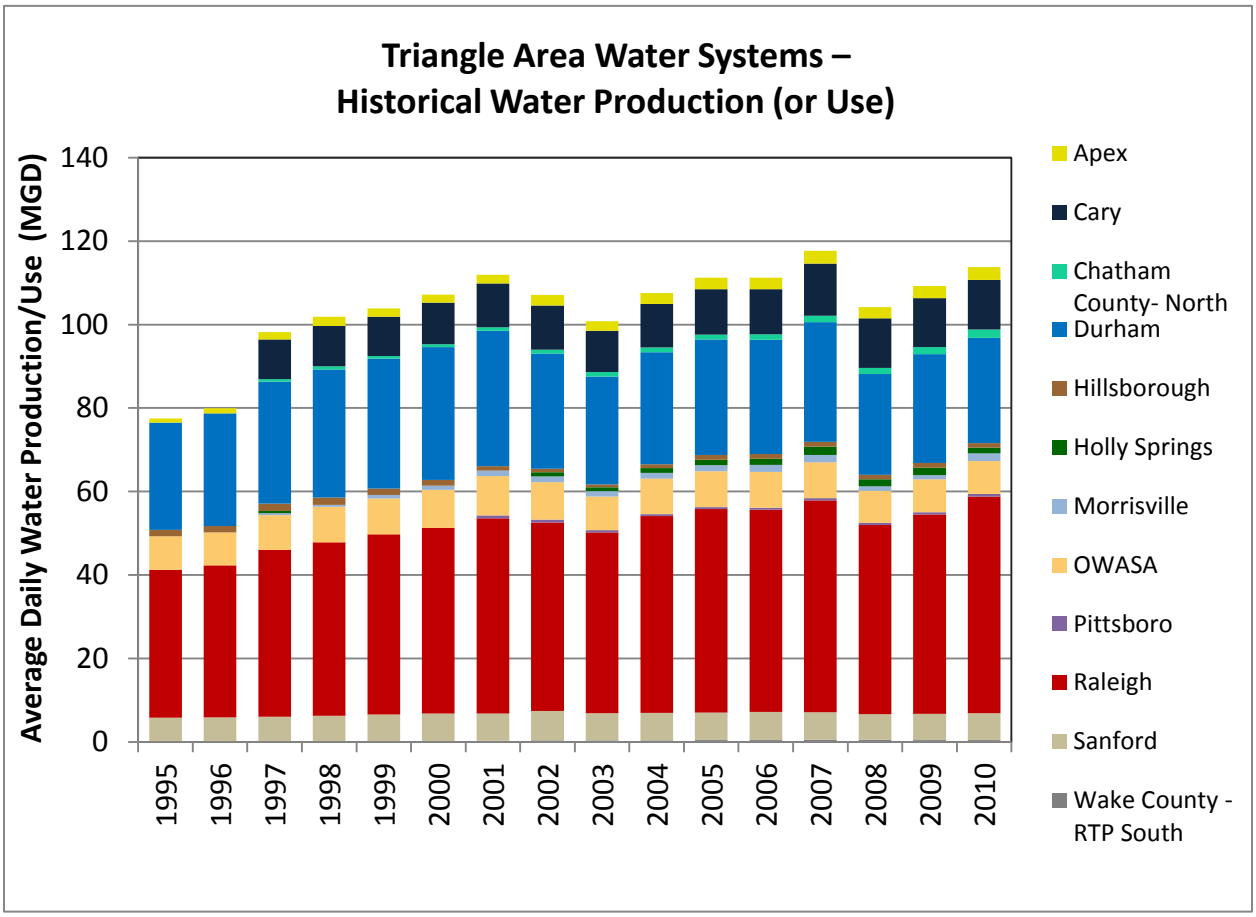

Figure 6. Triangle Area Water Systems – Historical Finished Water Production/Use.

SECTION VIII. WATER DEMAND PROJECTIONS

This section summarizes the total projected raw water demands of Jordan Lake Partnership water systems as provided by the individual systems. More detailed information about each system, including demand projections by sector and summaries of demand methodologies, can be found in the individual system summaries in Section XI.

Demand Projection Methodologies and Peer Review Process

Water demand projection methodologies varied widely by partner, as each had differing amounts and quality of water use data, land use data, and growth projections. The Partnership did not adopt a single methodology for all systems due to these differences. Each partner submitted their base data, projection methodologies, assumptions, and projections early in the TRWSP planning process. TJCOG collected the most recent version of water demand projections from each partner, including as much information on methodology as possible, and presented the results to all partners. Early meetings among the Partnership members led to several areas of discussion related to projection methodologies, including methods for reporting non-revenue (rather than "unaccounted-for") water. Non-revenue water was characterized on the basis of various system components, such as treatment plant process water, finished water used for distribution system maintenance (line flushing), plus other non-revenue elements, including water lost due to system leakage. Partnership members agreed to the importance of reducing non-revenue water to the greatest extent possible. They also agreed to specify and incorporate anticipated water use efficiency improvements into their projections. Accordingly, each system's projection summary includes a description of water use efficiency efforts and progress to date, as well as how additional (future) efficiencies are incorporated into their demand projections.

Peer review of each Partner's demand projections by other Partnership members was a key element of this document and was accomplished by several methods: questions and critiques of structured individual presentations to the whole group and through the submittal of anonymous peer review evaluations of each system's base data and assumptions, projection methodology, and overall credibility. This process included both scaled ratings and unstructured comments. Some partners requested help from TJCOG in evaluating options for their projections and in comparing their data and assumptions to those of other Partnership members. Each Partnership member's initial projections and methods were then further revised in response to those comments and procedures, resulting in approximately a 10% overall reduction of the initial demand projections. Finally, all Partnership members had the opportunity to review and comment on three successive drafts of this document, including the individual system summaries.

The resulting water demand projections presented in this report are likely more transparent, consistent, and credible than previous information submitted to the NC Division of Water Resources in State-mandated Local Water Supply Plans (LWSP). The information presented herein represents the most reliable and comprehensive overview of Triangle Area water use trends and demand projections that has been compiled to date.

Water Demand Projections

Table 6 shows the total projected future water demand for each system in ten-year increments from 2010 to 2060. Figure 7 shows this information graphically. Figure 8 presents the same projection information, but is organized by individual system showing the 2010, 2040 and 2060 projections.

Table 6. Triangle Area Water Systems – Total Projected Future Water Demand. (MGD)

Jurisdiction	Demand in projection year:					
	2010	2020	2030	2040	2050	2060
Apex	3.5	5.5	7.6	9.9	11.0	11.5
Cary	14.9	19.5	24.3	27.4	29.8	29.8
Chatham County N	2.2	5.3	8.3	11.9	14.2	18.1
Durham	28.2	32.7	36.4	40.7	44.7	47.5
Hillsborough	1.2	2.3	2.7	3.0	3.4	3.7
Holly Springs	2.0	4.7	5.7	6.7	7.7	8.8
Morrisville	1.7	2.5	2.9	3.4	3.5	3.6
Orange County	0.0	0.7	1.6	2.4	3.2	3.9
OWASA	7.9	8.3	9.7	10.8	11.9	12.9
Pittsboro	0.6	2.1	3.8	5.2	6.6	8.0
Raleigh & Merger Partners	52.0	69.9	82.4	92.3	102.7	115.0
Sanford	6.5	8.1	11.5	15.2	20.4	24.8
Wake County –RTP South	0.6	1.4	2.1	3.2	3.3	3.3
Total	**121.3**	**163.0**	**199.3**	**232.1**	**262.4**	**290.9**

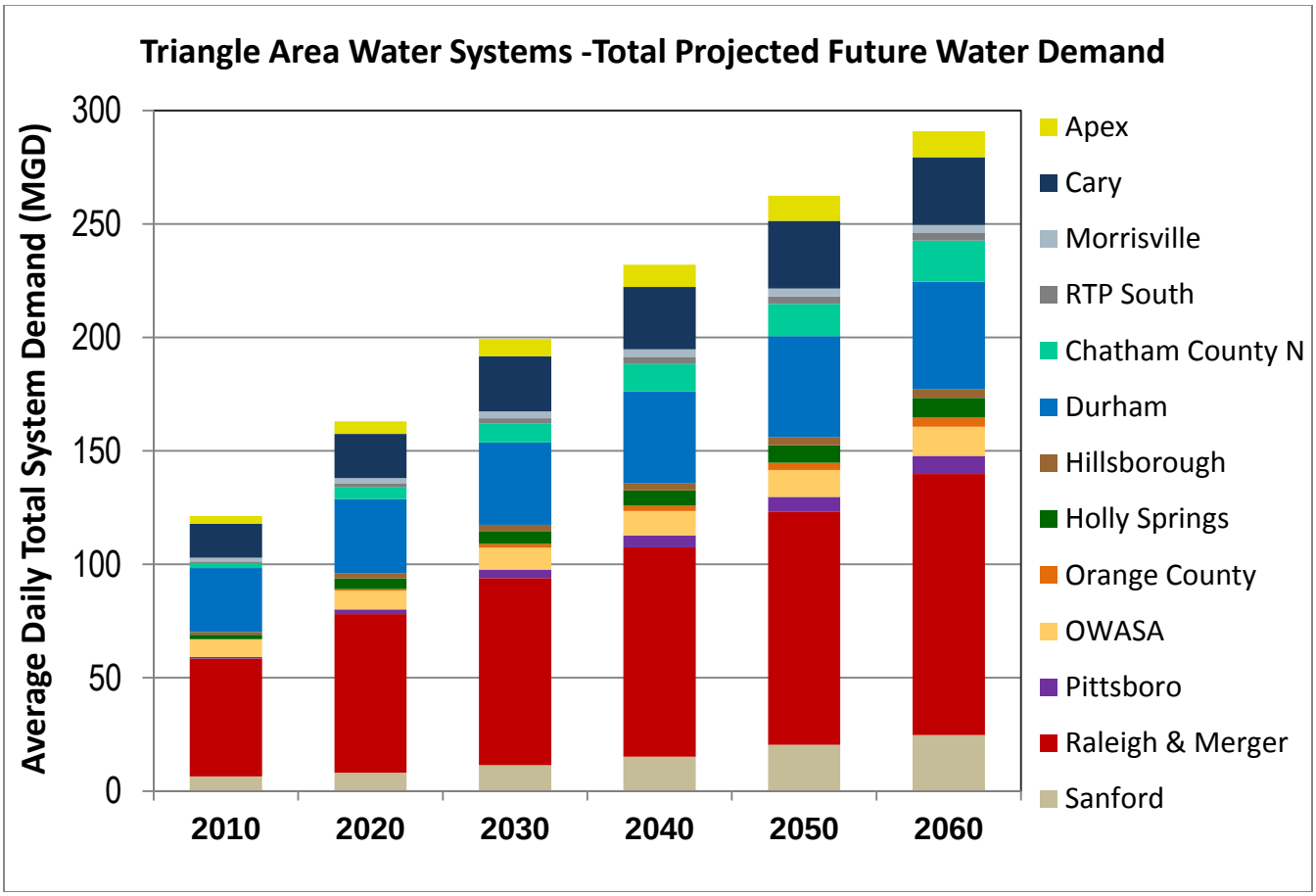

Figure 7. Triangle Area Water Systems – Total Projected Demands. (MGD).

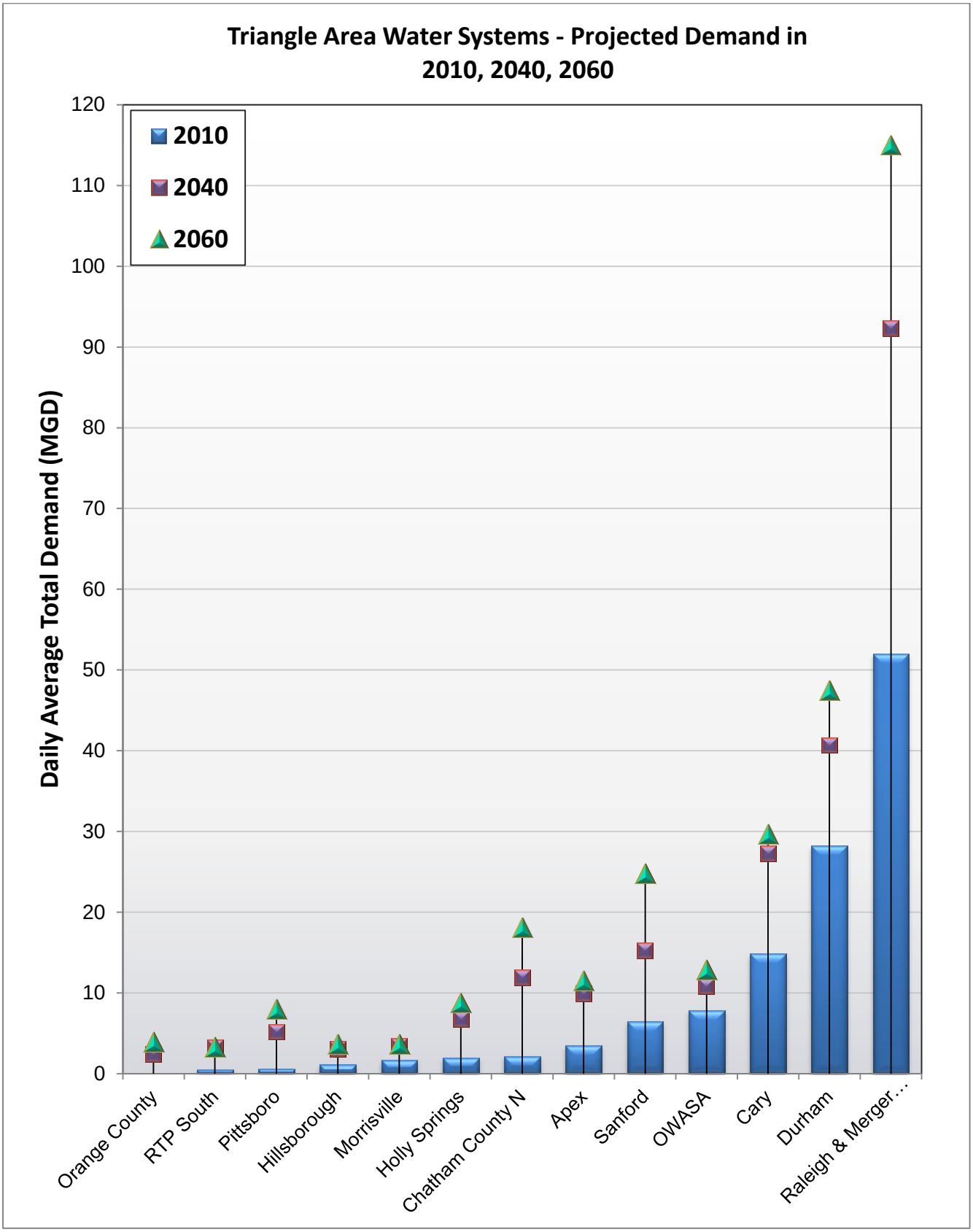

Figure 8. Triangle Area Water Systems – Projected Water Demand in 2010, 2040 and 2060.

Demand Projections by Sector

This subsection compares the major water use sectors of the projected demands for 2010, 2040 and 2060. The following sectors are used in the local water supply plans prepared by each system: residential, commercial, industrial, institutional, system process and unaccounted for. Some systems use a simpler residential/non-residential scheme for their internal planning, but then separate non-residential use into the sectors listed above for the LWSP.

The water utility industry is moving away from the term "unaccounted-for" water, and most systems in the Region are working toward a full accounting of all water in their systems. In this Triangle Regional Water Supply Plan, the term "non-revenue" water encompasses all non-billed water: process water used at the water treatment plant, water used to flush the distribution system, fire flows, hydrant testing, non-billed water for construction or certain temporary local government uses, non-billed water used at wastewater treatment plants, water lost through system leaks, and other water unbilled due to meter inaccuracies, expected leakage at pipe joints or other reasons. In this plan, non-revenue water is separated into three categories: "WTP process", "Distribution process" and "Other non-revenue" water. The *WTP process* category includes water used at the treatment plant to produce finished water; e.g., filter backwash water. *Distribution process* water includes flushing water and other non-revenue water used for distribution system maintenance. *Other non-revenue* water includes any other unbilled water not described by the categories above. In general, WTP process water is counted as a portion of raw water, while the other two categories are typically counted as finished water. Where possible, each partner has provided the breakdown of non-revenue water into these same three categories. Due to data limitations, or the way certain utilities are operated, several combined some or all of these non-revenue water categories in their projections, which is noted in tables in the Individual System Summaries in Section XI.

Each water system has a unique customer base of residential, commercial, industrial, and institutional users. Additionally, the water systems define their sectors somewhat differently. There is general uniformity in how the residential sector is defined, but several systems include master-metered multifamily residential customers in their commercial – rather than residential – sector. In Figure 9, all individual non-residential sectors have been combined, and the individual non-revenue sectors have been combined into a single non-revenue sector to allow a general comparison among the systems.

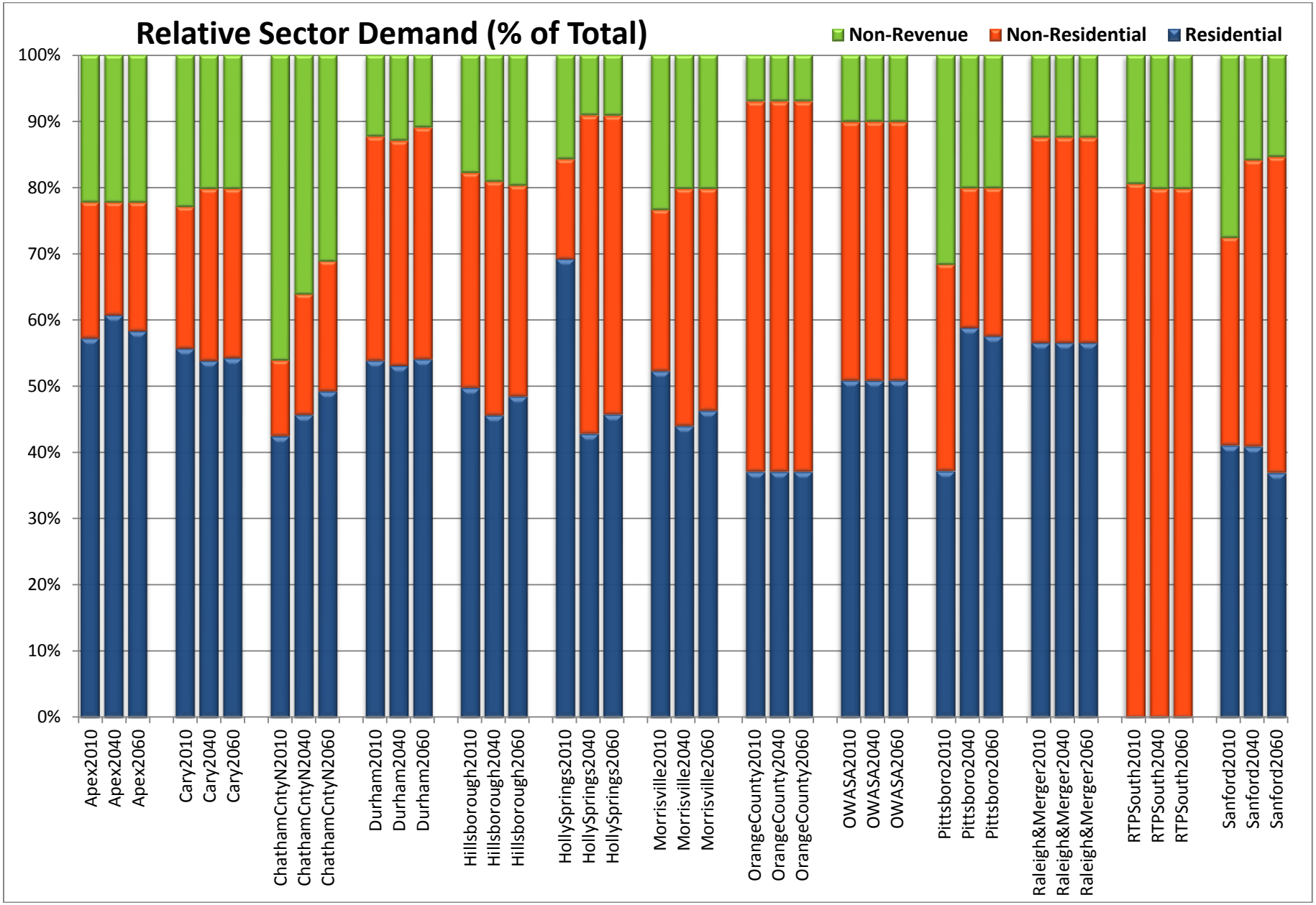

Figure 9. Relative Sector Demand as Percent of Total Demand in 2010, 2040 and 2060.

This page left intentionally blank.

SECTION IX. WATER SUPPLY SOURCES

This section summarizes the current, near-term, and future water supply sources of the Triangle Area water systems. Water systems in the Region currently access water through run-of-river intakes or local reservoirs, including Jordan Lake and Falls Lake. Several systems (Cary, Apex, Chatham County – North, Morrisville and Wake County – RTP South) rely solely on Jordan Lake, while others (Durham, Hillsborough, OWASA and Raleigh and its Merger Partners) are supplied from other reservoirs. Pittsboro, Sanford and Holly Springs (via Harnett County) are supplied by run-of-river intakes.

Current Water Supply Sources

Table 7 lists the current water supply sources with their estimated raw water supply capacity (i.e. yield). The values presented consider only the availability of raw water from the source, and do not reflect operational supply capacity.

Table 7. Average day raw water supply capacity of water sources used by Partnership members (MGD).

Basin	Supply Source	Type	Apex	Chatham County N	Cary	Morrisville	Wake County - RTP South	Durham	Holly Springs	Orange County	OWASA	Pittsboro	Hillsborough	Raleigh	Sanford	Grand Total
Cape Fear	Jordan Lake Allocation - Level I	Jordan Lake	8.5	6.0	23.5	3.5	3.5	10.0								**55.0**
	Jordan Lake Allocation - Level II	Jordan Lake							2.0	1.0	(5.0)					**3.0**
	Cane Creek Reservoir and University Lake	Reservoir System									10.5					**10.5**
	Cape Fear River	River													61.6	**61.6**
	Haw River	River										(9.8)				**0.0**
	Harnett County – Cape Fear River	Purchase (River)							6.7							**6.7**
Cape Fear Total			**8.5**	**6.0**	**23.5**	**3.5**	**3.5**	**10.0**	**8.7**	**1.0**	**10.5**	**0.0**			**61.6**	**136.8**
Neuse	Falls Lake	Falls Lake												68.4		**68.4**
	Lake Benson and Lake Wheeler	Reservoir System												11.2		**11.2**
	Lake Michie and Little River Reservoir	Reservoir System						28.9								**28.9**
	Lake Orange, Lake Ben Johnston, and W. Fork Eno reservoir	Reservoir System											2.6			**2.6**
Neuse Total								**28.9**					**2.6**	**79.6**		**111.1**
Grand Total			**8.5**	**6.0**	**23.5**	**3.5**	**3.5**	**38.9**	**8.7**	**1.0**	**10.5**	**0.0**	**2.6**	**79.6**	**61.6**	**247.9**

* Values in parentheses may not be included in totals subject to system's water supply plans.

Risk Assumptions and Water Supply Yields

"Yield" typically denotes the supply capacity of a surface source during extended periods of drought. Terms commonly used to express the reliability of a yield estimate include *safe*, *reliable*, *sustainable*, *operational*, or *firm*. *Safe yield* has a long history of use among water supply professionals, but some experts discourage its continued use because, without further qualification, *safe yield* incorrectly implies that a water supply is 100 percent reliable for a given level of demand.

The determination of yield requires reference to specific drought conditions, such as the drought of record, or a probability-based estimate with a specified return frequency, such as 30 or 50 years. A "50-year" yield therefore represents a 2 percent risk that a supply source will become depleted in any given year. Alternatively, the use of stream flow records from an actual period of drought can be used to calculate the amount of water that a source (usually an impoundment) could provide under those conditions without becoming totally depleted.

For purposes of this report, and for consistency with the methods used by Durham and OWASA, yields were generally calculated with 20 percent of a system's storage capacity held in reserve; i.e., the "yield" represents the amount of water that these systems can provide under drought of record conditions before total storage falls below the 20 percent reserve level. The rationale for this approach is that real-world water systems are not operated in anticipation of total depletion ("running out of water is not an option"), but have contingency or emergency plans in place that will be activated in advance of total depletion. For Durham and OWASA, these contingency triggers are 20 percent of total system storage.

The presentation of yield in this report reflects the following assumptions. The individual system summaries presented later in this document provide more detail on these yield assumptions.

