# Table of Contents

## Executive Summary
- E.1 Existing Reclaimed Water System..............................................................ES-1
- E.2 Analysis of Existing Reclaimed Water Demands.......................................ES-2
- E.3 Future Reclaimed Water Demand Scenarios............................................ES-3
  - E.4.1 Northwest Cary Service Area ..........................................................ES-5
  - E.4.2 South Cary Service Area .................................................................ES-6
  - E.4.3 Phasing.........................................................................................ES-7
- E.5 Capital Improvement Program (CIP)......................................................ES-8

## Section 1 Project Background and Objective
- 1.1 Project Background..................................................................................1-1
- 1.2 Objective..................................................................................................1-1
- 1.3 Report Format..........................................................................................1-2

## Section 2 Existing Reclaimed Water Program
- 2.1 Town Policy Statement............................................................................2-1
- 2.2 North Cary Service Area........................................................................2-3
  - 2.2.1 North Cary Water Reclamation Facility ........................................2-3
  - 2.2.2 Reclaimed Water Distribution System...........................................2-4
- 2.3 South Cary Service Area.........................................................................2-6
  - 2.3.1 South Cary Water Reclamation Facility ........................................2-6
  - 2.3.2 Reclaimed Water Distribution System...........................................2-7
- 2.4 West Cary Service Area .........................................................................2-7
  - 2.4.1 Triangle Wastewater Treatment Plant ...........................................2-7
  - 2.4.2 Reclaimed Water Distribution System...........................................2-9
- 2.5 Reclaimed Water System Operations....................................................2-9
  - 2.5.1 Blow-offs .......................................................................................2-9
  - 2.5.2 Minimum System Pressure ............................................................2-11
  - 2.5.3 Reclaimed Water Holiday ..............................................................2-11
  - 2.5.4 Cross-Connections .........................................................................2-11

## Section 3 Regulatory Review
- 3.1 National Trends......................................................................................3-1
- 3.2 North Carolina Trends............................................................................3-2

## Section 4 Existing Reclaimed Water Demands
- 4.1 Average Annual Demand.........................................................................4-1
- 4.2 System-Wide Peaking Factors................................................................4-2
  - 4.2.1 Seasonal Peaking Factors...............................................................4-2
  - 4.2.2 Maximum Daily Peaking Factor ....................................................4-3
  - 4.2.3 Diurnal Variations and Hourly Peaking Factors............................4-4
- 4.3 Customer-Specific Diurnal Variations....................................................4-5
  - 4.3.1 Meter Monitoring Program............................................................4-5
Section 5 Future Reclaimed Water Demands
5.1 Future Reclaimed Water Service Areas ................................................................. 5-1
5.2 Demand Scenarios ................................................................................................. 5-2
   5.2.1 Scenario 1 ........................................................................................................ 5-4
   5.2.2 Scenario 2 ........................................................................................................ 5-4
   5.2.3 Scenario 3 ........................................................................................................ 5-7
   5.2.4 Scenario 4 ........................................................................................................ 5-7
5.3 Maximum Day Customer Demand Projections .................................................... 5-10
5.4 Non-Revenue Water Demand Projections ............................................................ 5-10
Section 6 Reclaimed Water Supply Capacity
6.1 Methodology ......................................................................................................... 6-1
6.2 North Cary WRF Reclaimed Water Supply .......................................................... 6-2
   6.2.1 Scenario 3 Supply Considerations ................................................................. 6-4
   6.2.2 Scenario 4 Supply Considerations ................................................................. 6-5
6.3 South Cary WRF Reclaimed Water Supply ......................................................... 6-5
6.4 Western Wake WRF Reclaimed Water Supply .................................................... 6-8
6.5 Total Supply Capacity .......................................................................................... 6-10
Section 7 Hydraulic Model Development and Evaluation Criteria
7.1 General Evaluation Criteria .................................................................................... 7-1
   7.1.1 System Pressures ......................................................................................... 7-1
   7.1.2 Velocity and Headloss ............................................................................... 7-1
   7.1.3 Storage Volume Requirements .................................................................... 7-2
   7.1.4 Storage Evaluation Approach ..................................................................... 7-3
7.2 Model Development ............................................................................................. 7-4
   7.2.1 Physical Model ......................................................................................... 7-4
   7.2.2 Demand Allocation .................................................................................. 7-4
7.3 Model Calibration ................................................................................................. 7-5
7.4 Existing System Evaluation .................................................................................. 7-6
Section 8 Future Reclaimed Water Scenario Evaluation
8.1 Northwest Cary Service Area .................................................................................. 8-1
   8.1.1 Scenario 1 .................................................................................................... 8-1
   8.1.2 Scenario 2 .................................................................................................... 8-2
   8.1.3 Scenario 3 .................................................................................................... 8-2
   8.1.4 Scenario 4 .................................................................................................... 8-5
8.2 South Cary Service Area ....................................................................................... 8-8
   8.2.1 Scenario 1 .................................................................................................... 8-8
   8.2.2 Scenario 2 .................................................................................................... 8-8
   8.2.3 Scenario 3 and 4 ....................................................................................... 8-8
8.3 Preferred Scenario Phasing and Alternatives .................................................... 8-10
   8.3.1 Phasing Approach .................................................................................... 8-12
   8.3.2 Phase 1 (Implementation by 2020) ............................................................. 8-12
8.3.3 Phase 2 (Implementation between 2020 and 2030) ............................................... 8-15
8.3.4 Phase 3 (Implementation between 2030 and 2060) ............................................... 8-16
8.3.5 Storage Alternatives ............................................................................................. 8-19