- Yields for the reservoirs of the City of Durham and OWASA were calculated with 20% of their primary water supply storage held in reserve.
- DWR has estimated the yield of Jordan Lake to be 100 MGD, and this report follows DWR's convention of equating Jordan Lake water supply allocation *percentages* to *MGD*. For example, an allocation of 10 percent of Jordan Lake's water supply storage capacity is assumed to yield 10 MGD of supply. Additionally, all current Jordan Lake Level I and Level II Allocations are considered to be reliable raw water supplies, regardless of whether or not the allocation is currently being accessed.
- OWASA's current water supply system does not use its Jordan Lake Level II allocation, and it is not counted for the purposes of meeting average demand (though it may be used for peak demand periods). More details about OWASA's assumptions regarding its Jordan Lake allocations can be found in Section XI.
- Pittsboro's run-of-river intake in the Haw River is estimated to yield 9.8 MGD, which represents 20% of the 7Q10, as reported in the Cape Fear River Basin Water Supply Plan (2002). Pittsboro's internal water supply planning disputes the ability of the source to provide that much water from an infrastructure perspective. More details about Pittsboro's assumptions regarding the Haw River intake can be found in Section XI.
- Sanford's run-of-river intake in the Cape Fear River is estimated to yield 61.6 MGD, which also represents 20% of the 7Q10, as reported in the Cape Fear River Basin Water Supply Plan (2002).
- Holly Springs has a contract to purchase up to 10 MGD of finished water from Harnett County, which uses the Cape Fear River as its source. Because this represents the maximum amount allowed under the contract, the *average* demand supported by the contract is somewhat less than 10 MGD. For the purposes of this report, Holly Springs' 10 MGD supply contract is adjusted downward by a conservative peaking factor of 1.5. The effective "yield" of this contract for meeting average demands is therefore assumed to be 6.7 MGD.

SECTION X. FUTURE WATER SUPPLY NEEDS

This section summarizes the projected future water supply needs, which are defined here as the difference between available raw water supply and future projected demand. For this analysis, only the available raw water supply capacity of existing sources is counted.

Table 8 summarizes the projected water needs by system and year in units of MGD. Need is calculated by subtracting current source water supply availability (i.e. yield) from projected average day water demand. Current raw water supply availability (yield) is shown in the rightmost column. This number reflects the water supply availability each system factors into its water supply planning, which may differ slightly from the sources listed in Table 7. In most cases, this current supply number reflects total source yield (for reservoir sources) or calculated raw water withdrawal limit (for run-of-river sources). No future sources or sources currently under development are included. In certain cases, existing supplies are not counted because they can't be reasonably accessed or maintained into the future. The individual system summaries explain the source availability number used for planning.

All needs are presented in MGD. Surpluses are marked as "- -", no matter their actual value. The "Total" row is a sum of individual system needs, not a net representation of total demand projections minus total source availability.

Table 8. Triangle Area Water Systems -Future Water Supply Needs (MGD).

System	2010	2020	2030	2040	2050	2060	*Current Source Availability*
Apex	--	--	--	1.4	2.5	3.0	*8.5*
Cary	--	--	0.8	3.9	6.3	6.3	*23.5*
Chatham County - North	--	--	2.3	5.9	8.2	12.1	*6.0*
Durham	--	--	--	1.8	5.8	8.6	*38.9*
Hillsborough	--	--	0.1	0.4	0.8	1.1	*2.6*
Holly Springs	--	--	--	--	--	0.1	*8.7*
Morrisville	--	--	--	--	0.0	0.1	*3.5*
Orange County	--	--	0.6	1.4	2.2	2.9	*1.0*
OWASA	--	--	--	0.3	1.4	2.4	*10.5*
Pittsboro	--	0.1	3.8	5.2	6.6	8.0	*0.0 (9.8)*
Raleigh	--	--	2.8	12.7	23.1	35.4	*79.6*
Sanford	--	--	--	--	--	--	*61.6*
Wake County - RTP South	--	--	--	--	--	--	*3.5*
TOTAL	**0.0**	**0.1**	**10.4**	**33.0**	**56.9**	**80.0**	***247.9***

This table only considers raw water supply yield (or calculated withdrawal limit), and does not consider whether infrastructure upgrades are needed to treat and deliver the water. That is, the sources' capacity to provide water is examined, without considering whether the source water can currently be treated and delivered to customers.

A more detailed examination of water treatment and infrastructure needs will be presented in Volume II of the Triangle Regional Water Supply Plan, but it is necessary to present a few notes here. For systems without need shown in any of the projection years, additional infrastructure (e.g. WTP capacity, new intakes, pumps, etc.) may be needed even if the raw water supply is sufficient. For water systems showing need, the numerical values listed reflect only projected demand minus current raw water supply availability. In most cases, additional investment

(in WTP capacity and water delivery infrastructure) may be necessary to fully use the available raw water supply, even before new or expanded sources are built to meet the projected need. Furthermore, both raw water supply and treatment capacity will have to be increased in excess of the need shown in the table to ensure a factor of safety, meet peak demands, and partially account for uncertainty in the long-range demand projections.

SECTION XI. INDIVIDUAL SYSTEM SUMMARIES

This section summarizes the information which formed the basis of each Partnership member's demand projections. The following information is provided:

- References for **Prior Studies and Supporting Documents** conducted by the Partnership members or their consultants. Pertinent sections of these documents are presented in the Appendices.
- **Historical Finished Water Use** is presented for all Partnership water systems both graphically and in table form for the years 1995 – 2010, or for whatever subset of those years in which reliable data are available. For some Partnership members, this was based on production of finished water at their water treatment, and for other Partnership members, it reflects water purchased from another utility. Additionally, the 2010 single family residence (SFR) use rate is presented (as gpd per connection).
- **Future Demand** projections are shown at ten-year intervals from 2010 to 2060. Demand projections are shown by sector and presented in table form. A second table presents each sector's percentage contribution to the total demand for each forecast year. These sectors are generally consistent with those that are used in Local Water Supply Plans submitted to DWR by water suppliers, except for the characterization of non-revenue water. As described earlier, non-revenue water is broken into three categories for this report. The WTP Process sector includes water used by treatment plants in the process of making finished water. Distribution Process water includes a system's use of finished water for other normal operating and maintenance purposes such as line flushing, flow testing, and other processes needed to maintain quality in the distribution system. The Other Non-Revenue sector includes all other uses of unbilled water, such as leakage, main breaks, firefighting, etc. The full list of sectors includes:
    - Residential
    - Commercial
    - Industrial
    - Institutional
    - WTP Process
    - Distribution Process
    - Other Non-Revenue

  All future demand projections are presented as average daily demand in units of millions gallons per day (MGD). The data precision at which the water demand projections are presented in this section was determined by each Partnership member's preference.
- The **Demand Methodology** subsections lay out the methodologies, assumptions, and base data that were used to generate each system's demand projections. Each subsection contains three further subdivisions: **Population Estimate**, **Water Demand Projections**, and **Water Efficiency and Conservation**.
    - Because population estimates are often an important basis for projecting water demand, the **Population Estimate** subsection describes how population was estimated within each Partnership member's service area.
    - The **Water Demand Projections** subsections provides the necessary background and assumptions that explain how the future water demand was projected for the various sectors and projection years.
    - Finally, a **Water Efficiency and Conservation** subsection explains how each system has incorporated additional conservation and water use efficiency in their respective demand projections.
- The **Water Supply** subsection presents existing water supply sources and their yields. Future and planned water sources are not included in this document, but will be presented as supply alternatives and will be evaluated in detail in the *Triangle Regional Water Supply Plan Volume II: Regional Supply Options* report, which is planned to be completed later in 2012.

- Finally, **Future Water Supply Need** presents the projected need for future supplies based on demand projections and the existing water supply capacity.

Note: Text and figures in this section were obtained from a variety sources. Certain text and figures were excerpted from studies commissioned by individual Partnership members and are published here with the approval of those Partnership members. Studies from which these figures are derivative are cited to the extent possible. Individual Partnership member's summaries were developed and reviewed by the other Partnership members and by TJCOG staff through a collaborative, iterative review process.

Town of Apex

Prior Studies/ Supporting Documents

CH2M Hill, 2011. "Town of Apex Baseline Water Demand and Wastewater Flow Projections." Prepared by CH2M Hill for Town of Apex. Aug 17 2011.

CH2M Hill. 2010. "Town of Apex Population and Water Demand Projections through 2060, Modified Growth Assumption Scenario TM," Aug 2010.

CH2M Hill, 2008a. "Final Technical Memorandum: Town of Apex Population and Water Demand Projections." Prepared by CH2M Hill for Town of Apex. Aug 18 2008.

CH2M Hill, 2008b. "Technical Memorandum Addendum No. 1: Town of Apex Population and Water Demand Projections through 2060." Prepared by CH2M Hill for Town of Apex. Jul 21 2009.

CH2M Hill, 2008c. "Technical Memorandum Addendum No. 2: Town of Apex Population and Water Demand Projections through 2060, Modified Growth Scenario." Prepared by CH2M Hill for Town of Apex. Aug 25 2010.

DWR, 2007. *Local Water Supply Plan Report, Apex.* Submitted by the Town of Apex to North Carolina Division of Water Resources. Draft. Currently Under Review.

DWR, 2002. "Summary of Existing Jordan Lake Allocations." North Carolina Division of Water Resources, Permits and Registrations. Approved Jul 11 2002. <http://ncwater.org/Permits_and_Registration/Jordan_Lake_Water_Supply_Allocation/existing.php>

Historical Finished Water Use

In 2010, Apex pumped 3.13 MGD of finished water to its customers on average. The single family residence (SFR) use rate was 167.3 gpd per connection in 2010.

Table 9. Apex Historical Finished Water Production.

Year	Production (MGD)
1995	1.07
1996	1.22
1997	1.79
1998	2.23
1999	2.04
2000	1.97
2001	2.13
2002	2.48
2003	2.33
2004	2.60
2005	2.79
2006	2.74
2007	3.04
2008	2.72
2009	2.94
2010	3.13

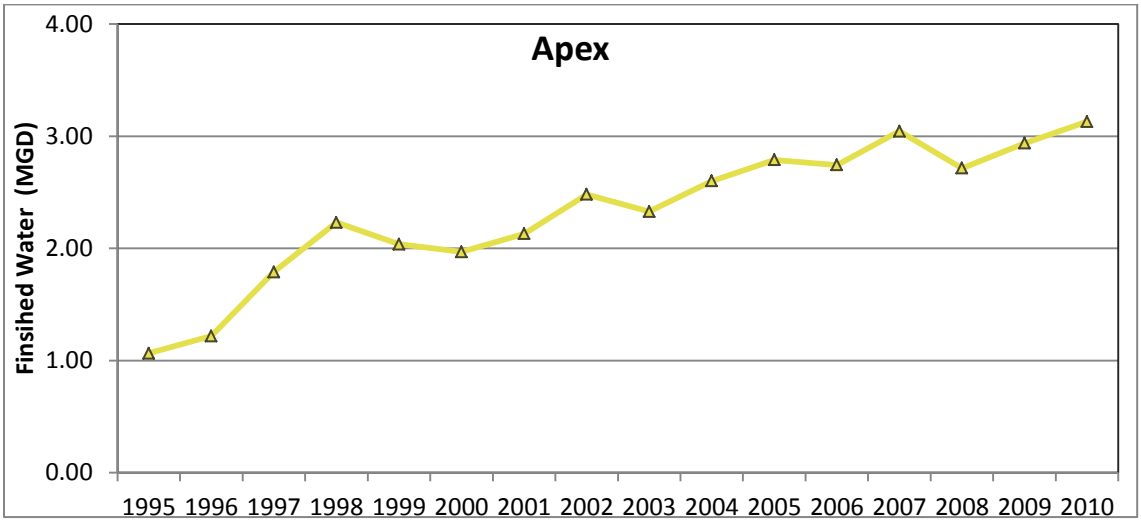

Figure 10. Apex Historical Finished Water Use (MGD)

Future Demand

Table 10. Apex Future Demand Projections (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	2.0	3.2	4.5	6.0	6.6	6.7
Commercial	0.6	0.9	1.1	1.3	1.5	1.7
Industrial	0.1	0.1	0.2	0.3	0.3	0.3
Institutional	0.1	0.1	0.1	0.2	0.2	0.2
WTP Process	0.5	0.8	1.1	1.4	1.6	1.7
Distribution Process	Included with Other Non-Revenue					
Other Non-Revenue	0.3	0.4	0.6	0.8	0.9	0.9
Total	**3.5**	**5.5**	**7.6**	**9.9**	**11.0**	**11.5**

Table 11. Apex Future Demand Projections (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	57.3%	57.4%	58.9%	60.7%	59.5%	58.3%
Commercial	16.2%	16.2%	14.1%	12.7%	13.4%	14.7%
Industrial	2.4%	2.4%	3.0%	2.5%	3.0%	3.0%
Institutional	2.0%	1.8%	1.8%	1.9%	1.9%	1.8%
WTP Process	14.4%	14.4%	14.4%	14.4%	14.4%	14.4%
Distribution Process	Included with Other Non-Revenue					
Other Non-Revenue	7.8%	7.8%	7.8%	7.8%	7.8%	7.8%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

Apex developed its population estimates based on planning projections through 2030, and a land use analysis to determine population thereafter. CH2M Hill prepared several technical memoranda detailing the population

projections. The basic population methodology is laid out in "Final Technical Memorandum: Town of Apex Population and Water Demand Projections" (CH2M Hill, 2008a):

> "CH2M Hill acquired total population projections by Traffic Analysis Zone (TAZ) for the Town of Apex from the Capital Area Metropolitan Planning Organization (CAMPO). These projections included the years 2007, 2010, 2015, 2020, and 2030. The total population projections were then adjusted to match the population estimates provided by the Town's Planning Department while maintaining the spatial distribution of the population data within each TAZ."
>
> "The water demand estimates were developed for the Apex water service area, which is defined as the combination of the: Town's corporate limits, extraterritorial jurisdiction (ETJ) and urban service area (USA)."
>
> "Neither the Town of Apex nor CAMPO had data available for the years 2030 through 2050. … CH2M Hill needed to determine the maximum population that the entire water service area could sustain based on the build-out conditions of the Town's 2025 Land Use Plan GIS data layer."

The 2030-2050 demands were determined through a parcel-based land capacity analysis. The land capacity analysis estimates the expected build-out population in Apex by taking into account existing land use from the Wake County parcel database, future land use from the Town's Land Use Plan, development density from the Town of Apex Comprehensive Plan, and persons per household assumption from US Census Bureau data for Apex. This analysis was later extended by CH2M Hill to 2060 in "Technical Memorandum Addendum No. 2: Town of Apex Population and Water Demand Projections through 2060, Modified Growth Scenario" (CH2M Hill, 2010). The land capacity analysis established the maximum population in the current corporate limits, ETJ, and USA. Under the chosen "Modified Growth Scenario", the combined population of the corporate limits and ETJ reaches its build-out population of 101,570 in 2050. The USA population does not reach build-out, and grows by four percent per year from 2015 to 2060. The population of the Corporate Limits/ETJ and USA areas were summed to obtain the total population estimate.

Water Demand Projection

The Town of Apex projected sector usage by quantifying the size of each sector and multiplying by a water use rate. Four use sectors were defined for the purposes of this analysis. The residential and institutional sector size were defined on a population basis. The commercial sector's size was quantified on the basis of commercial land area developed. Projections of the rate of increase of developed commercial land area was tied to the rate of increase in the CAMPO projections of employment by TAZ area. The industrial demand sector size was quantified by the acreage of developed industrial parcels.

Once sector size was projected for all of the use sectors, they were multiplied by a use rate to calculate water demand. The use rates remained constant for all forecast periods. The residential and commercial use factors were determined using the average 2004-2010 billing data, population estimates, land use data and commercial account estimates for the same time period. The industrial and institutional unit factors were determined from 2007 data. The use rates used in the projections include:

- Residential (RES): 60.0 gpd per capita
- Institutional (INS): 1.88 gpd per capita
- Commercial (COM): 602 gpd per acre COM development
- Industrial (IND): 221 gpd per acre IND development

Using these rates multiplied by the sector size, the water demand projections by sector were calculated. After these demands were calculated, the projected usage in the non-revenue categories of demand was projected.

For the purposes of these projections, the Town of Apex divided non-revenue into two categories. Most of the non-revenue use fell into a general other non-revenue category capturing all non-revenue uses of finished water. This includes leakage, pipe breaks, firefighting, and system flushing. For all forecast years, Apex calculated the other non-revenue usage as 9% of finished water demand. This category did not include water treatment plant system process usage. The system process use definition was limited to Apex's portion of system process usage to operate the Cary/Apex water treatment plant, in other words WTP Process only. For WTP system process projections, Apex used a factor equal to 0.17 times finished water production. This is equivalent to the factor used in projecting WTP Process for Cary since they jointly operate the Cary/Apex Water treatment plant. This was added to finished water production to obtain total projected average daily (raw) water demand.

Water Efficiency and Conservation

The Apex water demand projections address water conservation indirectly in the sector's use rates. The rates reflect fairly efficient use by its residential and commercial sectors. Apex treats its water at the Cary/Apex WTP, which due to the quality of Jordan Lake source water, requires a considerable amount of process water. Once the water is treated, Apex is committed to keeping the other non-revenue sector usage under control. It is kept to 9% of finished water demand, or 7.8 % of raw water demand, which is a fairly low, though attainable percentage.

Water Supply

Table 12. Apex Water Supply (MGD).

Sector	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation	8.5	8.5	8.5	8.5	8.5	8.5

Apex and Cary have a combined Level I allocation from Jordan Lake estimated to yield 32 MGD, of which 8.5 MGD is assigned to Apex.

Future Water Supply Need

Table 13. Apex Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Apex	0.0	0.0	0.0	1.4	2.5	3.0

Town of Cary

Prior Studies/ Supporting Documents

Town of Cary, 2012. *Long Range Water Resources Plan (LWRP): Town of Cary, Morrisville and RTP South Baseline Water Demand and Wastewater Flow Projections.*

CH2M Hill, 2012. *Long Range Water Resources Plan: Water Demand and Wastewater Flow Forecasting Tool.* Prepared by CH2M Hill for Town of Cary, North Carolina.

CH2M Hill, 2010. *Town of Cary Water Use Analysis TM.* Prepared by CH2M Hill for Town of Cary, North Carolina.

CH2M Hill, 2009. *Town of Cary Water Distribution System Master Plan* (WDSMP). Prepared by CH2M Hill for Town of Cary, North Carolina.

CH2M Hill, 2007. *Integrated Water Resources Management Plan*. (IWRMP) Prepared by CH2M Hill for Town of Cary, North Carolina.

DWR, 2007. *Local Water Supply Plan Report, Cary*. Submitted by the Town of Cary to North Carolina Division of Water Resources. 2007.

Historical Finished Water Use

In 2010, Cary produced 11.88 MGD of finished water for its own customers (does not include water sold to Morrisville customers or Wake County – RTP South). The Town of Cary's SFR customers used an average of 180 gallons per connection per day in 2010.

Table 14. Cary Historical Finished Water Production.

Year	Production (MGD)
1995	-
1996	-
1997	9.50
1998	9.69
1999	9.38
2000	9.90
2001	10.44
2002	10.59
2003	9.87
2004	10.47
2005	10.84
2006	10.81
2007	12.54
2008	11.83
2009	11.69
2010	11.88

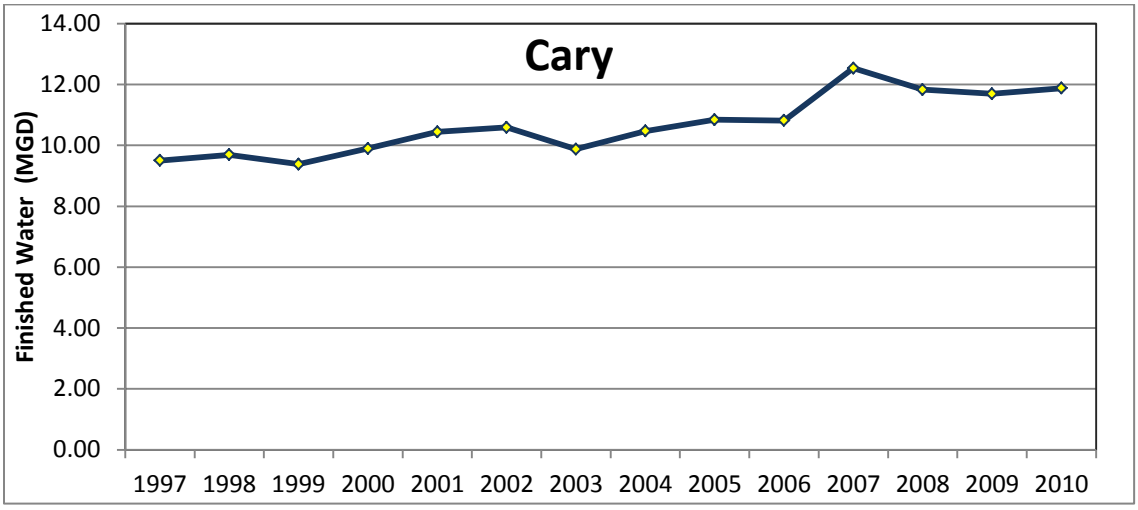

Figure 11. Cary Historical Finished Water Use (MGD).

Future Demand

Table 15. Cary Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	8.3	10.8	13.1	14.8	16.2	16.2
Commercial	2.9	4.3	5.4	5.9	6.3	6.3
Industrial	0.1	0.2	0.5	0.8	0.9	0.9
Institutional	0.2	0.3	0.4	0.4	0.4	0.4
WTP Process	2.7	2.8	3.5	4.0	4.3	4.3
Distribution Process	0.2	0.3	0.4	0.4	0.5	0.5
Other Non-Revenue	0.5	0.8	1.0	1.1	1.2	1.2
Total	**14.9**	**19.5**	**24.3**	**27.4**	**29.8**	**29.8**

Table 16. Cary Future Projected Demand (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	55.7%	55.4%	53.9%	54.0%	54.4%	54.4%
Commercial	19.5%	22.1%	22.2%	21.5%	21.1%	21.1%
Industrial	0.7%	1.0%	2.1%	2.9%	3.0%	3.0%
Institutional	1.3%	1.5%	1.6%	1.5%	1.3%	1.3%
WTP Process	18.1%	14.6%	14.5%	14.5%	14.5%	14.5%
Distribution Process	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%
Other Non-Revenue	3.1%	4.0%	4.0%	4.0%	4.0%	4.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Projection History

The Town has been reviewing population, water usage patterns and water demand projections annually since 2000 as a part of their ongoing water supply and infrastructure planning efforts, as well as engagement in the Jordan Lake Partnership. These efforts are most recently captured in the following two major planning documents and a water use analysis completed by the Town:

- *Town of Cary Integrated Water Resources Management Plan (IWRMP), June 2007*
- *Town of Cary Water Distribution System Master Plan (WDSMP), June 2009*
- *Town of Cary Water Use Analysis TM, September 2010*

The IWRMP utilized water billing data from 2001 through 2005, Capital Area Metropolitan Planning Organization traffic analysis zone (TAZ) population projections adjusted to Town projections and future land use plan data as the basis of future water demand and wastewater flow projections. The WDSMP utilized a method that established the current and future demand from existing accounts based on existing billing data, under the assumption that an existing account's historic usage pattern will continue into the future. For future development, a parcel based land development projection, based on each jurisdiction's future land use plan, was used to estimate a parcel based water demand projection. The primary goal of analyses completed for the *Town of Cary Water Use Analysis TM* was to utilize an expanded billing data set, beyond what was used in the IWRMP, including 2001 through 2009 data, to identify new consumption trends and estimate updated unit water demand factors based on the projection methodology developed for the WDSMP.

Population Estimate

Cary's water demand projections are built on a parcel-based land use analysis that does not consider population directly. Cary's population estimates are found in the Long Range Water Resources Plan: Water Demand and Wastewater Flow Forecasting Tool (CH2M Hill, 2012).

Water Demand Projections

LRWRP Projection Methodology

The water demand projection methodology described within this subsection was developed for the current Long Range Water Resources Plan (LRWRP) and is based upon the methodology initially defined in the Town's WDSMP. Updated unit water demand factors and assumptions based on specific future single family residential usage and development characteristics were derived as part of analyses documented in the *Town of Cary Water Use Analysis TM* (CH2M Hill, 2010).

Method Overview

Projected water demands were developed for existing and future conditions based on parcel-level land use information and water meter billing data. The total future system finished water demand is comprised of the existing demand, projected future demand, future non-revenue water, operational requirements and bulk water sales. Water demands were disaggregated by jurisdiction (Cary, Morrisville and RTP South), river basin (Cape Fear, Haw, and Neuse) and customer classification (single family residential, multi-family residential, commercial, industrial, and institutional). The projections were developed for the Town's water system service area, which is defined as the combination of the Towns of Cary and Morrisville urban service areas, RDU Airport and Wake County – RTP South. Demand projections for RTP South are being provided to the Jordan Lake Partnership by Wake County.

Projection of Future Development Methodology

The base methodology used to develop the projections for future land development was based on parcel-level land use data following a projection methodology developed with the Town for the WDSMP. The process of projecting future development for the LRWRP is included in an attachment to the LRWRP.

The methodology developed for the WDSMP was not changed for this projection effort but some of the data inputs that form the basis for the projection of future development have been updated. The primary updates since the completion of the WDSMP include:

- Town of Cary Engineering Department has updated the development data for the Developing Permitted and Developing (formerly Developing Unpermitted) water service categories. This category includes those parcels that have an approved site plan or a submitted site plan, respectively. The Town has added parcels to these categories or refined the development data for these parcels.
- The land development density data for the Town of Cary and the Town of Morrisville have been reviewed and updated based on input by each Town's respective Planning Departments.
- The Town of Cary Engineering Department reviewed all Vacant-Unclassified parcels and assigned them to a more appropriate water service connection category. The vacant - unclassified water service connection category is no longer used.
- A new water service connection category – named New Existing – was added. The intent of this water service connection category is to capture those parcels that transitioned from developing permitted to existing during the course of a calendar year and therefore do not yet have a full year's worth of water meter data and are not included in the water use data for Existing water service connections.
- The Town of Cary's Planning Department reviewed all parcels that were classified as Built without Service and larger than two acres. These parcels were subsequently identified as having the potential for future redevelopment to a higher density than the existing conditions. These parcels were converted to the Vacant water service connection category. In addition, a review of the Built without Service parcel attribute data identified approximately 650 parcels that had a "heated area" value of zero. These parcels were also converted to the Vacant water service connection category.
- The Town of Cary Parks and Recreation Department provided information on future park facilities for the Town. This information was used to identify current open space parcels that will be developed into Town operated parks in the future. These parcels were converted to the Developing water service connection category, with a unique customer classification of parks and unit demand factor.
- Wake County provided updated future development and water demand projection data for RTP South for incorporation into the LRWRP. Demand projections for RTP South are being provided to the Jordan Lake Partnership by Wake County and are not included in the demand projections provided by the Town of Cary to the Jordan Lake Partnership.

Water Demand Projections Methodology

The water demand projections were based in part on the assumption that the historic consumption patterns of the Town's water system customers will continue into the future. The billing data for 2001 through 2010 were assumed to be the baseline characteristic for existing and future customers for all use types. The 2001 through 2010 time period was analyzed because it includes the most recent data trends, as well as the occurrence of normal and outside of normal weather patterns in these years and the impact of an extended economic recession. Using these data captures the potential future trend of oscillating patterns of extreme and normal weather, as well as the implementation of conservation measures by the Town to manage demand during times of environmentally induced water shortages.

The unit-based water demand projections were developed and applied based on the projected future development for the years 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2050, and 2060. The following subsections provide a summary of the projection steps and methodology.

Step 1: Unit Demand Factors

Water demand unit factors form the base for the development of Cary's water demand projections. These factors are typically applied to water uses on an annual average basis and can be determined on a per capita, per account, or per acre basis.

Table 17 displays the water demand unit factors for the Town of Cary as identified from analyses detailed in the 2010 *Town of Cary Water Use Analysis TM*. Table 18 shows the corresponding factors for the Town of Morrisville.

Table 17. Town of Cary Water Demand Unit Factors.

Customer Classification and Abbreviation	Water Demand Unit Factor[a]	Data Source
Single Family Residential (SFR)	218 gpd/unit	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Multi-Family Residential (MFR)	116 gpd/unit	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Industrial/Commercial/ Institutional (ICI)	0.1 gpd/square foot of building	Town of Cary Engineering Department
Commercial (COM)	1,142 gpd/acre	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Industrial (IND)	376 gpd/acre	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Institutional (INS)	214 gpd/acre	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Parks (PKS)	25 gpd/acre	Determined for the LRWRP from existing Town park facility meter and parcel data.
Open Space (OS)	0 gpd/acre	No open space demand factors

[a] *Water demand unit factors include both domestic and outdoor usage.*

Table 18. Town of Morrisville Water Demand Unit Factors (from CH2M Hill, 2011).

Customer Classification and Abbreviation	Water Demand Unit Factor[a]	Data Source
Single Family Residential (SFR)	218 gpd/unit	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Multi-Family Residential (MFR)	130 gpd/unit	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Industrial/Commercial/ Institutional (ICI)	0.1 gpd/square foot of building	Town of Cary Engineering Department
Commercial (COM)	771 gpd/acre	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Industrial (IND)	312 gpd/acre	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Institutional (INS)	153 gpd/acre	Town of Cary Water Use Analysis (CH2M HILL, 2010)
Parks (PKS)	25 gpd/acre	Determined for the LRWRP from existing Town park facility meter and parcel data.
Open Space (OS)	0 gpd/acre	No open space demand factors

[a] *Water demand unit factors include both domestic and outdoor usage.*

The ICI square foot unit demand factor of 0.1 gpd/square foot of building space is a value that has historically been used by the Town's Engineering Department for capacity determinations. This value was validated as appropriate to continue to be used for water demand projections based on a review of non-residential water meter and building square footage data, from the Wake County parcel database. This review included 2007 meter data, reviewed during the development of the WDSMP, and 2010 meter data. The review yielded a range of potential square foot unit demand factors with 0.10 gpd/square foot being a reasonable estimate of unit consumption for non-residential facilities.

A number of assumptions were used to develop the SFR unit demand factor presented in Table 17 and these assumptions form the basis for the projected future SFR water demand and wastewater flows. These assumptions were developed during analyses completed for the *Town of Cary Water Use Analysis TM* and are as follows:

- Existing SFR accounts that use less than 50 gallons per day (gpd) will increase consumption to the projected SFR unit demand of 218 gpd/residence.
- SFR usage patterns for existing accounts for homes constructed after the year 2000 will continue into the future:
- Thirty-five percent of new homes will have in-ground irrigation systems, a continuation of the trend for homes constructed after 2005.
- The profile of new homes by square footage will be similar to that of homes constructed after 2005
    - <2,000 square feet – 16 percent
    - 2,001 – 3,000 square feet – 34 percent
    - 3,001 – 4,000 square feet – 35 percent
    - >4,001 square feet – 16 percent
- The current level of water efficiency for fixtures within homes constructed after 2005 will continue into the future.

Step 2: Non-Revenue Water

The *non-revenue water* represents the portion of the water produced that is not billed. This typically includes meter errors; water lost to system leaks, hydrant flushing, and fire flows.

Once water production and water sales have been determined for the system, the percent of non-revenue water can be estimated as:

$$U = 100 \times (Q_p - Q_s)/Q_p$$

Where U is non-revenue water percentage, Q_p is the total water production and purchases, and Q_s is the total water sales.

A constant non-revenue water percentage for the system was assumed for projections, and was based on Town data for non-revenue water for the time period of 2001 through 2010; these values are shown in Table 19. For the Town of Cary, the non-revenue water during this time period was estimated to be seven percent of the total finished water. Analyses completed by Town staff to disaggregate non-revenue water that is attributed to operational usage (e.g., pipeline flushing) versus leaks, failing water meters or water theft revealed that approximately two percent of the total finished water (which equates to 1.6% of total raw water) was used for the Town's operational purposes. This percentage was used to project operational demands into the future, and five percent of finished water (which equates to 4.0% of total raw water) was used to project other non-revenue demands into the future.

Table 19. Town of Cary Water System Non-Revenue Data Analysis, Jan 2001- Dec 2010 (MGD)

Year	Total Finished Water	Total Water Sold	Non-Revenue Water	Non-Revenue Water (% of Total Finished)
2001	12.0	11.2	0.8	6%
2002	12.8	11.9	0.9	7%
2003	11.5	11.2	0.3	3%
2004	12.3	11.4	0.8	7%
2005	12.8	12.4	0.4	3%
2006	12.9	11.9	1.0	7%
2007	15.4	13.9	1.5	10%
2008	13.9	12.8	1.1	8%
2009	13.2	12.3	0.8	6%
2010	14.2	13.4	0.8	6%

Step 3: Water Treatment Plant System Process Water

The WTP process water requirements include 1.17 gallons of raw water to produce one gallon of finished water, based on current treatment processes (filter backwash, etc.) at the CAWTP. This ratio was selected as reasonable for use based on a review of the long and short-term trends in the annual ratios, which varied little over the time periods investigated. Table 20 contains the historic CAWTP raw water demand to finished water produced ratios from 1998 through 2010.

Table 20. Cary/Apex WTP Raw Water Demand to Finished Water Produced Ratio.

Year	Average Day Raw Water Demand (mgd)	Average Day Finished Water Produced (mgd)	Raw Water: Finished Water Ratio
1998	10.75	9.81	1.10
1999	9.20	8.09	1.14
2000	7.30	6.42	1.14
2001	9.71	7.17	1.35
2002	17.41	14.59	1.19
2003	15.93	13.86	1.15
2004	17.04	14.82	1.15
2005	18.43	15.60	1.18
2006	17.60	15.54	1.13
2007	20.28	18.39	1.10
2008	19.28	16.57	1.16
2009	19.54	16.08	1.21
2010	20.94	17.12	1.22
	13-year Average Raw Water to Finished Water Ratio (1998-2010)		**1.16**
	5-year Average Raw Water to Finished Water Ratio (2006-2010)		**1.17**

Step 4: Calculating Average Day Water Demand Projections

The future year water demand was calculated by adding the base year (2010) water demand for existing customers by customer class to the future year water demand. The following sections are taken from the Section 2 of the WDSMP and have been updated to reflect updates to the projection methodology.

Water Service Connection Categories

As part of the WDSMP, each parcel was assigned a water service connection category which identified parcels with an existing water service connection (i.e., existing water demand) or that will have a connection in the future. The four primary general water service connection categories are: Existing, Developing, Developing Permitted, and Vacant. Individual parcels assigned to these categories were further assigned to a sub-category. The categories and sub-categories are shown Table 21.

The water service connection categories and sub-categories were used to define how the parcel would develop and contribute to the future demands. Table 21 shows a description of each of the water service connection categories and the method used to determine the categories. This table represents the latest information on the description and methods for classifying parcels by water service connection category. It should be noted that most of the parcel water service connection categories were identified for the WDSMP and maintained as originally identified or modified by the Town for the LRWRP projections.

Table 21. Water Service Connection Categories, Description, and Method of Determination.

Water Service Connection Category	Description	Method of Determination (for Wake County Parcel data)
Existing	These parcels contain an existing water meter that has an annual average day demand greater than 50 gpd.	Spatial join with the Customer meter/billing data
Existing-Unoccupied	These parcels contain an existing water meter that has an annual average day demand less than 50 gpd. It was assumed that these parcels contained a residence that was not yet occupied and future demands would need to be assigned.	Spatial join with the Customer meter/billing data.
Existing - New Existing	These parcels contain an existing water meter that has a demand greater than 50 gpd, but is a parcel that is transitioning, during the course of a calendar year, from Developing Permitted to Existing without a full year of meter data (to be able to assign an annual average day demand). These parcels will be switched to Existing once they have a full year of meter data.	Spatial join with the Customer meter/billing data. Identified as a recent transition from Developing Permitted to Existing WSC based on Town staff parcel updates.
Existing-With Redevelopment	These parcels contained an existing water meter that has an average day demand greater than zero and were identified by the Town as having the potential for future redevelopment and subsequently would have additional demand in the future above the existing demand.	Spatial join with the Customer meter/billing data and the manual interpretation of existing connections with planned future flows in the Permitted Development, Planned Development and the RTP South Development Plan data

Water Service Connection Category	Description	Method of Determination (for Wake County Parcel data)
Existing-Airport Redeveloped	This RDU Airport parcel was identified separately to assign additional future flows based on previous planning efforts. Future additional water demand was estimated at 200,000 gpd.	Manual identification of the main RDU Airport parcel. Total future demand has been estimated in previous planning to be 400,000 gpd; the difference between the existing meter demand and 400,000 gpd is the assigned future demand.
Existing-Built without Service (BWOS)	These parcels were identified to be within the developed areas of the Town's utility service area but currently do not have a connection to the water system. These include parcels that are currently served by an individual or community well and are considered to be fully developed with no future redevelopment potential (defined by a parcel size less than 2 acres and/or a heated area equal to zero).	Spatial overlay with a data layer that contained parcels that have a structure but no existing water meter. Parcels with a building heated area equal to zero and/or a land area of less than 2 acres (based on Wake Co. GIS data) were not included in this classification.
Developing	Parcels that are contained within a submitted site plan or preliminary development information, which may or may not have been approved by the Town.	Spatial overlay with the Town's Sites and Subdivisions data layer. Parcels with a Status listed within this data layer as "Active, "Approved" or "In Review" are classified as Developing.
Developing Permitted	Parcels without a water meter present but that have an approved site plan and have been issued a sewer extension permit.	Spatial overlay with the Town's Permitted Development data layer.
Vacant-Cary	Parcels that are within the Town's utility service area and the jurisdiction of Cary. These parcels currently do not contain a structure with heated area and there are no known development plans. In addition, parcels that are currently classified as BWOS, by definition in the 2009 WDSMP, with the potential for future redevelopment to a density that is greater than current conditions (defined as a BWOS parcels greater than 2 acres in size) were added.	Spatial overlay with Cary-Vacant data layer. BWOS parcels added by selection of the parcels within the BWOS classification that are greater than 2 acres and/or with a building heated area equal to zero.
Vacant-Morrisville	Parcels that are within the Town's utility service area and the jurisdiction of Morrisville. These parcels currently do not contain a structure with heated area and there are no known development plans. In addition, parcels that were classified as BWOS, by definition in the 2009 WDSMP, with the potential for future redevelopment to a density that is greater than current conditions (defined as a BWOS parcels greater than 2 acres in size) were added.	Spatial overlay with Morrisville-Vacant data layer. BWOS parcels added by selection of the parcels within the BWOS classification that are greater than 2 acres and/or with a building heated area equal to zero.
Vacant-RTP	These parcels were identified within the Town's utility service area and as having a future demand within RTP South. These parcels have no existing water meter and no known development plans.	RTP South Development Plan data, by parcel
Vacant-Open Space	These parcels were identified by the Town as open space within the current Land Use Plans.	Spatial overlay with the current Land Use Plan open space data layer, as well as additional non-developable land identified in the parcel data (i.e. common open space, etc.).

Customer Classification

To attribute demands to an individual customer type each parcel was assigned a generalized customer type classification which included single family residential, multi-family residential, commercial, industrial, institutional, parks or open space. For existing accounts the generalized use type was assigned based on the 2010 billing data. For the WDSMP and the LRWRP projections, the Developing and Developing Permitted parcels were classified based on the information provided by the Town for each permitted or planned development. The vacant parcels within the Town of Cary and Town of Morrisville were classified based each Town's respective future land use plan. Built without Service parcels were classified using each Town's respective land use planning data paired with the NC Department of Revenue codes contained in the Wake County parcel data to fill any data gaps and verify land use codes.

Build-out Rates

The rate at which a parcel would develop in the future varies based on its water service connection category. The build-out rates that were used to determine how each parcel would develop in the future are shown in Table 22. These values have been updated since the WDSMP and were used to determine the timing and extent of the water demand for each individual parcel for each planning period. The Town of Cary's Engineering and Planning Departments and the Town of Morrisville's Planning Department were consulted in assigning the build-out rates. The composite build-out rate for all water service connections is consistent with other planning estimates.

Table 22. Water Service Connection Category Parcel Build-out Rates.

Water Service Connection Category	2010	2015	2020	2025	2030	2035	2040	2050	2060
Existing	100%	100%	100%	100%	100%	100%	100%	100%	100%
Existing-New Existing	0%	100%	100%	100%	100%	100%	100%	100%	100%
Existing-Unoccupied	0%	100%	100%	100%	100%	100%	100%	100%	100%
Existing-Redevelopment[a]	100%	100%	100%	100%	100%	100%	100%	100%	100%
Existing-Airport Redeveloped	100%	100%	100%	100%	100%	100%	100%	100%	100%
Existing-Built without Service	0%	0%	0%	10%	20%	30%	50%	100%	100%
Developing	0%	40%	75%	95%	100%	100%	100%	100%	100%
Developing Permitted	0%	50%	100%	100%	100%	100%	100%	100%	100%
Vacant-Cary	0%	2%	10%	30%	50%	70%	80%	100%	100%
Vacant-Morrisville	0%	5%	15%	30%	50%	70%	80%	90%	100%
Vacant-RTP Future	Projection of development was provided by Wake County								
Vacant-Open Space	0%	0%	0%	0%	0%	0%	0%	0%	0%
Composite Build-out Percentage [b]	43%	52%	62%	72%	80%	88%	93%	99%	100%

[a] *Existing-Redevelopment parcels currently have existing water demand, but based on redevelopment plans approved by the Town these parcels have additional future demands.*
[b] *Based on cumulative finished water demand.*

Parcels identified as Existing-Redevelopment currently have an existing water demand and based on future development plans approved by the Town these parcels will have increased demands based on additional future development. The Vacant-RTP Future build-out rates were determined by individually assigned future demands, as provided by Wake County. The timing of this demand varied based on each individual parcel's redevelopment plan.

Baseline Reclaimed Water Demand

The Town has been meeting non-potable water demands, primarily irrigation, with reclaimed water since 2001. The existing reclaimed water system in 2010 had an annual average day demand of approximately 260,000 gpd. The Town is currently developing a Strategic Reclaimed Water Plan, as a component of the LRWRP, and a hydraulic model, as a component of a Reclaimed Water System Master Plan Update. These plans will set the strategic direction and infrastructure requirements for the future of the Town's reclaimed water program.

Currently, the Town has several capital projects under construction or planned for the near-term expansion of the reclaimed water system. In addition to the Town's current 645 reclaimed water meters, the new reclaimed water system infrastructure will connect an additional 60 existing potable water meters which serve irrigation systems. Many of these meters serve large water users in RTP South and Thomas Brooks Park, including the USA Baseball Complex. These 60 additional customers will add an annual average day demand of approximately 170,000 gpd to the reclaimed water system and reduce this demand from the potable water distribution system.

The baseline reclaimed water demands include the existing reclaimed water meter demand and the known existing water meters that will be transitioned from the potable water system to the reclaimed water system. The baseline reclaimed water demand will reduce the demand on the potable water system by approximately 430,000 gpd. For the determination of the baseline potable water demand projections, the existing potable water meters to be transitioned to the reclaimed water system have been removed from the potable water system demand projections starting in 2015.

Future Average Day Demands

The future demands were calculated using different methods dependent upon the water service connection category for an individual parcel. Additional detail on the calculation of future average day demands by water service connection category is provided in the appendices. The overall method overview is as follows:

- Existing meter demands: The 2010 water meter billing data provided by the Town of Cary were assumed to be the base year characteristic for existing water customers of all use classifications. The total annual consumption by individual account was used to determine the average annual day demand for each account. This demand is defined as the base water demand. This consumption pattern was assumed to remain constant in future years; with the exception of residential accounts using less than 50 gallons per day, as outlined in a preceding section. This meter data excludes those meters identified to connect to the Town's reclaimed water system as discussed in the preceding section.
- Future parcel demands: The development capacity of single family lots, multi-family units, or non-residential (commercial, industrial, institutional) square footage or acreage by parcel was determined based on submitted site plans or the future land use plan. The future development potential of a parcel was then used as the basis for the demand calculation. Demands were calculated by multiplying the development numbers (lots, units, square footage or acreage) by the appropriate unit demand factors and the rate of demand accumulation through the planning period. Irrigation demand at future Town park facilities was determined on a site specific basis. These park facilities include Thomas Brooks Park, the USA Baseball Complex, expansion of Mills Park, the addition of athletic fields at Panther Creek high school, the future Roberts Rd. Park and a future unnamed park facility that will border the American Tobacco Trail.

The following formulas present the general basis for calculation of the overall annual average day finished water and raw water demands:

The product of the following relationship is calculated as the total average day finished water demand for each use classification:

Base Projection = Existing water meter demand + Future parcel demand projection
Total Finished Water Demand = Base projection * Non-revenue Water Factor

The product of the following relationship is calculated as the total average day raw water demand for each use classification:

Total Raw Water Demand = Total Finished Water Demand * (Raw Water:Finished Water Ratio)

Limitations of the Water Demand and Wastewater Flow Projections

Estimates of future water demand are only as accurate as the land use projections and historic demand and flow information from which they are derived. The water demand projections for 2010 through 2060 were developed from (1) Town of Cary Engineering Department input on information related to submitted or approved site plans; (2) documentation related to the Town of Cary and Morrisville's planning for future land use (including land use type and development density); (3) assumptions related to the rate of build-out for parcels within the Town's service area; and (4) 2001-2010 water billing records, used in development of unit water consumption estimates for the demand projections.

Each of these data sources is regularly updated by its sponsoring departments as new data are compiled or conditions for development change. In specific locations, development may occur more or less quickly than currently projected or in a different pattern than in the future land use plan. The actual future year water demands for the service area may differ substantially from the projections presented if conditions upon which these projections are based change. Further, the consumption averages of the 2001 through 2010 billing data are assumed to represent the "normal" unit consumption rates. However, the unit consumption rates are most representative of that time period, and future variations in climate, as well as changes in consumption resulting from conservation or development patterns, will have an effect on unit consumption rates. The Town should monitor changes in the development projections, as well as periodically recalculating unit water consumption rates, in order to determine whether to adjust the demand projections.

Water Efficiency and Conservation

The demand projection methodology used by the Town of Cary (which includes the Town of Morrisville in its service area) is based on parcel-level information. Water demand is a function of current development with its existing demands and future development with its projected demands. Projected demands for future development are a function of parcel-based customer types and rates of water use expected for the various customer types.

Water conservation is implicit in the rates of water use assigned to the customer types. A large part of Cary and Morrisville's demand projection is the demand exerted by existing development. The unit rate of demand for existing development has dropped significantly as a result of progressive water conservation programs. A recent survey conducted by CH2M HILL stated in its report that Cary's overall gpcd (gallons per capita per day), ranked second lowest out of the 24 water systems that provided data, and well below the national average. The report further stated that Cary ranked second highest in per capita conservation program spending out of the nine utilities that provided data, and that Cary ranked second highest in per capita conservation staff out of the 15 utilities that provided data. The report concluded that the Town of Cary's water conservation program ranks high among the nation's long standing and successful conservation programs.

Residential water use per capita rates are more easily compared between utilities than total water use per capita rates. Figure 12 depicts Cary's per capita *residential* water use in actual and weather-adjusted values. The weather-adjusted values allow for comparison between relatively wet and dry years.

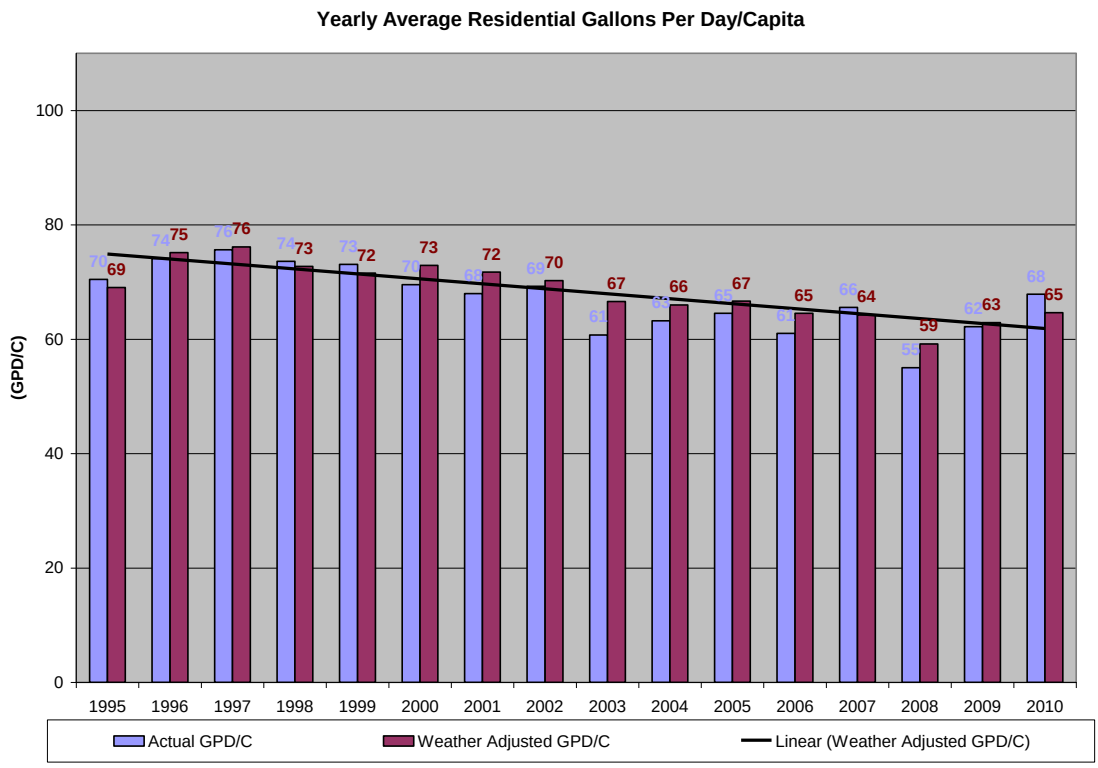

Figure 12. Cary residential per capita demand, 1995-2010.