Section 9 Recommended Capital Improvement Program

9.1 Cost Estimates .............................................................................................................. 9-1
  9.1.1 Unit Pipeline Construction Cost .............................................................................. 9-2
  9.1.2 Land Acquisition ..................................................................................................... 9-3
  9.1.3 Contingencies, Engineering, Legal, and Administrative Fees ................................ 9-3
9.2 Capital Improvement Program ..................................................................................... 9-3
   9.2.1 Phase 1A (2015) .................................................................................................... 9-4
   9.2.2 Phase 1B (2017) .................................................................................................... 9-4
   9.2.3 Phase 1C (2020) .................................................................................................... 9-9
   9.2.4 Phase 2 (2020-2030) .......................................................................................... 9-9
   9.2.5 Phase 2 (2030-2060) .......................................................................................... 9-11
   9.2.6 Summary .............................................................................................................. 9-14

9.3 Operational Considerations ......................................................................................... 9-14

9.4 Reclaimed Water Program Policy Considerations ..................................................... 9-15
   9.4.1 Policy Statement 132 ............................................................................................ 9-15
   9.4.2 Conversion Benefit to Encourage Connections .................................................. 9-15
   9.4.3 Design Standards .................................................................................................. 9-17

9.5 Summary ...................................................................................................................... 9-18