Total per capita water use rates have also declined in the Cary water system, as depicted in Figure 13.

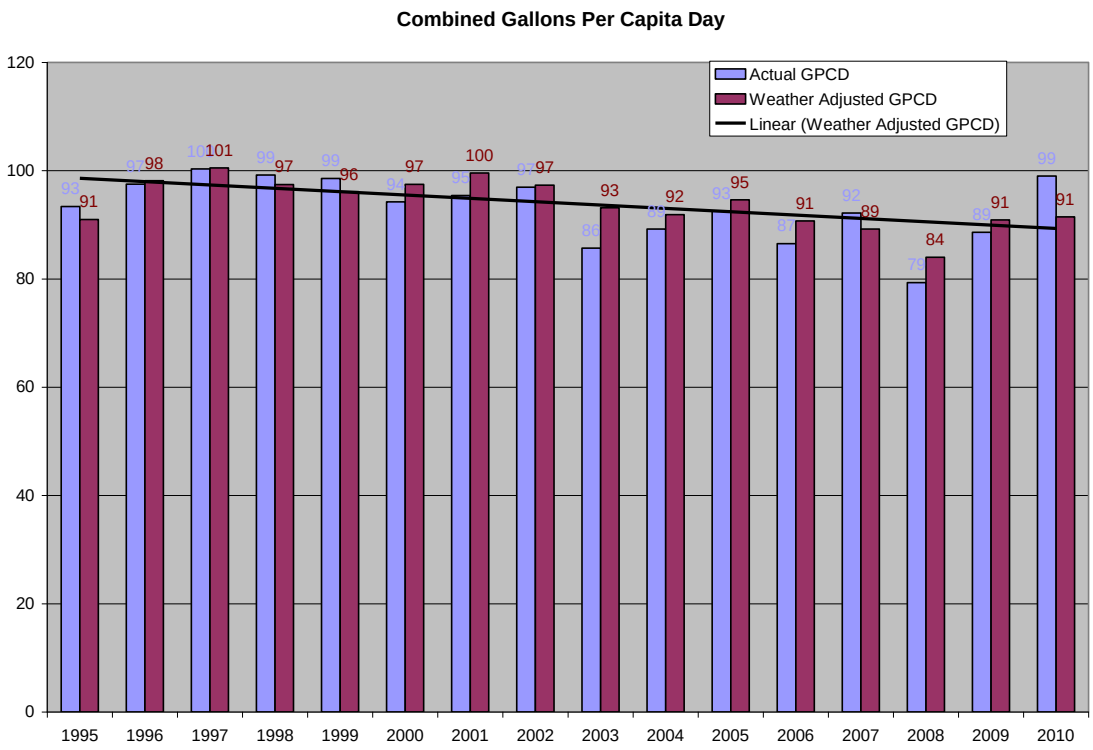

Figure 13. Cary total water use per capita, 1995-2010.

The Town of Cary analyzes rates of water use among its customers on a regular basis. The most recent analysis was conducted in 2010. Water use is examined by customer type as well as water use by year of residential construction. Based on analyses of water use, the Town selected rates of use for future development that seem the most likely, given the Town's history of water conservation and recent trends in water use for newer residential construction.

On the non-revenue side, Cary already controls its distribution system process water and other non-revenue water. Cary has implemented Advanced Metering Infrastructure (AMI) to read customers' demands accurately and in almost real time. This should allow better distribution management and quicker isolation of leaks. When the system is up and running fully, customers should be able to get more detailed information on their own use, which could spur greater water efficiency among customers.

Cary's major non-revenue contributor to raw water demand is its water treatment plant process water used at the CAWTP. The CAWTP uses a considerable amount of raw water in the treatment process to treat Jordan Lake water to drinking water standards. Potential improvements such as adding an aerator or mixer near the intake or improvements to the plant itself may improve efficiency in the future. Until more detailed analysis of potential improvements are completed, it is assumed WTP process water use will remain the same, as a percentage of overall demand.

Water Supply

Table 23. Cary Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation	23.5	23.5	23.5	23.5	23.5	23.5

Cary and Apex have a combined Level I allocation from Jordan Lake estimated to yield 32 MGD, of which 23.5 MGD is assigned to Cary (8.5 MGD are assigned to Apex). This allocation total does not include water treated by Cary for sale to customers in Morrisville or Wake County-RTP South. Each currently has a 3.5 MGD Level I allocation from Jordan Lake, but are provided water through Cary.

Future Water Supply Need

Table 24. Cary Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Cary	0.0	0.0	0.8	3.9	6.3	6.3

Chatham County – North

Prior Studies/ Supporting Documents

Chatham County Public Works, 2011. "Discussions with TJCOG." Personal meetings and emails with TJCOG staff. Jul 2011.

TJCOG, 2007. *Jordan Lake Water Supply Study*. Submitted to Chatham County. 2007.

DWR, 2002. *Local Water Supply Plan Report, Chatham County North.* Submitted by Chatham County to North Carolina Division of Water Resources. 2002.

Historical Finished Water Use

In 2010, the Chatham County – North Water system produced an average of 1.72 MGD of finished water. Chatham County- North's SFR customers used an average of 199.9 gpd per connection.

Table 25. Chatham County – North Historical Finished Water Production.

Year	Production (MGD)
1995	-
1996	-
1997	0.62
1998	0.70
1999	0.65
2000	0.69
2001	0.88
2002	0.94
2003	1.04
2004	1.17
2005	1.19
2006	1.33
2007	1.55
2008	1.51
2009	1.72
2010	1.72

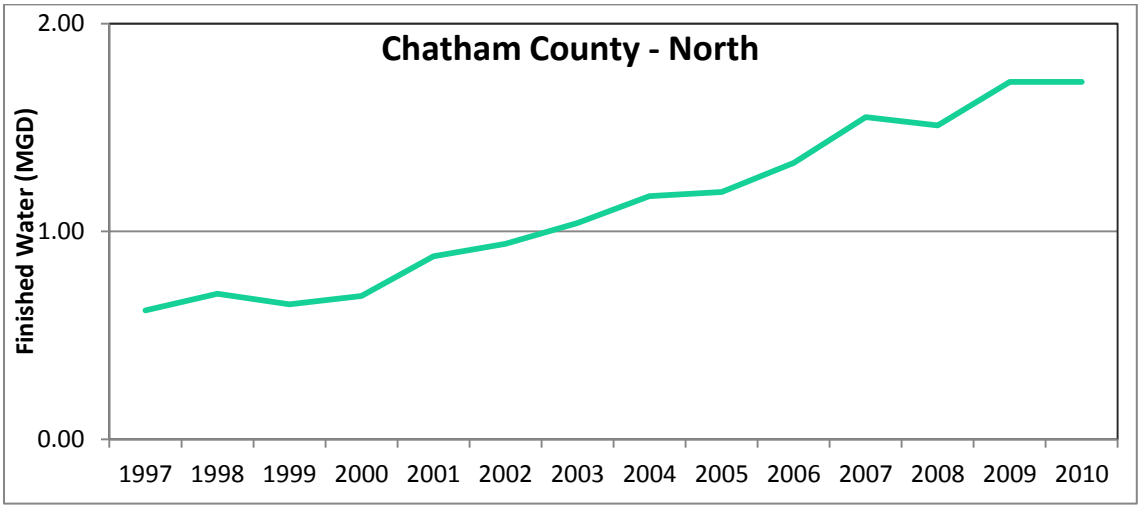

Figure 14. Chatham County – North Historical Finished Water Use (MGD).

Future Demand

Table 26. Chatham County - North Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	0.92	2.40	3.95	5.45	6.97	8.93
Non-Residential	0.25	0.72	1.38	2.18	2.79	3.57
WTP Process	0.30	0.74	1.17	1.67	1.98	2.54
Distribution Process	0.54	1.06	1.25	1.79	1.42	1.81
Other Non-Revenue	0.15	0.37	0.58	0.83	0.99	1.27
Total	**2.16**	**5.29**	**8.34**	**11.92**	**14.15**	**18.11**

Table 27. Chatham County- North Future Projected Demand (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	43.0%	45.0%	47.0%	46.0%	49.0%	49.0%
Non-Residential	11.0%	14.0%	17.0%	18.0%	20.0%	20.0%
WTP Process	14.0%	14.0%	14.0%	14.0%	14.0%	14.0%
Distribution Process	25.0%	20.0%	15.0%	15.0%	10.0%	10.0%
Other Non-Revenue	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Chatham County – North projected its future demand in only the residential/non-residential sectors listed in the tables above.

Demand Methodology

Population Estimate

Chatham County – North's population estimates are derived from a TAZ-based land use and build-out analysis and census data on population characteristics. The methodology for estimating population was based on estimates of residential development and planning and census data. The Water Demand Projection subsection below explains how residential development (and other development) was computed.

Water Demand Projection

The basic methodology for projecting development coincides with methodology used by Triangle Region MPOs in their Transportation Demand Model. The projection methodology is a parcel-based land use analysis supported by water usage rates from planning figures, water use data and economic development data.

Determining the developable land area was the first task. The future service area was determined by the IBT basin boundary (which divides the Chatham County – North system from other Chatham County water systems) and the Chatham County boundary. Additionally, the areas in the Pittsboro ETJ were removed. The remaining area was intersected with the parcel information in the 2005 Chatham County GIS data.

In the GIS parcel data, there were 33 prototype parcel classifications, which were divided among the following categories:

- Natural and Undeveloped Land Prototypes
- Residential Density Prototypes
- Non-Residential and Mixed Use Land Use Prototypes
- Government Infrastructure Project Types That Can Be Assigned To Parcels

Development was then assigned to the parcels based on several criteria. If there were existing plans for development on the parcels, those were assumed to be completed. For other parcels, development was assigned based on the prototypes and according to parcel size, zoning, and presence of existing structures. Undeveloped parcels were then classified as residential, non-residential, untraditional (open space, parks, etc.), and vacant.

The residential parcels were then used to develop residential build-out estimates and population estimates. First, 5% of the land area was set as undevelopable to account for non-suitable terrain, rights of way, etc. Then, existing residential development was analyzed to determine densities and occupancy rates. The number of base-year residential units was calculated from TAZ data for the service area. Using census data and TAZ data, the vacancy/occupancy rates were computed as 6.6%/93.4%. Census data (2010) were used to get a pph figure of 2.35. Future housing density was assumed to follow current conditions, and using this density, and the total number of developable parcels, build-out conditions were computed for housing units. Build-out population was calculated using pph and occupancy rates. The development conditions were assumed to reach ~95% of build-out by 2060. Development rates through 2040 were estimated to follow recent average trends on a linear basis (~6,690 units per decade), and after 2040, growth was projected to continue at 2.5% per year. Population for each projection year was calculated by multiplying housing units by 2.35 pph. Finally, residential demand was calculated by multiplying the number of households by the household water use rate, currently 200 gallons per household per day (gphd). New development being considerably larger and more landscaped than existing stock, the rate is projected to increase to 205 gphd in 2020 and 210 gphd in 2030-2060.

Non-residential demand was computed relative to residential demand. Over time, Chatham County's ratio of non-residential to residential demand has been growing at a relatively constant rate. This change occurs as Chatham County grows and attracts more commercial development to support its residential population and the area becomes more attractive for businesses and industry. This trend is expected to continue. Currently the ratio is 0.27, which is projected to grow to 0.3 by 2020, and reach 0.35 in 2030. By 2040, it is projected to reach 0.4 and cease changing thereafter. In each projection year, residential demand is multiplied by these factors to estimate non-residential demand.

Chatham County – North's Jordan Lake Treatment Plant uses a considerable amount of raw water in the treatment process to treat Jordan Lake water to drinking water standards. WTP Process water accounts for 14% of total demand, which is expected to continue into the future. Chatham County – North's large distribution system and currently low demand (relative to miles of pipe) results in a large need for distribution system flushing and maintenance. Currently, this amounts to 25% of total demand. As development fills in and the water system makes upgrades to the distribution system, it is expected this percentage will be reduced considerably. See Table

27 for the projected declines in percentage terms. Finally, other non-revenue usage is currently 7% of total demand, which is expected to remain constant.

Water Efficiency and Conservation

Chatham County's primary avenue for water efficiency gains is in reducing its non-revenue water as a percentage of total production. Chatham County – North relies on Jordan Lake water for its raw water supply, which is difficult to treat to the Safe Drinking Water Act requirements, and requires a significant amount of water treatment process water. As Chatham's water demand increases, this WTP process water should decline as a percentage of total water use because a certain amount of the WTP use is relatively fixed regardless of the amount of production. Chatham County – North also uses a significant amount of finished water on flushing because of the layout of its distribution system and the need to manage disinfection by-products. The current high distribution process water usage should decline as Chatham County's user base expands and evens out consumption. Combined with careful management of the treatment process, distribution system, and system improvements, Chatham County should be able to reduce its non-revenue water use in the future.

Water Supply

Table 28. Chatham County – North Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation	6.00	6.00	6.00	6.00	6.00	6.00

Chatham County – North has a Level I Jordan Lake allocation estimated to yield 6.0 MGD. Chatham County – North shares a raw water intake in Jordan Lake with the CAWTP, but treats water at its own Jordan Lake WTP, which is currently permitted at a capacity of 3.0 MGD.

Future Water Supply Need

Table 29. Chatham County North Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Chatham County North	0.00	0.00	2.34	5.92	8.15	12.11

City of Durham

Prior Studies/ Supporting Documents

CDM, 2010. "Memorandum: Water Demand Projections." Prepared for the City of Durham by CDM. Sep 16 2010.

Hazen and Sawyer, 2010, "Technical Memorandum: City of Durham Dam Regulatory Compliance Study, Task 5: Reservoir Yield Evaluations." Prepared by Hazen and Sawyer for City of Durham. Aug 9 2010.

Hazen and Sawyer, 2009. "Technical Memorandum: Preliminary OASIS Neuse River Basin Model evaluation of the existing reservoir system." Prepared by Hazen and Sawyer for City of Durham. Oct 2 2009.

DWR, 2007. *Local Water Supply Plan Report, Durham.* Submitted by Durham to North Carolina Division of Water Resources. Draft. Currently Under Review.

Historical Finished Water Use

In 2010, Durham produced a daily average of 25.24 MGD of finished water. Durham's SFR use rate for 2010 was 137 gallons per connection per day.

Table 30. Durham Historical Finished Water Production.

Year	Production (MGD)
1995	25.68
1996	27.04
1997	29.18
1998	30.71
1999	31.10
2000	31.87
2001	32.41
2002	27.58
2003	25.83
2004	26.82
2005	27.65
2006	27.34
2007	28.62
2008	24.12
2009	26.09
2010	25.24

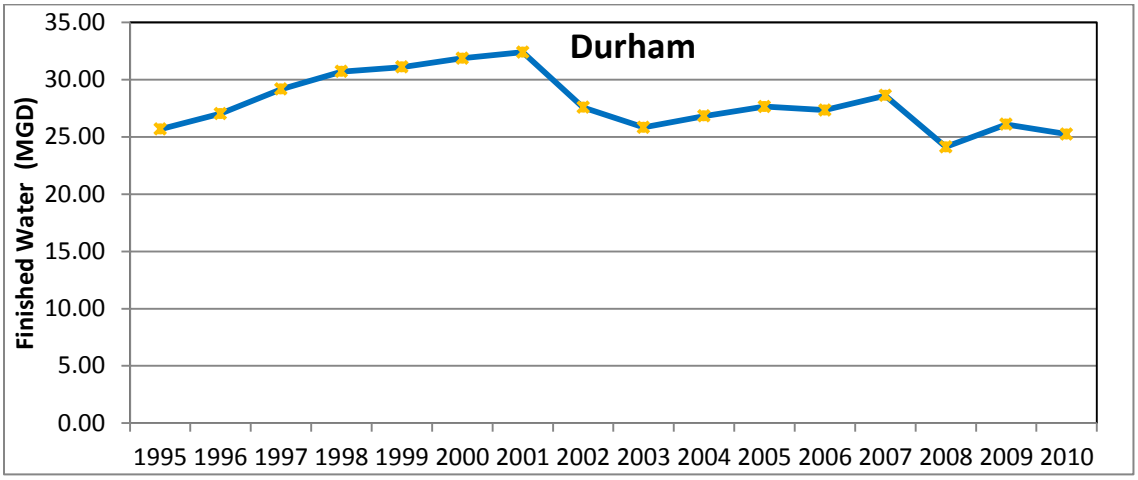

Figure 15. Durham Historical Finished Water Use (MGD).

Future Demand

Table 31. Durham Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	15.21	17.19	19.44	21.60	23.68	25.67
Commercial	5.49	7.19	8.40	9.50	10.53	11.49
Industrial	1.20	1.24	1.47	1.68	1.89	2.07
Institutional	2.87	2.19	2.41	2.63	2.84	3.05
WTP Process	0.96	1.11	1.24	1.38	1.52	1.61
Distribution Process	-	0.49	0.55	0.61	0.67	0.71
Other Non-Revenue	2.50	3.27	2.91	3.25	3.58	2.85
Total	**28.23**	**32.68**	**36.42**	**40.65**	**44.71**	**47.45**

Table 32. Durham Future Projected Demand (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	53.9%	52.6%	53.4%	53.1%	53.0%	54.0%
Commercial	19.4%	22.0%	23.1%	23.3%	23.6%	24.2%
Industrial	4.3%	3.8%	4.0%	4.1%	4.2%	4.4%
Institutional	10.2%	6.7%	6.6%	6.5%	6.4%	6.4%
WTP Process	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Distribution Process	-	1.5%	1.5%	1.5%	1.5%	1.5%
Other Non-Revenue	8.8%	10.0%	8.0%	8.0%	8.0%	6.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

From CDM (2010), "The Durham City/County Planning Department uses TAZ data as the source of population estimates. The most recent TAZ data is based on 2005 population estimates…TAZ forecasts predict growth within the water service area of approximately 3,000 additional residents per year through 2035. Assuming this growth continues linearly, it is estimated that build out would occur around 2080."

CDM's 2010 memorandum gives several alternate demand scenarios, including one ("Scenario 3") in which build out occurs by 2060. This scenario is the one used to make the population estimates in this report. These estimates are consistent with the 2010 US Census data.

Water Demand Projections

CDM's memorandum also projected water use by sector. Residential demand was computed based on population, and average residential use rates. Non-residential demand (commercial, industrial, and institutional) projections were completed in a two-step process. First, the large users in each sector were considered and their demand growth was considered. The numerous customers with smaller individual demand were lumped within each sector, and their demand was projected based on their projected number of employees and a per-employee water use rate. Demands for each sector also assume nominal but incremental decreases in gallon per capita per day for residential usage and gallon per employee for all non-residential sector use. These demands are relatively hardened and based on existing technology. For the residential sector, further demand reductions may be realized with increased installation of water efficient fixtures/devices for new/remodeled/retrofitted homes and with the installation of more water efficient appliances (dishwashers and clothes washers). Customers with separate irrigation meters are included in both the residential and non-residential water demands. Any reductions achieved in the indoor usage category may be offset by increased irrigation practices; however technology changes in irrigation systems may flatten the irrigation usage. Bulk reclaimed water is currently available at both Durham water reclamation facilities (WRFs) and these facilities are being upgraded. The City's water reuse master planning effort is in its initial stages and a robust reclaimed water system will not be fully established for several years. Therefore, reclaimed water usage and the associated demand offsets are difficult to estimate at this time. Essentially, demands for all sectors assume "status quo" for sector usage and apply modest growth rates.

The use rates below were used for each sector for the first decade of the planning period; a 1 gpcd reduction /decade was programmed into use rates for the remainder of the planning period.

- Residential 60 gpcd
- Commercial 41 gpd/employee
- Industrial 41 gpd/employee
- Institutional 41 gpd/employee

For the commercial sector, RTP large water users were projected separately from the rest of the commercial sector. The projected demand in 2010 was 1.75 MGD, which was projected to increase to 1.80 beginning in 2020 and remaining constant through 2060. The Research Triangle Park Owners & Tenants Association has commissioned a Master Plan for the park which could impact the demands for the customer sectors in the area. Similarly, for the industrial sector, the top industrial users were projected separately from the rest of the users. The top industrial users were projected to use a constant 0.34 MGD in each planning year. There were two institutional users that were projected separately from the rest of the sector: Duke University and Hospital and Durham County Hospital. Duke University and Hospital was projected to use 1.45 MGD in 2010, increasing by 0.1 MGD in each planning year to 1.85 MGD in 2060. Durham County Hospital was projected to use a constant 0.09 MGD.

System process water was calculated as 3.4% of total demand for WTP system process and 1.5% of total demand for distribution system process including flushing, hydrant tests, construction, main breaks, street cleaning, fire and water reclamation facility use. Other non-revenue water was calculated at 10% of total water demand in 2020, 8% of total water demand from 2030 through 2050 and 6% of total water demand in 2060 to reflect an enhanced leak detection and water loss reduction program.

Water Efficiency and Conservation

Durham has had an active education-based program since 1993. Between 1999 and 2010, the City's water usage has decreased by 12% due to a variety of actions and climatic conditions. Severe restrictions during the drought

of 2001-2002 fostered a stronger conservation ethic among customers, many of whom implemented permanent changes to reduce water use. These efforts were supported by increased public education and outreach efforts and expanded device retrofit efforts. The activities were further expanded during and immediately after the drought of 2007-2008. These included:

- Implementation of Bulk Reclaimed Water Program (June 2007)
- Implementation of multi-media DurhamSavesWater.org marketing/advertising/education campaign (June 2008)
- Implementation of tiered water rates (July 2008)
- Implementation of Toilet Rebate/Credit Program for Residential Customers (September 2008)
- Adoption of Year-round Irrigation Schedule (June 2009)
- Adoption of Rain/Moisture Sensor requirement for all new irrigation systems (June 2009)
- Adoption of Water Waste Ordinance (June 2009)
- Development and approval of Water Shortage Response Plan (November 2009)
- Consistent moderate increases in water and sewer rates and charges each year as a part of the annual budget/CIP process
- Implementation of Automated Meter Reading Program (Phase 1 complete December 2010)
- Expansion of Toilet Rebate/Credit Program to Non-Residential Customers (January 2011)
- Expanded Leak Detection/Water Loss Program (January 2012)

Water Supply

Table 33. Durham Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Lake Michie and Little River Lake	28.9	28.9	28.9	28.9	28.9	28.9
Current Jordan Lake Allocation	10.0	10.0	10.0	10.0	10.0	10.0
Total	**38.9**	**38.9**	**38.9**	**38.9**	**38.9**	**38.9**

Durham relies on a system of two reservoirs, Lake Michie and Little River Reservoir, which lie on adjacent tributaries of the Neuse River, upstream of Falls Lake, for its raw water supply. In addition, Durham has a Level I Jordan Lake allocation for 10 MGD, which Durham accesses by buying finished water from Cary.

The yield of Lake Michie and Little River Reservoir were investigated in Hazen and Sawyer (2009), which presents the results of an evaluation of the yield of the City of Durham's existing Lake Michie and Little River Reservoir system "for a range of reserve storage assumptions using a draft version of the OASIS Neuse River Basin Model… [W]ithdrawals by the City are limited to the volume of water stored between normal pool and elevation 312.5 feet above mean sea level (ft msl) for Lake Michie and elevation 326.0 ft msl for Little River Reservoir and with total system reserve storage within these limits ranging from zero to 20 percent. System yield estimates are presented for the 2007-08 record drought and for a drought with an estimated return frequency of 50 years." As a conservative assumption, 20% of storage was held in reserve for computing yield.

Additional work by Hazen and Sawyer (2010), utilizing the OASIS Neuse River Basin Model, indicates that when withdrawals from the lake are made proportional to the size of the individual watersheds of Lake Michie to Little River (roughly 2:1), the yield of the lakes are marginally increased. Accounting for sedimentation through the planning period and 20% of storage held in reserve, the remodeled safe yield of the two reservoirs is 28.9 MGD.

Currently, Durham is in the design phase to construct permanent facilities at the Teer Quarry to provide access to water stored "off-line." It is anticipated that any further expansion of Durham's treatment facilities will require the implementation of a minimum release from the Lake Michie Dam (Little River Reservoir currently has a

minimum release that varies depending on the water elevation in the reservoir.) Negative impacts to the yield of the reservoirs is expected but has not been quantified to date.