Section 10 References

Appendices

Appendix A – Town of Cary Policy Statement 132
Appendix B – Reclaimed Water Program Permits
Appendix C – Reclaimed Water System Facility Data Sheets
Appendix D – Reclaimed Water Meter Monitoring Data
Appendix E – Long Range Water Resources Plan Demand Projection Assumptions
   Memorandum
Appendix F – Pressure and Velocity Results for Recommended Improvements
Appendix G – Town of Cary Case Study from USEPA Guidelines for Water Reuse, September
   2012
# List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table E-1</td>
<td>2060 Maximum Day Demand and Available Supply for Reclaimed Water Scenarios</td>
<td>ES-4</td>
</tr>
<tr>
<td>Table E-2</td>
<td>Scenario 4 Reclaimed Water Demand Projections by Phase (in mgd)</td>
<td>ES-7</td>
</tr>
<tr>
<td>Table E-3</td>
<td>Summary of CIP Project Costs by Type and Year (in millions of dollars)</td>
<td>ES-8</td>
</tr>
<tr>
<td>Table 2-1</td>
<td>Minimum Reclaimed Water Quality Standards</td>
<td>2-1</td>
</tr>
<tr>
<td>Table 2-2</td>
<td>North Cary WRF Effluent Water Quality Parameters, January 2009 Through August 2011</td>
<td>2-3</td>
</tr>
<tr>
<td>Table 2-3</td>
<td>South Cary WRF Effluent Water Quality Parameters, January 2009 Through August 2011</td>
<td>2-6</td>
</tr>
<tr>
<td>Table 3-1</td>
<td>Type 1 and Type 2 Reclaimed Water Standards</td>
<td>3-2</td>
</tr>
<tr>
<td>Table 4-1</td>
<td>Summary of 2010 Annual Average Pumped and Billed Reclaimed Water Use</td>
<td>4-2</td>
</tr>
<tr>
<td>Table 4-2</td>
<td>Summary of Seasonal and Maximum Daily Reclaimed Water Peaking Factors</td>
<td>4-4</td>
</tr>
<tr>
<td>Table 4-3</td>
<td>Individual Customer Meters Monitored During 2010/2011</td>
<td>4-6</td>
</tr>
<tr>
<td>Table 4-4</td>
<td>Comparison of Maximum Monitored Day to Average Day Demand for North Cary Reclaimed Water Customers</td>
<td>4-10</td>
</tr>
<tr>
<td>Table 4-5</td>
<td>Comparison of Maximum Monitored Day to Average Day Demand for South Cary Reclaimed Water Customers</td>
<td>4-12</td>
</tr>
<tr>
<td>Table 4-6</td>
<td>Comparison of Maximum Mentored Day to Average Day Demand for Future Reclaimed Water Customers</td>
<td>4-13</td>
</tr>
<tr>
<td>Table 5-1</td>
<td>Summary of Scenario 1 Annual Average Reclaimed Water Customer Demands</td>
<td>5-4</td>
</tr>
<tr>
<td>Table 5-2</td>
<td>Summary of Scenario 2 Annual Average Reclaimed Water Customer Demands</td>
<td>5-7</td>
</tr>
<tr>
<td>Table 5-3</td>
<td>Summary of Scenario 3 Annual Average Reclaimed Water Customer Demands</td>
<td>5-7</td>
</tr>
<tr>
<td>Table 5-4</td>
<td>Summary of Scenario 4.1 &amp; 4.2 Annual Average Reclaimed Water Customer Demands</td>
<td>5-7</td>
</tr>
<tr>
<td>Table 5-5</td>
<td>Scenario 1 – Maximum Day Customer Demand Projections by Service Area</td>
<td>5-10</td>
</tr>
<tr>
<td>Table 5-6</td>
<td>Scenario 2 – Maximum Day Customer Demand Projections by Service Area</td>
<td>5-12</td>
</tr>
<tr>
<td>Table 5-7</td>
<td>Scenario 3 – Maximum Day Customer Demand Projections by Service Area</td>
<td>5-13</td>
</tr>
<tr>
<td>Table 5-8</td>
<td>Scenario 4.1 – Maximum Day Customer Demand Projections by Service Area</td>
<td>5-14</td>
</tr>
<tr>
<td>Table 5-9</td>
<td>Scenario 4.2 – Maximum Day Customer Demand Projections by Service Area</td>
<td>5-16</td>
</tr>
</tbody>
</table>
Table 6-1 North Cary WRF Reclaimed Water Supply Projections ............................................. 6-2
Table 6-2 NCWRF Reclaimed Water Supply and Northwest Cary Service Area Demand .......................................................................................................................... 6-4
Table 6-3 South Cary WRF Reclaimed Water Supply Projections ............................................. 6-6
Table 6-4 SCWRF Reclaimed Water Supply and South Cary Service Area Demands .......................................................................................................................... 6-6
Table 6-5 Western Wake WRF Reclaimed Water Supply Projections ............................................. 6-8
Table 6-6 Summary of Total Reclaimed Water Supply and Scenario 2 (Town-Wide) Demands .......................................................................................................................... 6-10
Table 8-1 Minimum Storage Volume by Scenario (2060 Demands) ............................................. 8-2
Table 8-2 Scenario 4 Reclaimed Water Demand Projections by Phase (in mgd) .......... 8-13
Table 8-3 Minimum Storage Volume by Phase for Scenario 4 .................................................. 8-19
Table 8-4 Modeled Flow Control Valve Settings for Baseball Tank Operations ............... 8-23
Table 8-5 Summary of Recommended Storage .......................................................................... 8-26
Table 9-1 Level of Cost Categories ............................................................................................. 9-2
Table 9-2 Unit Construction Costs for Trench Installation of Reuse Pipeline ................. 9-2
Table 9-3 Unit Construction Cost for Trenchless Road and Stream Crossings ............... 9-3
Table 9-4 Town of Cary Reclaimed Water System Capital Improvements Program ...... 9-5
Table 9-5 Summary of CIP Project Costs by Type and Year .................................................. 9-14