Future Water Supply Need

Table 34. Durham Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Durham	0.0	0.0	0.0	1.8	5.8	8.6

Durham's future supply need represents its projected demand minus the sum of the yield of its Lake Michie and Little River Reservoir system and its Jordan Lake allocation. The Teer Quarry is not included in the water supply need calculation.

This page left intentionally blank.

Town of Hillsborough

Prior Studies/ Supporting Documents

DWR, 2009. *Local Water Supply Plan Report, Hillsborough.* Submitted by Hillsborough to North Carolina Division of Water Resources. PWSID: 03-68-015. 2009.

DWR, 2008. *Local Water Supply Plan Report, Hillsborough.* Submitted by Hillsborough to North Carolina Division of Water Resources. PWSID: 03-68-015. 2008.

Peterson, Eric, 2008. "Memorandum: 2060 Water Capacity Model for Jordan Lake Work Group" Prepared by Eric Petersen, Town Manager of Hillsborough for Mayor Stevens and Board of Commissioners, Hillsborough. Dec. 31, 2008.

Historical Finished Water Use

In 2010, Hillsborough treated and pumped a daily average of 1.10 MGD of finished water to its customers. The 2010 average daily residential use rate was 110 gpd per connection. The single family residential use rate could not be isolated from multi-family residential accounts.

Table 35. Hillsborough Historical Finished Water Production.

Year	Production (MGD)
1995	1.50
1996	1.50
1997	1.78
1998	1.75
1999	1.56
2000	1.38
2001	1.13
2002	0.86
2003	0.71
2004	0.91
2005	1.16
2006	1.16
2007	1.15
2008	1.08
2009	1.09
2010	1.10

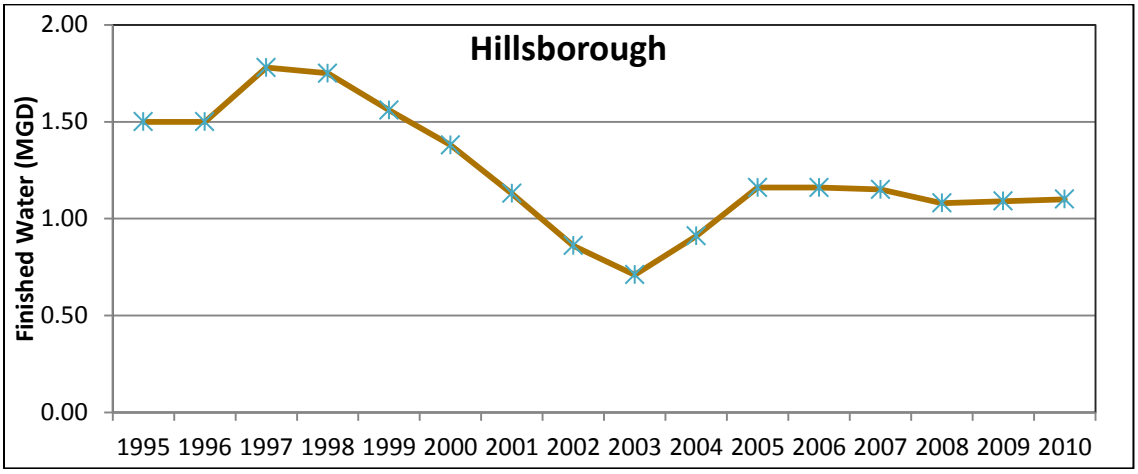

Figure 16. Hillsborough Historical Finished Water Use (MGD).

Future Demand

Table 36. Hillsborough Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	0.53	0.97	1.18	1.38	1.59	1.79
Commercial	0.21	0.51	0.54	0.57	0.59	0.62
Industrial	0.08	0.10	0.10	0.11	0.11	0.11
Institutional	0.05	0.31	0.38	0.41	0.44	0.45
WTP Process	0.18	0.28	0.33	0.38	0.43	0.48
Distribution Process	(Included with WTP Process)					
Other Non-Revenue	0.09	0.15	0.17	0.20	0.23	0.25
Total	1.14	2.32	2.70	3.04	3.38	3.70

Table 37. Hillsborough Future Projected Demand (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	46.5%	41.8%	43.7%	45.4%	47.0%	48.4%
Commercial	18.4%	22.0%	20.0%	18.8%	17.5%	16.8%
Industrial	7.0%	4.3%	3.7%	3.6%	3.3%	3.0%
Institutional	4.4%	13.4%	14.1%	13.5%	13.0%	12.2%
WTP Process	15.8%	12.1%	12.2%	12.5%	12.7%	13.0%
Distribution Process	(Included with WTP Process)					
Other Non-Revenue	7.9%	6.5%	6.3%	6.6%	6.8%	6.8%
Total	100%	100%	100%	100%	100%	100%

Demand Methodology

Population Estimates

Hillsborough's population estimates were developed by the Town's Planning Department. A constant rate of population growth of 2% was used, based on the rate of historical growth and expected future growth. As described below, the future water demand projections were not derived from the population estimates.

Water Demand Projections

Hillsborough's future water demand projections are based on their Water Capacity Model, which uses a land capacity/development-type analysis of known and potential future development. The water capacity model projects demands for residential and non-residential uses in the following ways. For residential usage projections, demands are split between committed residential units and potential residential units. Committed residential includes approved residential developments through 2020 plus four new in-town lots developed per year through 2060. Potential residential units includes other known potential residential development projects. The projects are delineated by the number and type of units and their estimated completion dates.

By 2020, the committed and known potential residential developments are built out except for the following development types: in-town lots, higher density infill of single-family, multi-family and townhouses, phase 4+ Habitat for Humanity, out-of-town development and out-of-town failed septic systems. For these types of developments, the following assumptions were made:

- In-town lots – 4 per year from 2010 through 2060
- Infill higher density – 30 units per year of single-family, multi-family and townhouses from 2020-2060
- Habitat Phase 4+ – 7.5 units per year from 2021-2060
- Out-of-town development – 25 units per year from 2010-2060
- Failed septic systems – 25 units per year from 2018-2060

For non-residential usage projections, demands are also split between committed and potential developments. Rather than the number of units, as in the residential projections, non-residential projections are based on the development building footprint. Committed non-residential development includes approved developments through 2020 and potential non-residential includes other known potential development projects. The projects are delineated by their building footprint or number of restaurant seats and their estimated completion dates. By 2020, the committed and potential non-residential developments are built out except for the following development types: higher density infill of office/institutional, restaurant and retail. For these types of developments, the following assumptions were made:

- Infill higher density: Office/Institutional – beginning with 125,000 square feet (sf) in 2020 and increasing 20,000 sf per year through 2050
- Infill higher density: Retail – beginning with 125,000 sf in 2020 and increasing 17,500 sf per year through 2030 and 15,000 sf per year through 2060
- Infill higher density: Restaurant – beginning with 400 seats in 2020 and increasing 40 seats per year through 2050

For both residential and non-residential water demand projections, the projected development units or building footprint, as described above, was multiplied by a usage factor to yield the projected water demand. The usage factors are shown below:

Residential	
Single Family	150 gpd/unit
Multi-Family	90 gpd/unit
Retirement Residencies	135 gpd/unit
Townhomes	135 gpd/unit
Commercial	
Hotels	108 gpd/room
Restaurant	36 gpd/seat
Retail	108 gpd/1,000 square feet of building
Industrial	
Industrial	108 gpd/1,000 square feet of building
Institutional	
Office/Institutional	90 gpd/1,000 square feet of building

School - Elementary	10.8 gpd/student
School - Middle	13.5 gpd/student
School - High	13.5 gpd/student

Water Efficiency and Conservation

The Town of Hillsborough's Water Capacity Model is used to guide planning for water and sewer infrastructure, and as a result, for consistency, keeps water use rates constant. Thus, additional conservation is not directly included in the projections. The current water use projections are reasonably conservative; for instance, the existing residential customers' use rate is only 110 gpd per connection. Due to changes in housing type being developed, future users' per connection demand is projected to be higher under the methodology used.

Hillsborough's water demand has actually fallen considerably from its peak in 1997. Part of the decrease in demand can be attributed to the loss of a few industrial users, but some of the decrease is believed to be due to greater conservation by its users, which is expected to continue in the future.

Water Supply

Table 38. Hillsborough Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Lake Ben Johnston	0.68	0.68	0.68	0.68	0.68	0.68
Lake Orange	0.08	0.08	0.08	0.08	0.08	0.08
West Fork of the Eno Reservoir	1.80	1.80	1.80	1.80	1.80	1.80
Total	**2.56**	**2.56**	**2.56**	**2.56**	**2.56**	**2.56**

Hillsborough's three water sources listed are operated as a single system, with Lake Orange and the West Fork of the Eno Reservoir located upstream of Lake Ben Johnson. The total system is estimated to yield approximately 2.56 MGD.

Future Water Supply Need

Table 39. Hillsborough Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Hillsborough	**0.00**	**0.00**	**0.14**	**0.47**	**0.82**	**1.14**

Town of Holly Springs

Prior Studies/ Supporting Documents

CDM, 2011. *Technical Memorandum: Town of Holly Springs Water Demand Forecasting.* Prepared by CDM for Town of Holly Springs, NC. Oct 2011.

CDM, 2007. *Town of Holly Springs, 2006 Local Water Supply Plan.* Prepared by CDM for Town of Holly Springs, NC. Jun 2007.

DWR, 2002. "Summary of Existing Jordan Lake Allocations." North Carolina Division of Water Resources, Permits and Registrations. Approved Jul 11, 2002. <http://ncwater.org/Permits_and_Registration/Jordan_Lake_Water_Supply_Allocation/existing.php>

DWR, 2006. *Local Water Supply Plan Report, Holly Springs.* Submitted by Holly Springs to North Carolina Division of Water Resources. PWSID: 03-92-050. 2006.

DWR, 2007. *Local Water Supply Plan Report, Holly Springs.* Submitted by Holly Springs to North Carolina Division of Water Resources. PWSID: 03-92-050. 2007.

Holly Springs, 2010. "Temporary water system write-up August 2010." Short description of water system sent to TJCOG. August 2010.

Historical Finished Water Use

Holly Springs purchases its water supply from Harnett County. In 2010, Holly Springs used an average of 1.34 MGD. Holly Springs residential customers used an average of 142 gallons per day per connection.

Table 40. Holly Springs Historical Finished Water Use (finished water purchased from Harnett County).

Year	Production (MGD)
1995	--
1996	--
1997	0.52
1998	--
1999	--
2000	--
2001	--
2002	0.96
2003	0.94
2004	1.11
2005	1.33
2006	1.51
2007	1.99
2008	1.69
2009	1.77
2010	1.34

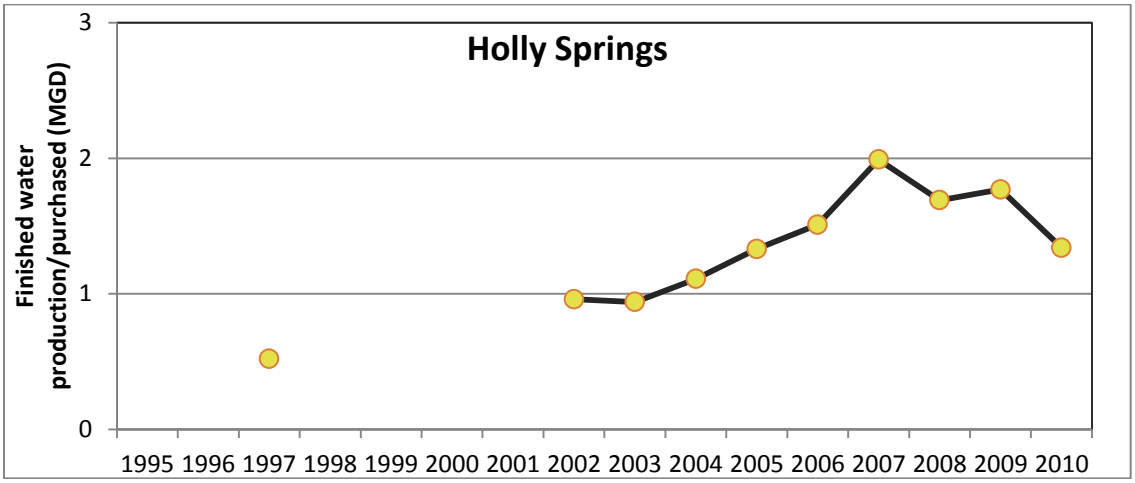

Figure 17. Holly Springs Historical Finished Water Use/Purchase (MGD).

Future Demand

Table 41. Holly Springs Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	1.37	1.86	2.32	2.89	3.45	4.02
Commercial	0.15	0.44	0.73	0.91	1.09	1.27
Industrial	0.15	1.62	1.83	1.93	2.03	2.14
Institutional	0.00	0.16	0.32	0.40	0.47	0.55
WTP Process (N/A)	(Holly Springs does not operate a WTP. All water is purchased.)					
Distribution Process	(Included with Other Non-Revenue)					
Other Non-Revenue	0.31	0.61	0.52	0.61	0.70	0.80
Total	**1.98**	**4.69**	**5.72**	**6.74**	**7.74**	**8.78**

Table 42. Holly Springs Future Projected Demand (percent of total water demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	69.2%	39.7%	40.6%	42.9%	44.6%	45.8%
Commercial	7.6%	9.4%	12.8%	13.5%	14.1%	14.5%
Industrial	7.6%	34.5%	32.0%	28.6%	26.2%	24.4%
Institutional	0.0%	3.4%	5.6%	5.9%	6.1%	6.3%
WTP Process (N/A)	(Holly Springs does not operate a WTP. All water is purchased.)					
Distribution Process	(Included with Other Non-Revenue)					
Other Non-Revenue	15.7%	13.0%	9.1%	9.1%	9.0%	9.1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

Historical population data and future population forecasts for the Town of Holly Springs are presented in Figure 18. Historical data from 1970 through 2004 were retrieved from the North Carolina Office of State Planning; estimates from 2005 through 2009 were retrieved from the Town Planning and Zoning Department; and, 2010 population data were retrieved from the 2010 Census. Future population forecasts through 2030 were retrieved

from the 2009 Western Wake Regional Wastewater Management Facilities Engineering Report (ER). The population projections included in the ER were developed for and are documented in the Town of Holly Springs Utley Creek WWTP 201 Facility Plan Amendment for the Utley Creek WWTP (Davis-Martin-Powell, August 2006). They were based upon historical trends in Holly Springs from 2000 to 2004. Note that these projections take into account an assumption that was made for the purposes of the ER document that 50 percent of the unresolved area between Apex and Holly Springs will be served by each town.

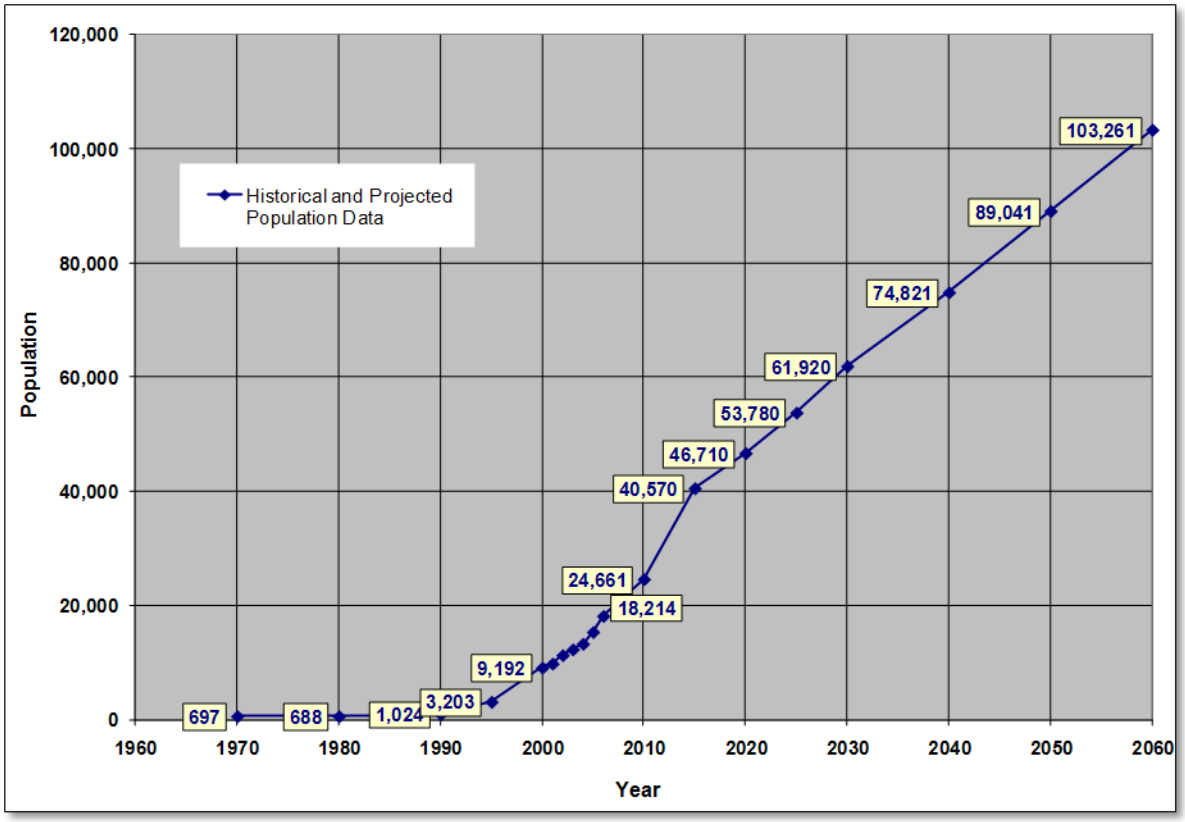

Figure 18. Holly Springs historic population data and future population estimates (from CDM, 2011).

CDM evaluated population projections taken from the ER and the Town's expected growth patterns to continue projections from 2030 through 2060. This resulted in an estimated future population of just over 100,000 people. As a check, CDM evaluated the population density for surrounding "built-out" cities to determine if the 100,000 figure was reasonable for Holly Springs. The cities of Raleigh and Cary currently have population densities in the range of 3.5 to 3.8 people per acre, as reported by the US Census. If Holly Springs were to reach a build-out population of 100,000 people for their ultimate planning jurisdiction of 56 square miles, the estimated population density for the Town would be approximately 2.8 people per acre. Therefore, the population projections for a near build-out scenario appear to be reasonable in lieu of better available data.

Water Demand Projections

While there are various techniques and methods available for developing projections of future water demands, in general, the demands will be a function of the growth and development conditions that result over the course of the planning period (in this case, through the year 2060). There are four aspects of growth that have a direct impact on long-range water and sewer service planning:

1. Rate and timing of growth
2. Location of growth
3. Amount and density of growth
4. Type and quality of growth

Historical water demand data were used in conjunction with assumptions of future growth for the Town to project future water demands for the average day. Water billing account data were analyzed by category to estimate how water accounts have grown and how different accounts have used water over the past five years of record. This information forms the basis of a disaggregated demand forecast. Generating disaggregated demand forecasts required several assumptions. First, an assumption of how much water will be used for each account type was made. A calculation was made to determine an average of the three highest daily average water usage values over the last five-year period for each account type. These three-year highest average water type usages are shown in Table 43.

Secondly, an assumption regarding the growth of total accounts through the planning horizon was made. Although a significant reduction in account creation occurred between the peak of the economic boom (1,039 new accounts in 2006) and fiscal year 2010 (236 new accounts), signs of an economic recovery were also considered. Therefore, for this study, it was assumed that total accounts will grow at an average of 400 accounts per year through 2060. This estimated rate of growth is less than the average growth rate of total accounts per year over the past five years (an average of 594 new accounts). This recognized the economic downturn, but is more than the accounts added in the last two years (277 accounts added in 2009 and 236 total accounts added in 2010).

Table 43. Three-Year Highest Average Daily Water Usage by Water Type (adapted from CDM, 2011).

Water Use Type	Average Water Consumption: Past 5 Years (gal/acct/day)	Average Water Consumption: 3 Highest Years (gal/acct/day)
Residential	167	177
Commercial	237	371
Industrial[1]	572	649
Institutional	451	511

Notes:

1. For the industrial sector, the per account averages do not include the year 2010 as the data is skewed by the addition of a large user, Novartis. Novartis and other future large industrial users were considered separately and added into the projections of industrial sector demand.

Lastly, developing the disaggregated demand forecasts required an assumption regarding the future distribution of water accounts. While the current distribution of accounts is predominately residential, the Town planning and engineering staff has set a goal of approximately 80% residential accounts and 20% non-residential accounts by the year 2025. Therefore, the disaggregated demand projections incorporated this shift in account distribution. The account distribution for this scenario is shown in Table 44.

Table 44**.** Holly Springs Future Water Account Distribution Scenario (from CDM, 2011).

Account Type	Proposed Account Growth Scenario (assumes 80/20 split for res/non-res accounts by 2025)					
	2010	2015	2020	2025	2030	2060
Residential	7,966	9,351	10,535	11,520	13,120	22,720
Commercial	412	756	1,195	1,728	1,968	3,408
Industrial	14	150	338	576	656	1,136
Institutional	5	136	317	547	623	1,079
Total	8,400	10,400	12,400	14,400	16,400	28,400

The account distributions in Table 44 were then applied to the assumed change in accounts for the planning horizon at the average daily water usage (3 highest years) in Table 43 to produce the disaggregated water demand forecasts through 2060.

Water Efficiency and Conservation

Holly Springs based its water use rates on recent water use data which builds in efficiency from customer response to the recent drought. Additionally, Holly Springs' non-revenue water is projected to decline from 15% to 9% of the amount of water purchased from Harnett County. Given that all their water is purchased from Harnett County, Holly Springs has a financial motivation to reduce the amount of water that it pays for but for which it receives no revenue.

Water Supply

Table 45. Holly Springs Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation – Level II	2.0	2.0	2.0	2.0	2.0	2.0
Cape Fear River via Harnett County	6.7	6.7	6.7	6.7	6.7	6.7
Total	**8.7**	**8.7**	**8.7**	**8.7**	**8.7**	**8.7**

Holly Springs' contract with Harnett County is for a maximum of 10 MGD. The contract currently runs through 2040, but is likely to be extended. Given that this is a maximum-day contract, Holly Springs can not allow its average water demand to approach 10 MGD without exceeding this contract limit on peak days. Holly Springs' current peaking factor (maximum day use relative to average day use) is 2.0 (CDM, 2011).

Given this reality, the Harnett County contract should not be considered to provide 10 MGD of supply on the average day. Adjusting the theoretical average day "yield" of this connection downward by the current maximum day peaking factor is probably inappropriate because this study is focused on average day supply and it is likely that this factor will come down in the future as Holly Springs' customer base grows. A seasonality (that is, maximum month relative to year average) based factor may be more appropriate for adjusting the "yield" value of the contract downward because at an average yearly demand of 10 MGD, many whole months would have daily demand much higher than 10 MGD.

For each year of Holly Springs' purchase records from 2002 to 2010, the highest month demand divided by the average year demand was calculated at a factor of 1.37, on average. Dividing the 10 MGD by this factor would suggest a reasonable "yield" of 7.3 MGD from the Harnett County contract. For planning purposes, Holly Springs has chosen a conservative factor of 1.5 to "pro-rate" the Harnett County contract that will account for seasonality and most peak day usage. Accordingly, the average-day "yield" value of the Harnett County contract is 6.67 MGD.

Holly Springs counts its 2.0 Level II allocation as part of its water supply portfolio for planning purposes, though it will need to negotiate agreements with neighboring utilities to access its allocation.

Future Water Supply Need

Table 46. Holly Springs Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Holly Springs	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**

Based on the demand projections and use of both water supplies listed in Table 45, Holly Springs reaches a shortage of slightly less than 0.1 MGD in 2060.

This page left intentionally blank.

Town of Morrisville (part of the Town of Cary's service area)

Prior Studies/ Supporting Documents

Town of Cary, 2012. *Long Range Water Resources Plan: Town of Cary, Morrisville and RTP South Baseline Water Demand and Wastewater Flow Projections.*

CH2M Hill, 2010. *Town of Cary Water Use Analysis TM.* Prepared by CH2M Hill for Town of Cary, North Carolina.

CH2M Hill, 2009. *Town of Cary Water Distribution System Master Plan.* (WDSMP) Prepared by CH2M Hill for Town of Cary, North Carolina.

CH2M Hill, 2007. *Town of Cary Integrated Water Resources Management Plan*. Prepared by CH2M Hill for the Town of Cary, North Carolina.

DWR, 2002. *Local Water Supply Plan Report, Morrisville.* Submitted by Morrisville to North Carolina Division of Water Resources. 2002.

Historical Finished Water Use

Morrisville does not operate a water treatment plant, but historically purchased finished water from the Town of Cary, until 2006, when the Morrisville water and sewer systems were merged with the Town of Cary and are now operated as part of the Cary system. In 2010, Morrisville customers used an average of 1.87 MGD of finished water. Morrisville's SFR customers used an average of 156 gpd per connection in 2010.

Table 47. Morrisville Historical Finished Water Use.

Year	Production (MGD)
1995	--
1996	--
1997	0.46
1998	0.50
1999	0.83
2000	0.95
2001	1.26
2002	1.39
2003	1.27
2004	1.43
2005	1.47
2006	1.68
2007	1.81
2008	1.05
2009	1.00
2010	1.87

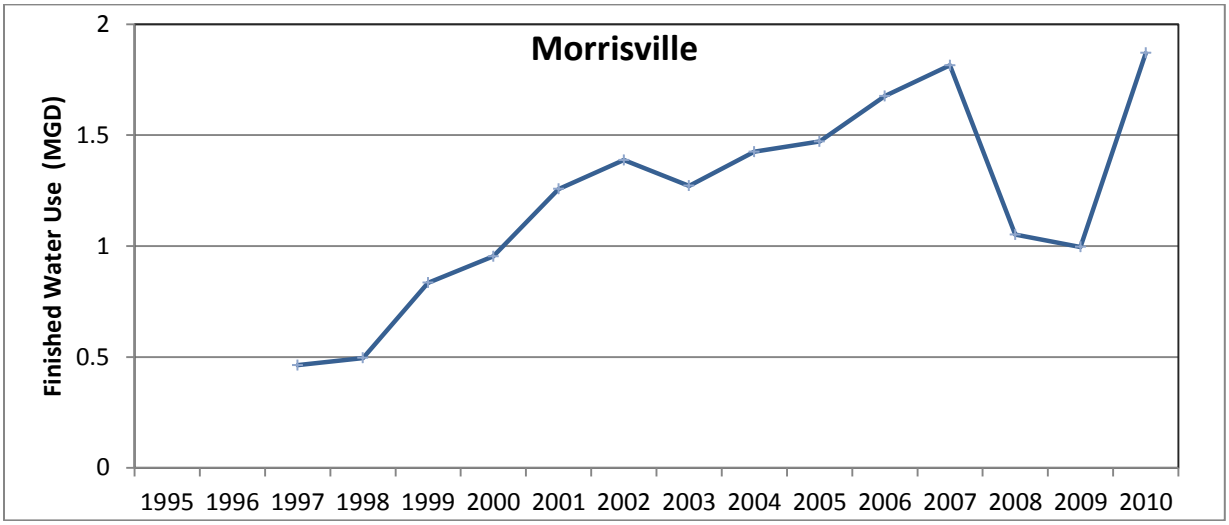

Figure 19. Morrisville Historical Finished Water Use/Purchase (MGD).

Future Demand

Table 48. Morrisville Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	0.9	1.2	1.4	1.5	1.6	1.7
Commercial	0.4	0.8	0.9	1.1	1.1	1.1
Industrial	0.0	0.0	0.1	0.1	0.1	0.1
Institutional	0.0	0.0	0.0	0.0	0.0	0.0
WTP Process	0.3	0.4	0.4	0.5	0.5	0.5
Distribution Process	0.0	0.0	0.0	0.1	0.1	0.1
Other Non-Revenue	0.1	0.1	0.1	0.1	0.1	0.1
Total	1.7	2.5	2.9	3.4	3.5	3.6

Table 49. Morrisville Future Projected Demand (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	52.7%	47.0%	47.0%	44.1%	45.3%	46.3%
Commercial	23.4%	31.3%	30.2%	32.3%	31.2%	30.0%
Industrial	0.6%	1.2%	2.0%	2.9%	2.8%	2.7%
Institutional	0.6%	0.4%	0.7%	0.6%	0.6%	0.8%
WTP Process	18.0%	14.5%	14.5%	14.5%	14.5%	14.5%
Distribution Process	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%
Other Non-Revenue	3.1%	4.0%	4.0%	4.0%	4.0%	4.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Since April 2006, the Town of Morrisville's water and sewer systems have been operated as part of the Town of Cary's systems. Accordingly, the future demand projections have been completed as part of the Town of Cary water demand projection process, and the same methodology applies.

Population Estimates

Morrisville's population estimates can be found in the Long Range Water Resources Plan: Water Demand and Wastewater Flow Forecasting Tool (Town of Cary, 2012). Further description is provided in the Town of Cary system summary.

Water Demand Projections

The Town of Morrisville water demand projections were generated in tandem with the Town of Cary water demand projections, and use the same methodology. The major difference was in the water demand unit factors. Morrisville's water demand unit use rates were based on billing data specific to Morrisville's customers. Table 18 (in the Cary Water Demand Projections subsection) displays the unit water demand factors specific to Morrisville. These factors were calculated based on recent billing data and corrected for climate variation. The rates shown were used for making the future projections in a methodology consistent with the methodology used for Cary's projections.

Water Efficiency and Conservation

See the Water Efficiency and Conservation section for the Town of Cary, which includes the Morrisville customers in the data presented.

Water Supply

Table 50. Morrisville Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation	3.5	3.5	3.5	3.5	3.5	3.5

The Town of Morrisville's supply is provided by the Town of Cary's treatment plant, but Morrisville has its own Level I Jordan Lake allocation estimated to yield 3.5 MGD.

Future Water Supply Need

Table 51. Morrisville Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Morrisville	0.0	0.0	0.0	0.0	0.0	0.1

Orange County

Prior Studies/ Related Documentation

Orange County, 2008. Orange County, North Carolina: 2030 Comprehensive Plan. Orange County Planning and Inspections Department. Adopted 18 Nov 2008. Ch. 5 Land Use Element.

Historical Finished Water Use

Orange County does not currently operate a water system or water treatment plant, and does not plan to operate either in the future. Water customers in the County are directly served by existing utility systems. As a result, Orange County has no records of current usage, either in terms of finished water or SFR use rates.

Orange County intends to develop agreements with other water providers for the provision of finished water to three economic development districts (EDDs) in the county. The total projected water demands for these EDD areas are tabulated below.

Future Demand

Table 52. Orange County Future Demand Projections (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	0.01	0.26	0.59	0.90	1.19	1.46
Non-Residential	0.01	0.39	0.89	1.35	1.79	2.19
WTP Process (N/A)	(Orange County does not operate a WTP. All water will be provided by other systems.)					
Distribution Process	(Included with Other Non-Revenue)					
Other Non-Revenue	0.00	0.05	0.11	0.17	0.22	0.27
Total	**0.02**	**0.70**	**1.59**	**2.42**	**3.20**	**3.92**

Table 53. Orange County Future Demand Projections (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	37.2%	37.2%	37.2%	37.2%	37.2%	37.2%
Non-Residential	55.8%	55.8%	55.8%	55.8%	55.8%	55.8%
WTP Process (N/A)	(Orange County does not operate a WTP. All water will be provided by other systems.)					
Distribution Process	(Included with Other Non-Revenue)					
Other Non-Revenue	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Orange County does not currently operate a water system and does not plan to operate a system in the future. Nevertheless, the County has significant areas identified in their Comprehensive Plan for future economic development and is committed to ensuring adequate water supplies will be available for these areas. The County is planning to partner with neighboring water systems to serve the Eno, Hillsborough and Buckhorn EDDs. Recently, Orange County reached agreement with the City of Durham to provide water to the Eno EDD. Orange County also has an agreement with the Town of Mebane to provide water service in the Buckhorn EDD. A similar agreement may be reached with the Town of Hillsborough for the provision of water to the Hillsborough EDD. Without the benefit of having historical customer usage information, Orange County has instead used a land use planning approach to estimate future water demand.

Population Estimates

Orange County prepared population estimates for its service areas by performing a land use analysis to determine the total potential population at build-out based on available acreage. In general, the available land area slated for development was broken down into three EDD service areas: Buckhorn, Eno and Hillsborough. Each of these areas was divided into smaller nodes, which are blocks of land with a relatively homogeneous land use. These nodes included several non-residential land use types as well as residential land use types of low and high density. All of the service areas contain some areas designated for residential development.

Population estimates were based on capacity assumptions, which were made for the available area in the residential land use nodes. In total, 10,248 acres were contained in a total of six low-density residential nodes and one high-density node. Within each node, a percentage of the total area was deemed "not developable" to accommodate the space needed for transportation infrastructure, utilities, open space, etc. The percentage of each node which remained available for development varied but ranged from 50% to 75%.

After the amount of developable land was calculated, the number of households was then determined for each node. The amount of developable land area was then multiplied by an assumed household density of two households per acre for low-density residential areas and four households per acre for high-density residential areas. Once the number of households was estimated, the population could then be determined.

Population was calculated by multiplying the number of households by an assumed average of 2.35 persons per household for areas of high-density and low-density housing. The resulting population was determined to be the total population at build-out.

Orange County determined the population at ten-year increments by assuming the percentage of build-out achieved at each interval. In 2010, the population was estimated at 0.5% of the built-out population. By 2020, it was assumed the population would reach 15% of build-out. Each subsequent forecast year (ten-year increments) increased the percentage of build-out by 20%, starting with 35% in 2030 and culminating in 95% of the total built-out population being present in 2060.

Water Demand Projections

The Orange County Planning Department also used a similar land use analysis to project future water use. Water demand was first calculated at build-out, and subsequent forecast year demand projections were calculated based on the percentages of build-out reached. Future water demand was projected at ten-year increments by assuming the percentage of the built-out water demand achieved at each of these intervals. In 2010, water demand was estimated at 0.5% of the built-out water demand. By 2020, it was assumed that water demand would reach 15% of the built-out water demand. Each subsequent forecast year (ten-year increments) increased the percentage of the built-out water demand by 20%, starting with 35% in 2030 and culminating in 95% of the built-out water demand occurring in 2060.

Residential sector demands were based on the projected population and a per capita usage rate. Population projections are described in the population estimates section above. The assumed per capita water use rate utilized for this analysis was 70 gallons per person day. Non-residential demand was calculated on a per area basis. Each of the three economic development service areas contain defined non-residential nodes. Each node type includes areas designated as Economic Development District (EDD), Commercial Node (CN), Commercial Industrial Node (CIN), Urban Growth Area (UGA), among other designations. Even though the node descriptions provided some information concerning the division of non-residential demand into sectors such as commercial, industrial, etc., a decision was made to account for all of the nodes as non-residential. As with the residential nodes, Orange County again assumed that 75% of the non-residential area would ultimately be developed. Finally, Orange County assigned a non-residential use rate of 1,000 gallons per acre of developable land to all of the non-residential nodes.

Orange County assumed that water conservation programs and improvements in plumbing and appliances would result in reductions in water demand over time. In order to reflect these improvements, a water conservation factor was applied to the water demand projections. The County assumed that conservation efforts and increased efficiencies would have the net effect of lowering demand at a fixed rate of 2.85% per decade.

While Orange County does not plan to operate a water system, the County's projections do include allowance for non-revenue water. This was done because non-revenue water will be attributable to Orange County's service area due to leakage and flushing (and to a lesser extent, WTP process water used by another utility to treat the water sold to customers in the Orange County service area). Orange County assumed a rate of 7.5% of total residential and non-residential demand would be non-revenue water. All types of non-revenue water are grouped together in these projections.

In summary, Orange County's key assumptions include:

- 75% of non-residential acreage is developable and 50-75% of residential acreage is developable
- 2.35 persons per household
- 2 or 4 households per acre for low- and high-density residential areas, respectively
- 70 gallons per person per day for residential acreage
- 1,000 gallons per acre per day for non-residential acreage
- 95% of service areas will be developed by the year 2060
- Water conservation will result in a 2.85% decrease per decade in residential and non-residential use rates
- The amount of non-revenue water (distribution system process and other non-revenue water) is fixed as 7.5 percent of revenue water

Water Efficiency and Conservation

Orange County's projections include significant improvements in water efficiency. As noted earlier, average water use rates for all users was assumed to decrease by 2.85% every decade. From the perspective of residential usage, this means that residential customers will reduce their average usage from 70 gallons per person per day today to 58 gallons per person per day in 2060.

Orange County does not operate and does not plan to operate a water treatment plant, so the County does not have control over the efficiency of the water plant (or plants) that treat the water used by Orange County customers. Orange County will have a distribution system, which will likely be built by Orange County, and then turned over to another water system. Orange County projects distribution system process water and other non-revenue usage will be equivalent to 7.5% of revenue water.

Water Supply

Table 54. Orange County Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation	1.0	1.0	1.0	1.0	1.0	1.0

Orange County has a Level II allocation from Jordan Lake estimated to yield 1 MGD, but Orange County would have to access it through another Partnership member.

Future Water Supply Need

Table 55. Orange County Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Orange County	**0.00**	**0.00**	**0.59**	**1.42**	**2.20**	**2.92**

Orange Water and Sewer Authority (OWASA)

Prior Studies/Supporting Documents

Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, 2008. *2035 Long Range Transportation Plan Alternative Analysis Report.*

DWR, 2011. *2010 Local Water Supply Plan, Orange Water and Sewer Authority*. Submitted by OWASA to North Carolina Division of Water Resources. PWSID: 03-68-010. Provisional draft, currently under review by DWR.

McKim & Creed, 2010. *Technical Memorandum: Carolina North Campus Utility Infrastructure Planning to Support US Army Corps of Engineers Permitting Submittal*. Exhibits 1-2 and 1-3. March 26, 2010.

OWASA, 2010. *Long Range Water Supply Plan, Final Report.* Orange Water and Sewer Authority. Carrboro, NC. April 8, 2010.

University of North Carolina at Chapel Hill, 2006. *UNC Campus Master Plan*.

Historical Finished Water Use

In 2010, OWASA produced an average of 7.87 MGD of finished water. This does not include reclaimed water. OWASA's SFR customers used an average of 154 gallons per connection per day in 2010. Table 56 shows the historical production by OWASA since 1995.

Table 56. OWASA Historical Finished Water Production.

Year	Production (MGD)
1995	8.04
1996	7.91
1997	8.38
1998	8.45
1999	8.56
2000	9.18
2001	9.46
2002	9.01
2003	8.06
2004	8.47
2005	8.58
2006	8.55
2007	8.57
2008	7.70
2009	7.91
2010	7.87

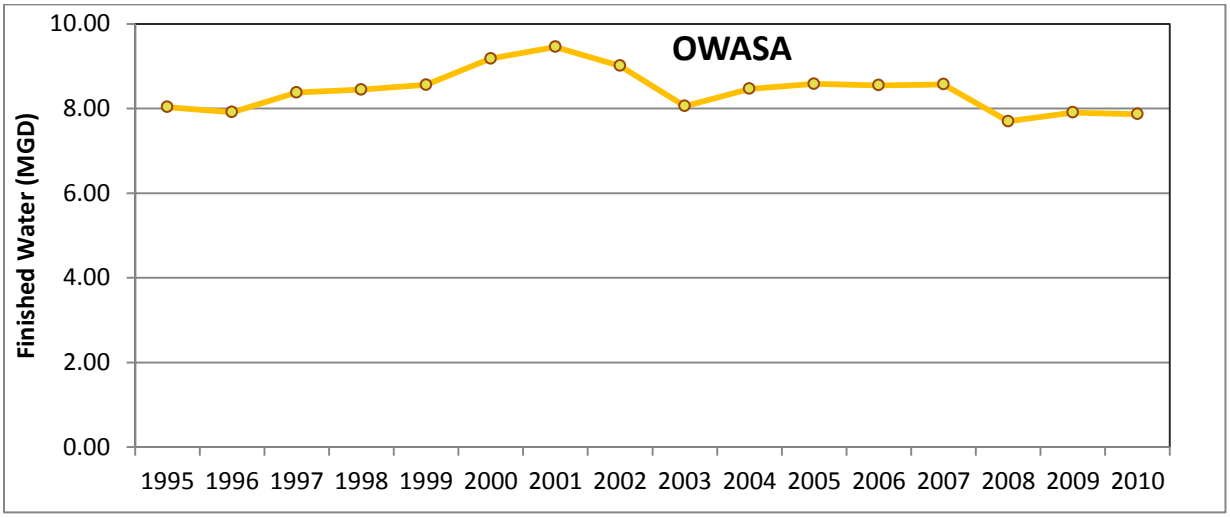

Figure 20. OWASA Historical Finished Water Production (MGD).

Future Demand

Table 57. OWASA Future Water Demand Projections (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	4.00	4.23	4.93	5.49	6.03	6.57
Commercial	1.17	1.24	1.44	1.61	1.77	1.92
Industrial	0.00	0.00	0.00	0.00	0.00	0.00
Institutional	1.90	2.01	2.34	2.61	2.87	3.12
WTP Process	0.09	0.10	0.11	0.12	0.14	0.15
Distribution Process	(Included with Other Non-Revenue)					
Other Non-Revenue	0.70	0.74	0.86	0.96	1.05	1.15
Total	**7.87**	**8.31**	**9.68**	**10.79**	**11.86**	**12.91**

Table 58. OWASA Future Water Demand Projections (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	50.9%	50.9%	50.9%	50.9%	50.9%	50.9%
Commercial	14.9%	14.9%	14.9%	14.9%	14.9%	14.9%
Industrial	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Institutional	24.2%	24.2%	24.2%	24.2%	24.2%	24.2%
WTP Process	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Distribution Process	(Included with Other Non-Revenue)					
Other Non-Revenue	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

OWASA's 2010 – 2060 population projections are based on an average growth of approximately 1,500 persons per year, as derived from residential and mixed use development projections presented in OWASA's *2010 Long-Range Water Supply Plan*. This corresponds to approximately 650 new dwelling units per year at 2.26 persons

per dwelling unit (2010 U.S. Census data for Carrboro/Chapel Hill). As explained below, water demand projections are not driven by population projections *per se*, but by new meter equivalents allocated among the various customer account sectors.

Water Demand Projections

Demand projections by sector were based on the expected growth in the number of 5/8-inch "meter equivalents." Key assumptions (from OWASA, 2010, plus subsequent information provided by OWASA staff) in the demand projections include:

- Water consumption rates for major user groups are based on actual OWASA averages observed from 2004-2007, which was a non-drought period of relatively stable annual demands and considered to represent "new normal" demand patterns for OWASA customers.
- The future development profile of OWASA's service area is expected to follow recent trends with respect to the overall mix of single versus multifamily residential, commercial, and other uses.
- By 2015, the pace of development activity is expected to return to the 1980-2000 average of approximately 560 new meter equivalents (MEs) per year and will continue at this (linear) rate through 2060. [One ME represents the water demand exerted by a typical single family residential customer. A non-residential or institutional customer with greater needs requires a larger meter, and therefore represents multiple MEs. Average consumption per ME varies among the customer classes.] Overall growth projections through 2035 are consistent with data provided to the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (MPO) by the Towns of Carrboro and Chapel Hill for the *2035 Long Range Transportation Plan Alternative Analysis Report (2008)*. Because neither these data nor the Comprehensive Plans of Carrboro or Chapel Hill include longer range projections or ultimate build-out scenarios, the post-2035 water demand forecasts for OWASA's service area assume that pre-2035 growth and development trends will continue through 2060.
- UNC Central Campus and UNC Hospitals building space will increase by 4.6 million gross square feet (GSF) (per the *2006 UNC Campus Master Plan)* at a constant rate of approximately 0.16 million GSF per year through 2028, which is the projected build-out date for UNC's Central Campus. OWASA projections reflect UNC's estimates that reclaimed water (RCW) will meet 27% of all Central Campus water demands.
- Carolina North will build out to a total of 8 million GSF at a constant rate of 0.17 million GSF per year through 2060. Water demand projections are based on McKim & Creed's *Technical Memorandum: Carolina North Campus Utility Infrastructure Planning to Support US Army Corps of Engineers Permitting Submittal, March 26, 2010, Exhibits 1-2 and 1-3.* Per guidance from UNC Energy Services staff, OWASA's "Expected Demand" projection assumes that 8.7% of total Carolina North water needs will be met with non-potable water (NPW).

For purposes of this report, projected water use for all future years was distributed proportionately per actual distribution patterns observed during 2010 among the various sectors:

Residential	51%
Commercial/Other	15%
Industrial	0%
Institutional	24%
WTP System Process	1%
Distribution System Process	(included with Other Non-revenue Water)
Other Non-revenue Water	9%
Total Raw Water	100%

OWASA's *2010 Long Range Water Supply Plan* presented three demand scenarios: "Higher Demand," "Expected Demand," and "Lower Demand." The Higher and Lower scenarios assumed greater and lesser rates of local development activity, and the Lower Demand scenario also assumes a greater degree of non-potable water use on

UNC's Carolina North campus. Expected Demand projections were presented in Table 57 and are shown graphically relative to the Higher and Lower scenarios in Figure 21, below.

Water Efficiency and Conservation

OWASA reported a 25 percent reduction in use by all customer groups between 2002 and 2009, and attributes this to a series of actions undertaken since the severe drought of 2001-2002:

- Implementation of seasonal water rates (2002).
- Adoption of new conservation standards, including year-round water use restrictions, and new local ordinances adopted by Carrboro, Chapel Hill, and Orange County (2003).
- Implementation of a permanent process water recycling system at OWASA's water treatment plant (2005).
- Introduction of increasing block rate structure, including drought surcharges, for all individually-metered residential customer accounts (2007).
- Deployment of a reclaimed water system with the University of North Carolina at Chapel Hill (2009).
- Additional revisions to OWASA's conservation standards and local ordinances incorporating experience gained and "lessons learned" during the 2007-2008 drought (2009).
- Substantial increases in overall OWASA water and sewer charges to more accurately recover the "true cost" of water (ongoing).

Projections assume that the demand reductions achieved since 2001 will be sustained in the future and that further decreases will be achieved through additional passive conservation; e.g., replacement of conventional plumbing fixtures and appliances with more efficient devices as older homes and businesses are renovated and as new development responds to more aggressive local water use efficiency requirements and the increasing cost of OWASA water. In addition to demand reductions already in place, the following additional efficiencies have been assumed and are reflected in OWASA's 2010-2060 demand projections:

- Unit demand (gallons per account) for existing (pre-2010) development will be 15% lower in 2060 than it is today.
- Unit demand (gallons per account) for all new development will be 10% lower in 2060 than today.
- Future efficiencies and reductions for UNC's Central Campus and Carolina North expansion are reflected in the estimates provided to OWASA by the University.

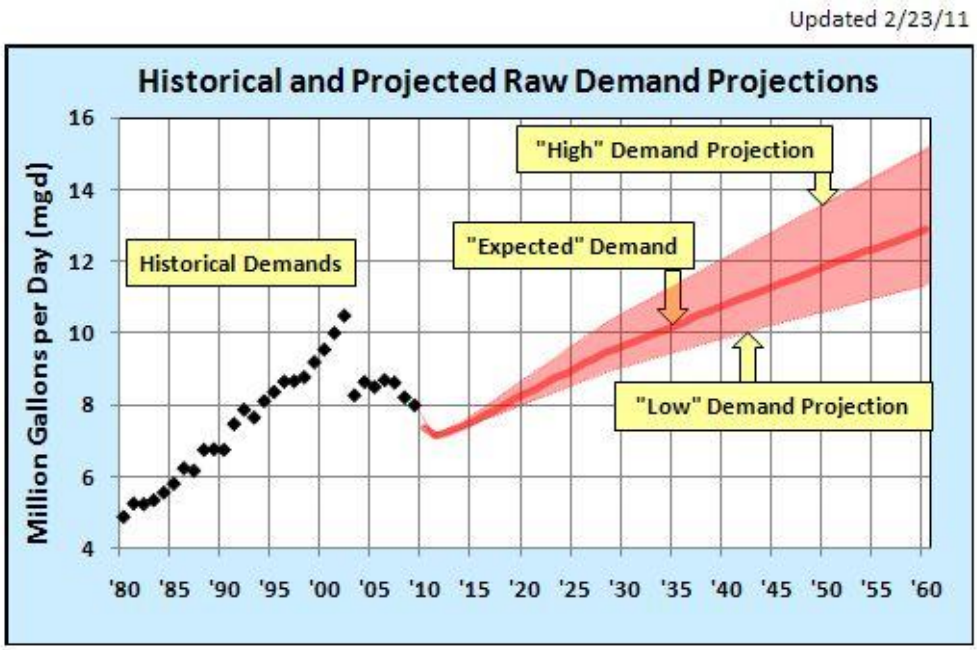

Figure 21. OWASA historical and Projected Raw Water Demands (from OWASA, 2010).

Water Supply

Table 59. OWASA Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Cane Creek Reservoir, University Lake, and Quarry Reservoir	10.5	10.5	10.5	10.5	10.5	10.5
Total - Current	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**

Yield Assumptions

OWASA's *2010 Long Range Water Supply Plan* describes the yield calculations for its current reservoir system. Yields were derived from historical (daily) stream flow from 1926 through 2007, and total system yield was determined with the OWASA-ROM (Reservoir Optimization Model) spreadsheet model developed by Hazen and Sawyer Engineers. OWASA's system includes the Cane Creek Reservoir, University Lake, and the existing Quarry Reservoir. The 10.5 MGD *operational yield* (reported above) is based on a 20 percent (700 MG) storage reserve, which would provide adequate time to implement emergency supply measures during extreme drought conditions.

OWASA's long-term plans include the expansion of its existing Quarry Reservoir by an additional 1.3 billion gallons of storage capacity, which will increase the operational yield of OWASA's overall system by 2.1 MGD; but, this will not be available until 2035. OWASA plans to maintain its 5 MGD Jordan Lake allocation as a drought management "insurance policy" for supplemental use during periods of severe drought, especially until the expanded Quarry Reservoir becomes available.

Because OWASA has no direct access to Jordan Lake, water from its allocation would be withdrawn and treated by the Town of Cary and delivered to OWASA through existing finished water interconnections between Cary and Durham and between Durham and OWASA. If in the future, it is determined that OWASA will need Jordan Lake to support its long-term needs (i.e., as more than a drought management insurance policy), it may choose to

obtain its Jordan Lake water through additional intake and treatment facilities that might be developed by Durham, Chatham County, and others.

Future Water Supply Need

Table 60 presents OWASA's future water supply needs, which are calculated as the difference between its projected raw water demands (from Table 57) and the 10.5 MGD yield of its existing reservoir system.

Table 60. OWASA Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
OWASA	0	0	0	0.3	1.4	2.4

OWASA can adequately meet its "Expected" demand projections under the following conditions:

- Recent gains in water efficiency (25% demand reduction from 2002-2009) are sustained in the future; and
- Future Federal and State regulations allow OWASA to continue recycling its water treatment plant process water and operating its reclaimed water system with UNC; and
- The NC Environmental Management Commission authorizes OWASA to convert its 5% Jordan Lake water supply storage allocation from Level II to Level I; and
- Quarry Reservoir storage volume is increased by 1.3 billion gallons no later than 2035.

Town of Pittsboro

Prior Studies/ Related Documentation

DWR, 2007. *Local Water Supply Plan Report, Pittsboro*.

Hydrostructures, P.A., 2007. *Hydraulic Model Update and Planning Study*. Prepared for the Town of Pittsboro.

Hydrostructures, P.A., 2007. *Sewer Collection System master Plan*. Prepared for the Town of Pittsboro.

Operations Research & Education Laboratory, 2007. Integrated Planning for School & Community, *Land Use Study*.

Hydrostructures, P.A., 2010. "Memorandum: 50-Year Water Demand Projection." Prepared for Bill Terry, Town of Pittsboro.

Historical Finished Water Use

In 2010, Pittsboro produced 0.62 MGD of finished water on average. The Town of Pittsboro's SFR customers used an average of 112 gpd per connection in 2010. No data were available prior to 2001.

Table 61. Pittsboro Historical Finished Water Production.

Year	Production (MGD)
1995	--
1996	--
1997	--
1998	--
1999	--
2000	--
2001	0.67
2002	0.67
2003	0.54
2004	0.52
2005	0.46
2006	0.45
2007	0.53
2008	0.54
2009	0.54
2010	0.62

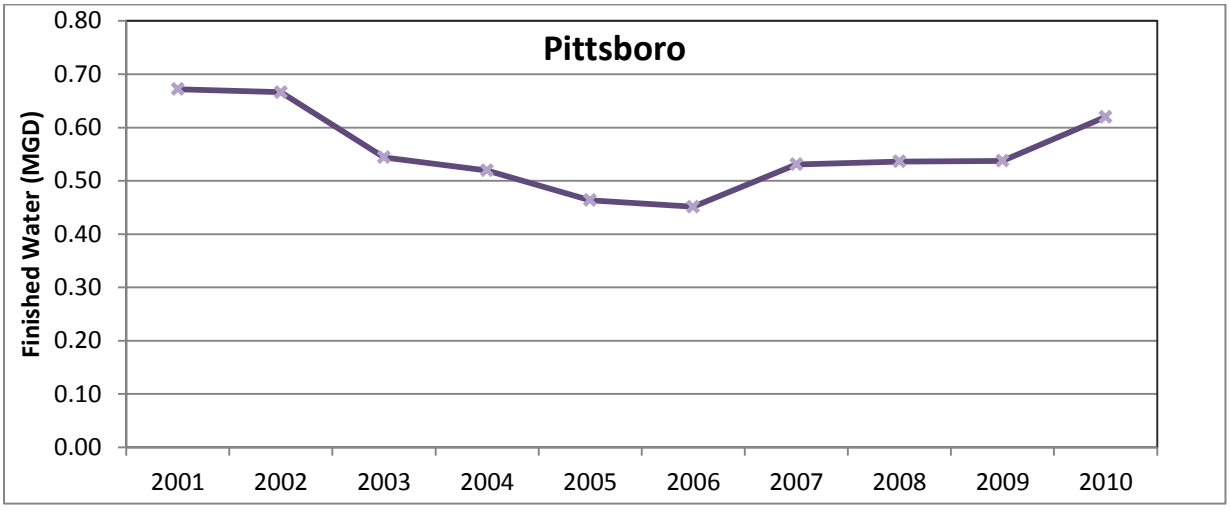

Figure 22. Pittsboro Historical Finished Water Production (MGD).

Future Demand

Table 62. Pittsboro Future Water Demand Projection (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	0.17	0.94	1.73	2.51	3.30	4.09
Bulk Sales	0.06	0.29	0.52	0.52	0.52	0.52
Commercial & Institutional	0.13	0.34	0.68	1.03	1.37	1.73
Industrial	0.07	0.07	0.07	0.07	0.07	0.07
WTP Process	0.09	0.21	0.38	0.52	0.66	0.80
Distribution Process	(Included with WTP Process)					
Other Non-Revenue	0.10	0.21	0.38	0.52	0.66	0.80
Total	**0.62**	**2.05**	**3.75**	**5.16**	**6.58**	**8.02**

Table 63. Pittsboro Future Water Demand Projection (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	26.9%	45.9%	46.0%	48.7%	50.2%	51.0%
Bulk Sales	9.7%	14.2%	14.0%	10.1%	8.0%	6.5%
Commercial & Institutional	21.2%	16.7%	18.3%	19.9%	20.8%	21.6%
Industrial	11.2%	3.2%	1.7%	1.3%	1.0%	0.8%
WTP Process	14.5%	10.0%	10.0%	10.0%	10.0%	10.0%
Distribution Process	(Included with WTP Process)					
Other Non-Revenue	16.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

The population estimate methodology described here corresponds to the population estimate presented in Section VI as well as the population estimate used in the projection methodology below. The Hydrostructures memo (2010) located in the Appendices includes three other population estimates for comparison.

Pittsboro is a small town that is projected to grow rapidly over the next 50 years. The current corporate limits make up only a small percentage of the Town's relatively large extra-territorial jurisdiction (ETJ), which is its future water service area. Land developers have purchased large tracts of land within the Town's ETJ, with plans for future development. The known areas for future development far exceed the size of the current corporate limits of Pittsboro.

Pittsboro's population estimate was a combination of existing/infill population growth along with known and potential future residential development. The population of Pittsboro's current service area (i.e. current corporate limits) was assumed to grow by 1% each year as infill growth. Future development was determined for three separate areas: Chapel Ridge, an existing bulk water customer; known future developments; and other potential development. The Chapel Ridge subdivision was assumed to be built out to 1,975 units by 2030, which was used to calculate a population estimate using the 2010 US Census figure of 2.33 people per household (pph).

For known and potential future development areas, a percentage of the area (40%) was assumed to be undeveloped space for transportation infrastructure, utilities, open space, etc. The remaining land (60%) was assumed to be developable. For the areas where future development was known, a residential density of 2 units per acre was assumed with 2.33 pph. For the other areas within the Town's ETJ, a density of 0.4 units per acre was assumed with 2.33 pph, after excluding certain undevelopable areas (areas already subdivided and existing spray fields).

Water Demand Projections

Pittsboro's future water demand projections were developed based on a land capacity/development type analysis of the known and potential future development. The projected future demand is a combination of current water demand; infill water demand growth; bulk sales to Chapel Ridge; industrial water demand; and residential, commercial and institutional water demand from known and potential future developments within the future service area, which is the Town's ETJ. Pittsboro has ten-fold more land available for development in the future (25,000+ acres) than is currently developed (2,200 acres). Of the land in the ETJ, over 11,000 acres are already listed in known residential developments.

The first components in the future water demand projection were current and infill water demand, bulk sales and industrial water demand. Beginning with the current system demand, the infill water demand was projected to increase by 1% per year to account for growth within the current town boundary. The Town has one bulk customer, Chapel Ridge, and it was assumed that this customer would grow to build-out by 2030. Next, industrial water demand was projected to remain flat at its current demand through 2060.

The residential, commercial and institutional future water demands were developed based on estimated per capita use rates and population estimated from developable land, development density and household size. The future development was separated into two categories: known developments and other undeveloped land in the ETJ. For these areas, use rates were derived for residential uses and commercial and industrial uses.

The residential use rate was developed by examining the billing data from several recently built single-family residential subdivisions (These subdivisions will likely be more representative of future development than older housing stock in Pittsboro.) Billing records indicate an average household water use of 240 gpd in these neighborhoods. Using the 2010 census average household size of 2.33 pph, a per capita residential use rate was calculated at 103 gpcd, which was rounded down to 100 gpcd for the future water projections. Next, a combined

commercial and institutional use rate was determined by examining 2009 billing records. Given a total commercial and institutional use of 123,610 gpd and a 2009 population of 2,670, according to the US Census website, a system-wide commercial and institutional use rate of 46 gpcd was calculated. Thus, for each resident, 46 gallons per day of commercial and institutional water use is used to support the residential population. These use rates agree fairly well with the 2010 gross estimate of 165 gpcd of raw water use, computed from 2010 raw water use data and the 2010 census population of 3,743.

After the use rates were determined, the population was determined for the known and potential future development. For all future development areas, a percentage of the area was assumed as not developable due to space needed for transportation infrastructure, utilities, open space, etc. The percentages of remaining developable land was assumed to be 60%. For the known developments, a density of 2 units per acre was assumed with 2.33 pph. For the other areas within the Town's ETJ, a density of 0.4 units per acre was assumed with 2.33 pph, after excluding certain undevelopable areas (areas already subdivided and existing spray fields). Then, the residential and commercial/institutional use rates were applied to the population estimates to develop the future water demand projections.

Finally, non-revenue water demand projections were developed. There was a limited set of historical data for use in determining the Town's WTP process water, flushing water and other non-revenue water. The Town has several historically unmetered uses including distribution system flushing, cleaning water at the Town's WWTP and utility vehicle washing. The Town has taken steps to begin tracking the amount of water used for flushing distribution mains by purchasing a hydrant meter. Based on 2010 billing records, 14.5% of all raw water was used for WTP production, finished water monitoring and flushing, and an additional 16.4% of raw water was other non-revenue. For the projections, 10% of the total system demand was assumed for other non-revenue water and 10% was assumed for WTP process and distribution system process water combined. These projections represent a reasonable attempt by Pittsboro to conserve water relative to current operations. Pittsboro's near term plans to address this include purchasing hydrant meters to help monitor and control use for flushing, public works, and wastewater treatment plant use. Eventually, Pittsboro may need to replace its water and wastewater plants with larger, more efficient facilities.

In summary, the following assumptions were used in Pittsboro's water demand projections:

- Infill water demand growth of 1.0% per year
- Residential use of 100 gpcd
- Known developments were assigned a residential density of 2 dwelling units per capita: 100 gpcd, with 60% of the total acreage assumed to be developed as residential
- Acreage not included in a known development was assigned a residential density of 0.4 dwelling units per acre, with 60% of total acreage assumed to be developed as residential
- Certain undeveloped areas were left undeveloped (spray fields & areas to be served by Chatham County)
- Allow 10% other non-revenue (system losses, meter inaccuracies, etc.)
- Allow 10% for process water (WTP process & distribution system flushing)
- Keep industrial use flat over time (65,120 gpd)
- Allow bulk customer to grow to build-out by 2030
- The per capita rate for commercial and institutional uses needed to support residential development is 46 gpcd

Water Efficiency and Conservation

Pittsboro's development pattern in the future may differ significantly from current development around Pittsboro's historic center. The new developments will in general include houses that are larger than existing housing stock and use more water per connection. Pittsboro's water use projections keep these use rates static over time instead of increasing them.

The Town does have in place an increasing block rate structure or tiered rate structure that strongly encourages conservation by customers.

In June 2010, the Town completed installation of a Reclaimed Water System. The RCW system has a capacity to pump up to 0.43 MGD, but the facility currently operates for 8-10 hours per day and provides a capacity of 0.14-0.18 MGD. In just 7 months they delivered over 157 million gallons to an industrial customer, and in the last 3 months of 2011 have averaged 100,00 gpd in usage by a single industrial customer. (Potable water to this customer was originally supplied by Chatham County and therefore the demand reduction is at the Chatham County WTP). Plans are to expand the infrastructure of this system as the Town finds new customers, though the reclaimed water supply is limited by the volume of water treated at the WWTP, which averaged 0.375 MGD in 2011.

Water Supply

Table 64. Pittsboro Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Haw River	9.8	9.8	9.8	9.8	9.8	9.8
Haw River (Infrastructure)	2.0	2.0	0.0	0.0	0.0	0.0

The 20% of 7Q10 flow of the Haw River at Pittsboro's intake is 9.8 MGD, which is the appropriate yield to use for water supply purposes. Pittsboro's current WTP is only permitted for a treatment capacity of 2 MGD.

Pittsboro would need to make significant infrastructure upgrades to be able to access the full 9.8 MGD that is potentially available. While there is ample supply in the Haw River, the viability of the intake is dependent on the water impoundment from the Bynum Dam. Built in 1880, the dam has not been maintained for several decades (since 1980) and is not owned by Pittsboro. As such, a dam failure could leave Pittsboro without a functioning water supply. Furthermore, the depth of the pool in which the intake sits is not sufficient to support withdrawals of much more than 2.0 MGD. Given that Pittsboro's water demand is projected to exceed its 2 MGD treatment capacity by 2020, and even a treatment plant expansion would not guarantee a reliable supply due to concerns about the Bynum Dam, Pittsboro does not consider its existing water supply viable after 2020 for planning purposes.

Pittsboro's next water treatment plant upgrade will likely require changing the intake location. Currently, the most viable location would be directly into Jordan Lake. The Town of Pittsboro plans to make an individual request to the State of North Carolina for a portion of the Jordan Lake water supply during the next round of allocations. As soon as the new wastewater treatment plant is completed (2013-2015), the Town plans to pursue planning construction of a new water treatment plant with a Jordan Lake intake.

Future Water Supply Need

Table 65. Pittsboro Future Water Supply Need (MGD).*

System	2010	2020	2030	2040	2050	2060
Pittsboro	0.0	0.05	3.8	5.2	6.6	8.0

* Calculation of future need considers current infrastructure will only support 2 MGD or less through 2020.

As explained in the previous section, the Haw River withdrawal and associated treatment are not considered viable for continued usage after 2020 without significant upgrades.

While the Haw River has sufficient flow to continue to supply Pittsboro's estimated future water supply needs for many years, the Bynum Dam cannot be equally relied upon. The Town plans to pursue partnerships for construction of a western intake on Jordan Lake as opposed to risking future growth and dependence on the longevity of the Bynum Dam. Instead of meeting its need by withdrawing from the available 9.8 MGD from the Haw River, Pittsboro plans to build a new intake on Jordan Lake. Since Pittsboro's Haw River withdrawal is only a few miles upstream of Jordan Lake, the hydrologic effect on the lake should be negligible.

City of Raleigh and Merger Partners

Prior Studies/ Related Documentation

Hazen and Sawyer, 2010. *Little River Reservoir Draft Environmental Impact Statement*. Prepared by Hazen and Sawyer for the City of Raleigh. Draft in process.

Hazen and Sawyer, 2008a. City of Raleigh Water Quality Study and Master Plan Update. Prepared by Hazen and Sawyer for the City of Raleigh. Project No. 30684-000. February 2008.

Hazen & Sawyer/CH2M Hill, 2008b. "Population and Water Demand Projections." Technical Memorandum. Prepared by Hazen & Sawyer and CH2M Hill for the City of Raleigh. April 16 2008.

City of Raleigh, 2008a. "Purpose and Need." Draft Memorandum. City of Raleigh. April 9, 2008.

City of Raleigh, 2008b. "Summary of Safe Yield Evaluations for Proposed Little River Reservoir, Wake County, North Carolina." City of Raleigh. August 2008.

DWR, 2006. Local Water Supply Plan Report, City of Raleigh. Submitted by City of Raleigh to North Carolina Division of Water Resources. PWSID: 03-92-010. 2006.

Historical Finished Water Use

Table 66. Raleigh Historical Finished Water Production.

Year	Production (MGD)
1995	35.47
1996	36.44
1997	39.95
1998	41.57
1999	43.18
2000	44.46
2001	41.57
2002	45.20
2003	43.30
2004	47.17
2005	48.70
2006	48.48
2007	50.77
2008	45.29
2009	47.81
2010	51.94

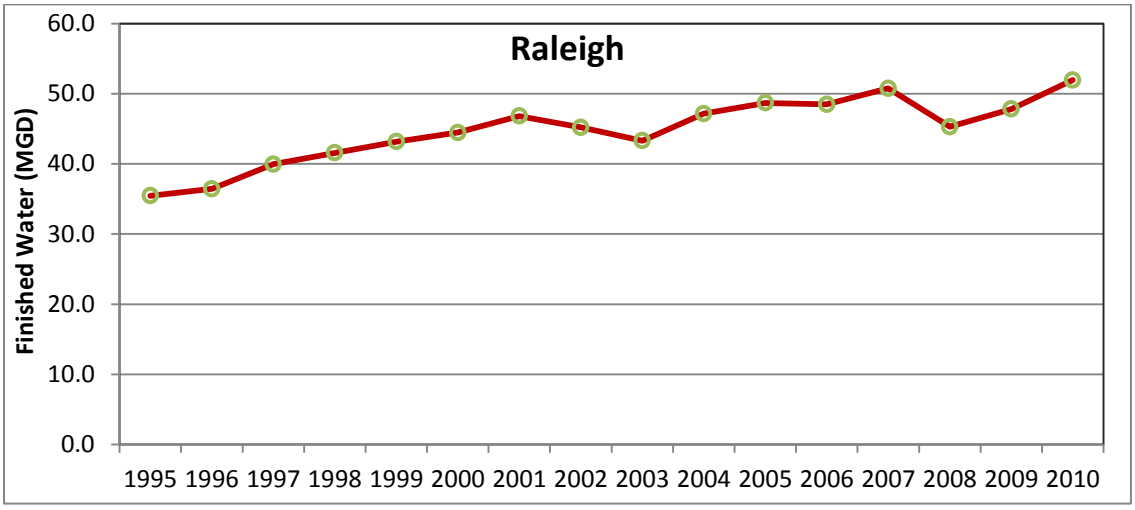

Figure 23. Raleigh Historical Finished Water Production (MGD).

Future Demand

Table 67. Raleigh Future Water Demand Projection (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	29.43	39.56	46.63	52.23	58.12	65.08
Commercial	11.42	15.36	18.1	20.28	22.56	25.26
Industrial	1.30	1.75	2.06	2.31	2.57	2.88
Institutional	3.4	4.57	5.39	6.04	6.72	7.52
WTP Process	0.13	0.17	0.21	0.23	0.26	0.29
Distribution Process	2.16	2.90	3.42	3.83	4.26	4.77
Other Non-Revenue	4.16	5.59	6.59	7.38	8.22	9.20
Total	**52.00**	**69.90**	**82.40**	**92.30**	**102.71**	**115.00**

Table 68. Raleigh Future Water Demand Projection (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	56.6%	56.6%	56.6%	56.6%	56.6%	56.6%
Commercial	22.0%	22.0%	22.0%	22.0%	22.0%	22.0%
Industrial	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Institutional	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
WTP Process	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
Distribution Process	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%
Other Non-Revenue	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

Population projections for the City of Raleigh and Merger Partners seem to uniformly agree on continued growth. Several population estimates have been developed, but the City of Raleigh's "Purpose and Need" memo provided the preferred population estimates through 2030. These "recommended population projections were primarily

based on the WQMP (Hazen and Sawyer, 2008a), which used data for Traffic Analysis Zones (TAZs) from the Capital Area Metropolitan Planning Organization (CAMPO) 2030 Long-Range Transportation Plan. The TAZ data was used with future service area boundaries determined in consultation with City of Raleigh [and Merger Partners] staff to arrive at future populations." (City of Raleigh, 2008a). The population projections used a constant population growth rate of 2.1% per year.

Water Demand Projections

Raleigh's demand projections are based on gallons per capita day methodology. Thus, for each projection year, total population is multiplied by a per capita use rate (in gpcd). The population, as described, was assumed to grow at constant, conservative rate of 2.1% over the planning horizon. The use rates were not forecast to remain the same throughout the projection window.

Raleigh's water use rates are projected as a combined gallons per capita per day water demand factor, which is multiplied by the total estimated population. Raleigh's projections include a dramatic reduction in the water demand factor over time. Currently, water is used in the Raleigh service area at a rate of 106.6 gpcd. This factor declines by 4 -10% each decade, falling to 92.7 gpcd by 2040, and 76.2 gpcd by 2060. The justifications for the feasibility of this magnitude of reduction in water use intensity and specific actions needed to achieve these targets are summarized in the Water Efficiency and Conservation subsection.

Raleigh's projection methodology combines all demand and non-revenue uses together. In order to disaggregate the sector usage for the purpose of this report, the percentage breakdowns for each the sectors from 2010 are simply carried forward to all the projection years. As a result, Raleigh's sector-based demand estimates are only representative of current conditions, and should not be used to interpret how the water use by sector will change.

Water Efficiency and Conservation

Raleigh has paid an increasing amount of attention to water efficiency in recent years. Based on potable water consumption data from 2010, the City of Raleigh service area (i.e. Raleigh, Zebulon, Rolesville, Wendell, Knightdale, Wake Forest and Garner) consumed an average of 106.6 gallons per capita day (gpcd). While this compares favorably with other similarly sized systems throughout the United States, it is anticipated that further reductions will be realized in the future through the following actions:

- continued development of the Reuse system
- continued support of water fixture replacement incentives
- reduction of elective use demand due to tiered rate implementation
- continued indoor water fixture efficiencies through Federal regulation

The City of Raleigh Public Utilities Department (CORPUD) has initiated the development of a robust reuse water distribution system throughout the service area. Currently, Phase 1 of the project is near completion. The estimated system build-out date is approximately 2037, but much of the system capacity are expected to be in place well before 2025. The system will be designed to distribute up to 8-10 million gallons per day (MGD) upon build out, which will result in a 1.6 gpcd reduction in demand on average for the entire system.

The CORPUD has established an aggressive toilet replacement program for all water customers in its service area. In order to maximize the program's effectiveness, we have made it available to both residential and non-residential customers and required that all replacement toilets meet EPA Water Sense criteria. The program was created in 2009 and to date has replaced 5,088 toilets, which are conservatively estimated to provide a 90,000 gallon per day savings. It is estimated that when the program is fully realized, the toilet replacements represent a 5.8 gpcd reduction potential. In addition, CORPUD is currently exploring additional water conservation/ efficiency incentives such as cistern/rain barrel and clothes washing machine rebates.

As of November 1st, 2010, the CORPUD implemented a tiered rate pricing structure for residential potable water service customers (irrigation rate also applies to all non-residential customers). The rates are summarized below:

Table 69. CORPUD rate tiers.

TIER	VOLUME IN CCF	RATE PER CCF
1	0 - 4	$2.28
2	4 - 10	$3.08
3	10 +	$5.07

CCF is 100 cubic feet

Due to the recent adoption of this rate structure, it is not yet clear to what degree it will impact demand, but as with most tiered rate structures, it is expected that average and maximum demand will decrease in response to the acute financial impact on elective uses such as irrigation. For reference, the City of Greensboro, NC adopted a residential tiered rate structure similar to the City of Raleigh's in 1999, which resulted in a 7% reduction in residential demand, and an additional 4.5% reduction the year after the rate structure was adopted. It is difficult to quantify the overall impact of the new rate structure at this time, but it is expected that it will have a substantial impact on the current irrigation demand and other similar uses (estimated to represent 4.8 gpcd).

The United States Environmental Protection Agency (EPA) established the Water Sense Program in 2006, which was created to promote high levels of water efficiency in common indoor water fixtures such as toilets, faucet, showerheads, etc. In addition, the EPA created the Energy Star Program to encourage the purchase of energy efficient appliances such as clothes washers and refrigerators, and also includes water efficiency as a criteria for some products such as clothes washers. It is estimated that the appliance/fixture replacements over time will represent an additional 2.6 gpcd reduction due to the improved efficiency of the new models.

In summary, it is estimated the combined savings of the reuse program, expansion of the water fixture replacement incentive program, residential demand impact from the tiered rate structure, and improved efficiency of replacement water fixtures and appliances will result in an approximate 13% reduction of the current average demand of 106.6 gpcd by 2040. This reduction to 92.7 gpcd is a realistic goal and in line with other Triangle area municipal systems such as the Town of Cary and OWASA, which have realized similar reductions thanks to their own conservation and efficiency improvement efforts.

For the 2050 and 2060 estimates, Raleigh's projections further assume that all outdoor irrigation with potable water will be phased out. It may be met in the future by on-site reuse, reclamation, rainwater harvesting or other measures. This leads to a significant reduction in gpcd use rate.

As described previously, Raleigh's non-revenue use percentages are built into the projection based on the approximate 2010 percentage breakdown, and conservation measures such as aggressive leak detection, can't be included directly under this projection methodology. Nonetheless, Raleigh is committed to good stewardship of its distribution system, and aims to maintain a non-revenue percentage of roughly 12% of total demand. Furthermore, Raleigh's WTPs have onsite reuse of process water, which diminishes the WTP Process water usage to a miniscule percentage of demand (~0.25%).

Water Supply

Table 70. Raleigh Existing Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Falls Lake	68.4	68.4	68.4	68.4	68.4	68.4
Lake Benson and Lake Wheeler	11.2	11.2	11.2	11.2	11.2	11.2
Total	**79.6**	**79.6**	**79.6**	**79.6**	**79.6**	**79.6**

Yield Assumptions

Raleigh's primary source of water is Falls Lake, which has a yield of 68.4 MGD. The 2006 LWSP reported an estimated yield of Lake Benson and Lake Wheeler at 20 MGD. The more conservative yield estimates in the Little River Draft EIS (2010) were used instead. The EIS projected the Lake Benson and Lake Wheeler system may provide 11.2 MGD.

Future Water Supply Need

Table 71. Raleigh Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Raleigh	0.0	0.0	2.8	12.7	23.1	35.4

This page left intentionally blank.

City of Sanford

Prior Studies/ Related Documentation

DWR, 2010. Local Water Supply Plan Report, Sanford. Submitted by City of Sanford to North Carolina Division of Water Resources. PWSID: 03-53-010. 2010.

DWR, 2009. Local Water Supply Plan Report, Sanford. Submitted by City of Sanford to North Carolina Division of Water Resources. PWSID: 03-53-010. 2009.

Hazen and Sawyer, 2009. City of Sanford Big Buffalo Wastewater Treatment Plant Expansion Engineering Report. Prepared by R. Christopher Belk of Hazen and Sawyer for the City of Sanford. 25 May 2009. Chapter 3.

DWR, 2002a. *Cape Fear River Basin Water Supply Plan.* Division of Water Resources. March, 2002.

DWR, 2002b. Local Water Supply Plan Report, Sanford. Submitted by City of Sanford to North Carolina Division of Water Resources. PWSID: 03-53-010. 2002.

Historical Finished Water Use

In 2010, Sanford produced an average of 6.52 MGD of finished water. Sanford's SFR customers used an average of 136 gallons per connection per day.

Table 72. Sanford Historical Finished Water Production

Year	Production (MGD)
1995	5.79
1996	5.86
1997	5.92
1998	6.18
1999	6.42
2000	6.59
2001	6.46
2002	6.99
2003	6.55
2004	6.57
2005	6.63
2006	6.78
2007	6.61
2008	6.17
2009	6.23
2010	6.52

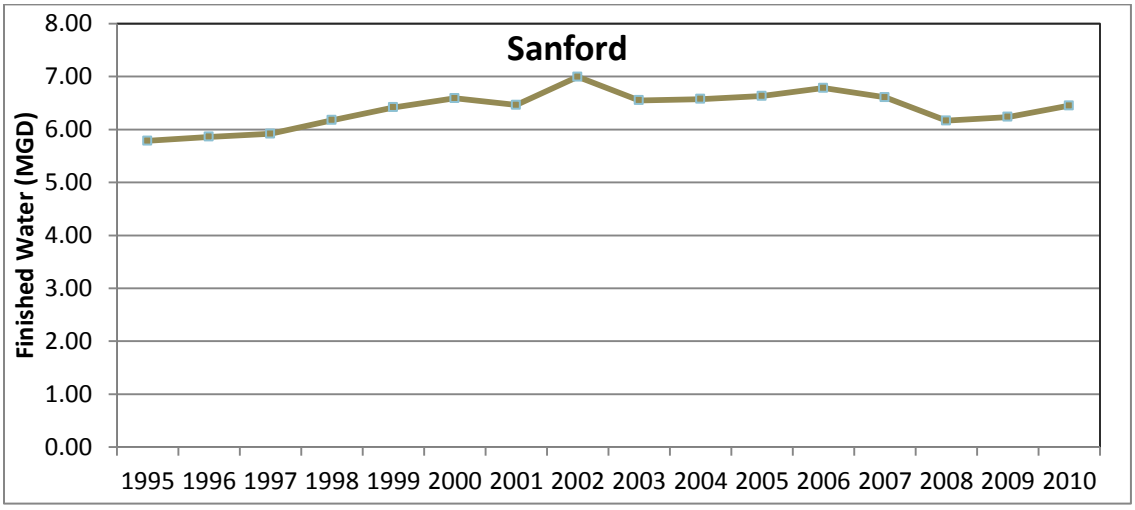

Figure 24. Sanford Historical Finished Water Use (MGD).

Future Demand

Table 73. Sanford Future Water Demand Projection (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	2.08	2.88	3.99	4.84	5.87	7.12
Wholesale (RES)	0.60	0.83	1.15	1.39	1.69	2.05
Commercial & Industrial	1.85	2.74	4.05	6.00	8.88	10.82
Institutional	0.20	0.28	0.41	0.58	0.82	1.00
WTP Process	1.03	0.41	0.57	0.76	1.02	1.24
Distribution Process		0.20	0.20	0.20	0.20	0.20
Other Non-Revenue	0.80	0.77	1.09	1.45	1.94	2.35
Total	**6.52**	**8.11**	**11.46**	**15.21**	**20.42**	**24.79**

Table 74. Sanford Future Water Demand Projection (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	32.0%	35.5%	34.8%	31.8%	28.7%	28.7%
Wholesale (RES)	9.2%	10.2%	10.0%	9.2%	8.3%	8.3%
Commercial & Industrial	28.4%	33.7%	35.4%	39.4%	43.5%	43.7%
Institutional	3.1%	3.5%	3.5%	3.8%	4.0%	4.0%
WTP Process	15.8%	5.0%	5.0%	5.0%	5.0%	5.0%
Distribution Process		2.5%	1.7%	1.3%	1.0%	0.8%
Other Non-Revenue	11.7%	9.5%	9.5%	9.5%	9.5%	9.5%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Population Estimates

The Sanford population estimates were developed from the sources listed above. The Big Buffalo Creek WWTP Expansion Engineering Report (Hazen and Sawyer, 2009) used historical population growth and a combination of state and local projections for Sanford and Lee County to generate estimates of the City of Sanford service area's population growth rates through 2030. Using these sources, a population growth rate of 3.3 percent per year was estimated for the next few decades. Sanford officials estimate population growth will slow thereafter due to some portions of the service area reaching build-out, and continue at 1.95% per year from 2030 to 2060.

Water Demand Projections

Sanford is a community with an ample water supply in the Cape Fear River, and a location primed for development due to availability and reasonable proximity to major employment and population centers in the larger region. The area is likely to have to some residential growth, but potentially even more significant commercial and industrial growth. Sanford is predicting rapid growth over the next 20 years, with continued steady growth thereafter.

Sanford's demand projections are based upon forecasting a percentage growth rate for each sector of its demand. Sanford has broken down its use into three sectors and three categories of non-revenue use. Sanford's three primary sectors include residential, commercial, and institutional. Sanford's residential sector water use is projected to grow at the same rate as the Sanford population estimates.

Sanford sells water to several wholesale customers. The City provides finished water and system administration to the Lee County Water & Sewer District #1. The City also provides finished water to the East Chatham County water system. In addition, the City provides finished water to the Town of Broadway to meet demands that are in excess of the capacity of their wells to provide water supply. These wholesale customers have a majority of their demand in the residential sector. As a result, their future water demands (and purchases from the City of Sanford) are projected to grow at the same rate as Sanford's own residential sector demand.

The commercial sector projection includes Sanford's industrial use. Though separated in the 2010 Local Water Supply Plan data, industrial sector usage was included with commercial usage sector in these projections because changes in industrial demand were difficult to predict on their own. Sanford's institutional sector includes schools, hospitals, and other public buildings as well as estimates of known (but unmetered) municipal and public water uses.

The 2010 projections reflect actual 2010 water use in Sanford from billing records. After 2010, Sanford based its projections on expectations of yearly percentage growth rates for each sector. The percentage growth rates for the sectors change over time to reflect an eventual slowing in the rate of growth. The projected yearly percentage growth rates by sector were:

Residential	3.3% through 2030, 1.95% from 2030 to 2060.
Commercial/Industrial	4.0% through 2050, 2.00% from 2050 to 2060.
Institutional	3.6% through 2050, 2.00% from 2050 to 2060.
Wholesale	3.3% through 2030, 1.95% from 2030 to 2060.

The non-revenue demand was broken down into three use categories. *WTP process* includes system process usage at the water treatment plant. *Distribution process* includes water used for flushing of the water distribution system. For the 2010 forecast year, WTP system process and distribution process are grouped into a single sector. After 2010, WTP process usage is expected to be five percent of the total water demand. Distribution process usage is mostly a function of the size and layout of the distribution system. Sanford's distribution network is already very large and spread-out, so Sanford expects the system flushing need will remain constant in future years at roughly 200,000 gallons per day (0.2 MGD). *Other non-revenue* water use includes line breaks, leaks,

meter inaccuracies and fire fighting usage. Sanford projects that by 2020, other non-revenue water will make up a relatively consistent ten percent of total finished water (excludes WTP system process water).

Water Efficiency and Conservation

In its projections, Sanford does not directly take into account water use rates, so it is difficult to demonstrate conservation directly. Sanford's total residential sector water use grows at the same percentage rates as population, so it can be inferred that the residential per capita usage rate does not increase over time.

Sanford's projection methodology uses a decrease in the sectors' rates of growth over time. The residential sector and wholesale water sector growth rate decreases in 2030, and commercial/industrial and institutional sectors lower their growth rates after 2050. These shifts, especially in the non-residential sector, can represent either a slowing in the pace of development or greater efficiency.

The primary area where Sanford's projections demonstrate conservation and efficient management of water is in managing non-revenue water. Sanford currently has a very large distribution system which requires roughly 0.2 MGD of water for distribution system process usage including flushing. The geographic extent of the distribution system will not change much in the future as it already spans most of Lee County, but many additional connections will be added as infill. Through careful management of the distribution system, and careful hydraulic design of additional pipes added to the system, Sanford intends to keep the flushing usage roughly constant. By keeping the usage constant, the percentage of total usage will fall over time. Furthermore, Sanford will have to expand its treatment plant, and it is expected that after the upgrades the WTP will be able to use less water (percentage-wise) for process usage. Finally, the City of Sanford will work to keep other non-revenue water (leakage, etc.) to 10% of finished water pumpage.

Water Supply

Table 75. Sanford Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Cape Fear River	61.6	61.6	61.6	61.6	61.6	61.6

Yield Assumptions

Sanford has a run-of-river intake in the Cape Fear River behind the impoundment created by Buckhorn Dam, which was once referred to as Yarborough Lake. Water supply yield (50-year safe yield) was documented as 12.6 MGD in the 2010 Draft LWSP and this yield analysis for the Cape Fear River was based on flow in the river before Jordan Lake was constructed. In the Cape Fear Basin Water Supply Plan (DWR, 2002a), this intake on the Cape Fear River was estimated to safely yield 61.6 MGD, which was calculated as 20% of the 7Q10 by DWR, and accounted for the operation of Jordan Lake. Therefore, 61.6 MGD is the more valid yield estimate, and is used in this planning process. Currently, the City of Sanford WTP is permitted produce 12 MGD of finished water.

Future Water Supply Need

Table 76. Sanford Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Sanford	0.0	0.0	0.0	0.0	0.0	0.0

Sanford shows no need based on its availability of ample raw water supply in the Cape Fear, but will need to expand its treatment plant capacity, perhaps more than once.

Wake County – RTP South

Prior Studies/ Supporting Documents

CH2M Hill, 2007. *Town of Cary Integrated Water Resources Management Plan*. Prepared by CH2M Hill for the Town of Cary.

DWR, 2002. *Local Water Supply Plan Report, Wake County – RTP South.* Submitted by Wake County to North Carolina Division of Water Resources. 2002.

DWR, 2001. *Jordan Lake Water Supply Storage Allocation Recommendations – Round Three*. Prepared by Division of Water Resources.

Historical Finished Water Use

In 2010, Wake County – RTP South used 0.41 MGD of water on average, all of which was supplied by the Town of Cary. Wake County – RTP South's users do not include any residential customers, so no SFR use rate can be calculated

Table 77. Wake County – RTP South Historical Finished Water Production.

Year	Production (MGD)
1995	--
1996	--
1997	0.12
1998	0.12
1999	0.17
2000	0.21
2001	0.32
2002	0.40
2003	0.36
2004	0.35
2005	0.44
2006	0.41
2007	0.50
2008	0.49
2009	0.46
2010	0.41

Note: Wake County – RTP South purchases its water from the Town of Cary.

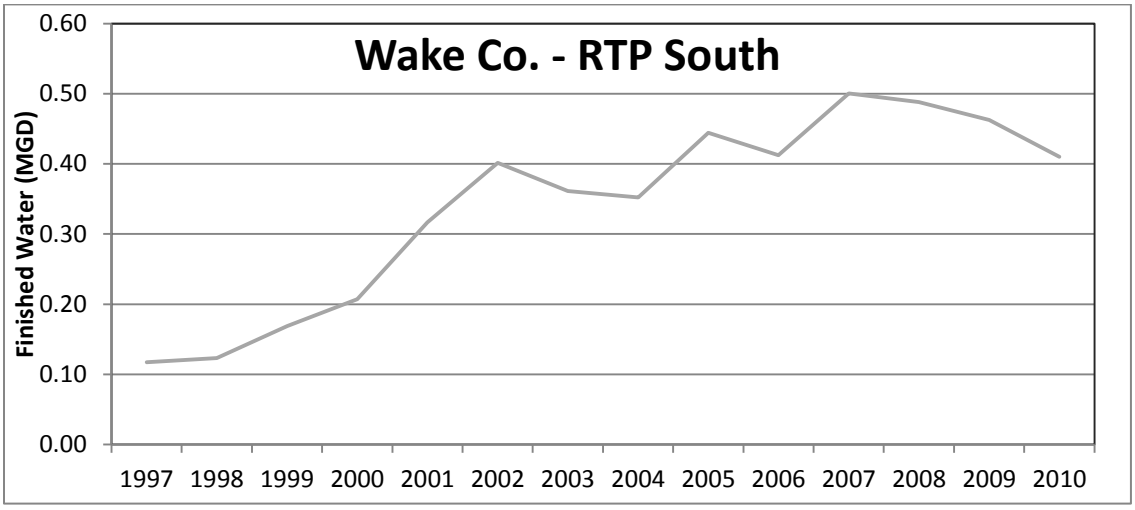

Figure 25. Wake County – RTP South Historical Finished Water Use/Purchase (MGD).

Future Demand

Table 78. Wake County – RTP South Future Projected Demand (MGD).

Sector	2010	2020	2030	2040	2050	2060
Residential	-	-	-	-	-	-
Commercial	0.11	0.35	0.6	0.84	0.85	0.85
Industrial	0.28	0.76	1.26	1.72	1.75	1.78
Institutional	-	-	-	-	-	-
WTP Process	0.07	0.20	0.34	0.47	0.47	0.48
Distribution Process	0.01	0.02	0.04	0.05	0.05	0.05
Other Non-Revenue	0.02	0.06	0.09	0.13	0.13	0.13
Total	**0.48**	**1.39**	**2.33**	**3.20**	**3.25**	**3.29**

Table 79. Wake County – RTP South Future Projected Demand (percent of total demand).

Sector	2010	2020	2030	2040	2050	2060
Residential	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Commercial	22.4%	25.1%	25.8%	26.1%	26.1%	26.1%
Industrial	57.1%	54.6%	54.1%	53.7%	53.7%	53.7%
Institutional	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WTP Process	18.1%	14.7%	14.5%	14.5%	14.7%	14.7%
Distribution Process	1.3%	1.5%	1.6%	1.8%	1.6%	1.6%
Other Non-Revenue	3.4%	4.1%	4.0%	3.9%	3.9%	3.9%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Demand Methodology

Wake County is not a water provider itself. Generally speaking, the municipalities within the county provide water to the areas that fall within their jurisdictions. RTP South is an entity in itself and therefore cannot be annexed into the jurisdiction of a surrounding municipality. The Research Triangle Foundation (RTF) serves as the property management agency and Wake County serves as the governmental jurisdiction. RTP South obtains

its water supply and wastewater services from the Town of Cary through an interlocal agreement with Wake County and RTF.

Population Estimate

There is currently no residential development in RTP South. Likewise, no future residential development is currently expected to occur within RTP South. For this reason, no projection of population or residential demand has been included. RTF is conducting a master planning effort during 2010/11 investigating potential changes in the land use patterns.

Water Demand Projections

RTP South currently has ten (10) existing or planned tenants and nine (9) vacant parcels. Questionnaires were sent by Wake County to each of the existing tenants to determine the projected employee counts for the years 2040 and 2060. Those projected employee counts were utilized by Wake County in estimating the projected water demands in RTP South. The questionnaires also included information related to the tenants' plans to use reclaimed water at their facilities. A project to supply RTP South with reclaimed water for irrigation and other uses has been planned and is expected to be operational by late 2011.

RTP South is a defined area with a limited number of lots. The area's future growth is therefore limited to the existing parcels. Since Cisco's arrival in 1994, all but nine (9) of the existing parcels have been developed. Since more than half of the lots have been developed in approximately 17 years, it is estimated that the remaining vacant parcels in RTP South will be developed within the next 29 years, or by the year 2040.

Currently, approximately 35% of the existing built-upon acreage in RTP South is occupied by bio-industrial tenants that consume, proportionally, a larger amount of water than other tenants. The other 65% of RTP South is occupied by commercial office facilities. Predicting the nature of future tenants is always speculative. The most aggressive water demand projections would assume that 100% of the remaining vacant land would develop with bio-industrial facilities. The least aggressive – and one might argue tenuous – demand projections would assume that 0% of the vacant land would be developed for bio-industrial.

For the purposes of this report, it is assumed that the vacant sites will develop in a manner similar to historic development patterns. Therefore, it is assumed that 35% (119 acres) of the remaining 339 acres will be developed for bio-technology companies, with the remaining 65% (220 acres) being developed for commercial tenants. The range of possible water demand projections is demonstrated in Figure 26. The selected demand curve is for 35% bio-industrial development.

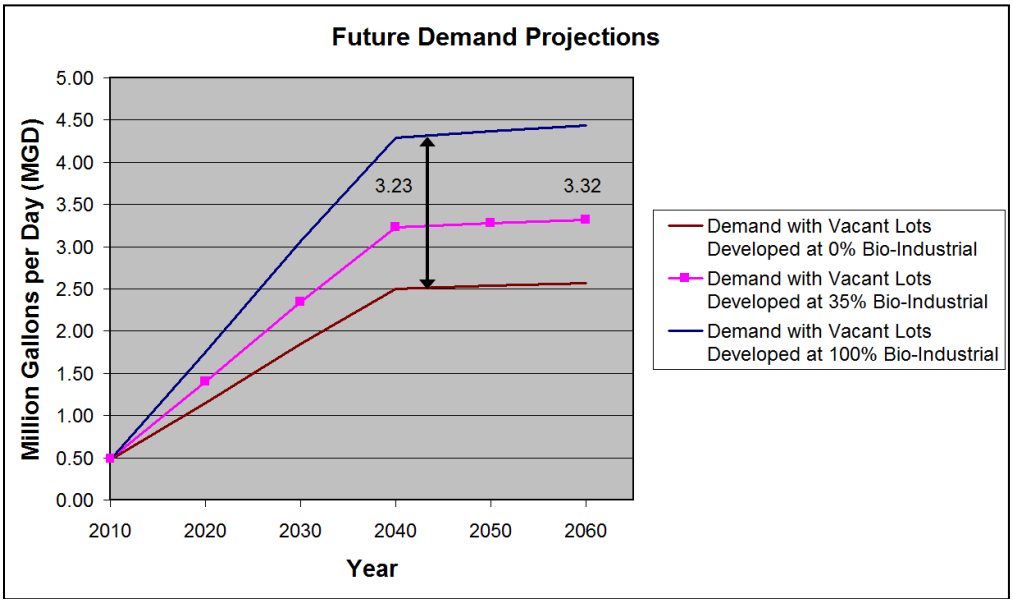

Figure 26. Wake County – RTP South Future Demand Projections.

Historically, the existing commercial tenants in RTP South have an average of 20 employees per acre and an average water demand of 19 gpd per employee. Commercial tenants are projected to develop to 47 employees per acre by 2040 and 48 employees per acre by 2060. These employee densities were calculated using the previously mentioned questionnaire. For future demand projections, each employee is projected to use 25 gpd per NCAC T15A:18C.0409, which is similar to historical use.

Currently, the existing bio-industrial tenants are developed at 10 employees per acre. The average water demand is 20 gpd per employee. In the future, bio-industrial tenants are projected to develop to 20 employees per acre by 2040 and 29 employees per acre by 2060. These employee densities were calculated using the previously mentioned questionnaire. Each employee is projected to use 25 gpd per NCAC T15A:18C.0409, which again is consistent with historical use.

In addition to the water demands expected due to employee use, the bio-industrial tenants will also have process water use. A process water rate of 0.6 gpd/ft^2 of projected building square footage was utilized. This rate is equivalent to the permitted process use per square foot of the existing bio-industrial tenants in RTP South. The existing building square footage in RTP South represents 19% of their respective lot acreage, as several sites contain multi-level buildings. For projections, the building square footage for future bio-industrial facilities is projected to be 20% of their lot coverage.

There are currently no institutional demands in RTP South. No future institutional development is expected to occur within RTP South. For this reason, no projection of institutional demand has been included.

Non-revenue water for RTP South consists of RTP South's share of the process water loss (filter backwashing, sampling, etc.) at the Town of Cary's water treatment plant, and other non-revenue losses such as flushing of the distribution system and small leaks and deficiencies in the system.

All projections for 2020, 2030 and 2050 were determined by interpolating between the 2010 estimates and the 2040 and 2060 calculated projections. Additionally, it was assumed that all irrigation needs will be met using reclaimed water.

Water Efficiency and Conservation

Wake County – RTP South customers are unique for a water system as RTP South has no residential users, and it was developed relatively recently. The newer construction is already relatively water efficient with respect to

fixtures. Water use rates for commercial and institutional tenants is very dependent on the types of tenants attracted, which is difficult to predict. Figure 26 shows this uncertainty graphically. As such, it is believed that water use rates of the existing tenants will be reasonably reflective of future water use rates for new development.

Water Supply

Table 80. Wake County – RTP South Water Supply (MGD).

Source	2010	2020	2030	2040	2050	2060
Current Jordan Lake Allocation	3.5	3.5	3.5	3.5	3.5	3.5

As mentioned previously, RTP South is supplied by the Town of Cary for its water supply. The Town of Cary withdraws water from Jordan Lake, treats it, and distributes it to RTP South. From a supply standpoint, though, RTP South has its own Jordan Lake allocation estimated to yield 3.5 MGD. Though treated by Cary, the water sold to RTP South is from RTP South's allocation from Jordan Lake.

Future Water Supply Need

Table 81. Wake County – RTP South Future Water Supply Need (MGD).

System	2010	2020	2030	2040	2050	2060
Wake County – RTP South	0.0	0.0	0.0	0.0	0.0	0.0

Prepared For:

Jordan Lake Partnership

www.jordanlakepartnership.org

Prepared By:

Triangle J Council of Governments

www.tjcog.org

For more information contact:

Mike Schlegel
mschlegel@tjcog.org
(919) 295-0017

or

Lars Hanson
lhanson@tjcog.org
(919) 558-9392