List of Figures

Figure 2-1 Town Policy Statement 132 Reclaimed Water Service Areas (adopted 2010) .............................................................. 2-2
Figure 2-2 Existing North Cary Reclaimed Water Distribution System ............................. 2-5
Figure 2-3 Existing South Cary Reclaimed Water Distribution System ............................. 2-8
Figure 2-4 Existing West Cary Reclaimed Water Distribution System ......................... 2-10
Figure 4-1 Historical Pumped and Billed Reclaimed Water ............................................... 4-2
Figure 4-2 Normalized Monthly Reclaimed Water Use (Based on 2007-2011 Data) ...... 4-3
Figure 4-3 Unit Diurnal Reclaimed Water use Pattern for Peak Flow Days .................... 4-5
Figure 4-4 2010/2011 Reclaimed Meter Monitoring Locations ......................................... 4-7
Figure 4-5 Daily Reclaimed Water Flow – Summer 2010 .................................................... 4-8
Figure 4-6 Daily Reclaimed Water Flow – Summer 2011 .................................................... 4-8
Figure 4-7 North Cary Customer-Specific Unit Diurnal Reclaimed Water Use Patterns ........................................................................ 4-10
Figure 4-8 South Cary Customer-Specific Unit Diurnal reclaimed Water Use Patterns ........................................................................ 4-11
Figure 4-9 West Cary Customer-Specific Unit Diurnal Reclaimed Water Use Patterns ........................................................................ 4-13
Figure 5-1 Optional Routes for Northwest Connector Reclaimed Water Pipeline ............ 5-2
Figure 5-2 Selected Northwest Connector Route and Extended Service Area ............... 5-3
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 5-3</td>
<td>Scenario 1 Reclaimed Water Demand Projections</td>
<td>5-5</td>
</tr>
<tr>
<td>Figure 5-4</td>
<td>Scenario 2 Reclaimed Water Demand Projections</td>
<td>5-6</td>
</tr>
<tr>
<td>Figure 5-5</td>
<td>Scenario 3 Reclaimed Water Demand Projections</td>
<td>5-7</td>
</tr>
<tr>
<td>Figure 5-6</td>
<td>Scenario 4 Reclaimed Water Demand Projections</td>
<td>5-8</td>
</tr>
<tr>
<td>Figure 5-7</td>
<td>Buildout (2060) Maximum Day Reclaimed Water Demand by Service Area</td>
<td>5-11</td>
</tr>
<tr>
<td>Figure 6-1</td>
<td>Reclaimed Water Supply and Demand for the North and West Cary Service Area</td>
<td>6-3</td>
</tr>
<tr>
<td>Figure 6-2</td>
<td>Reclaimed Water Supply and Demand for the South Cary Service Area</td>
<td>6-7</td>
</tr>
<tr>
<td>Figure 6-3</td>
<td>Location of Western Wake WRF</td>
<td>6-9</td>
</tr>
<tr>
<td>Figure 6-4</td>
<td>Reclaimed Water Supply and Demand for the Urban Service Area (Scenario 2)</td>
<td>6-11</td>
</tr>
<tr>
<td>Figure 7-1</td>
<td>Storage Requirements for Supply and Demand Equalization; NCWRF Scenario 1 – 2060 Maximum Day Demand</td>
<td>7-3</td>
</tr>
<tr>
<td>Figure 7-2</td>
<td>Unit Diurnal Reclaimed Water Use Patterns</td>
<td>7-5</td>
</tr>
<tr>
<td>Figure 7-3</td>
<td>Field Test Locations and Data</td>
<td>7-7</td>
</tr>
<tr>
<td>Figure 7-4</td>
<td>Existing Reclaimed Water System; Peak Hour Pressure and Velocity</td>
<td>7-8</td>
</tr>
<tr>
<td>Figure 8-1</td>
<td>Northwest Service Area Scenario 1: 2060 (buildout)</td>
<td>8-3</td>
</tr>
<tr>
<td>Figure 8-2</td>
<td>Northwest Service Area Scenario 3: 2060 (buildout)</td>
<td>8-6</td>
</tr>
<tr>
<td>Figure 8-3</td>
<td>Northwest Service Area Scenario 4: 2060 (buildout)</td>
<td>8-7</td>
</tr>
<tr>
<td>Figure 8-4</td>
<td>South Service Area Scenario 1: 2060 (buildout)</td>
<td>8-9</td>
</tr>
<tr>
<td>Figure 8-5</td>
<td>South Service Area Scenario 3 and 4: 2060 (buildout)</td>
<td>8-11</td>
</tr>
<tr>
<td>Figure 8-6</td>
<td>Service Area Scenario 4: Phase 1 (2020) Improvements</td>
<td>8-14</td>
</tr>
<tr>
<td>Figure 8-7</td>
<td>Service Area Scenario 4: Phase 2 (2030) Improvements</td>
<td>8-17</td>
</tr>
<tr>
<td>Figure 8-8</td>
<td>Service Area Scenario 4: Phase 3 (2060) Improvements</td>
<td>8-18</td>
</tr>
<tr>
<td>Figure 8-9</td>
<td>Model-Simulated Tank Levels for 0.75 MG Baseball Tank</td>
<td>8-21</td>
</tr>
<tr>
<td>Figure 8-10</td>
<td>Model-Simulated Tank Levels for 0.25 MG Baseball Tank</td>
<td>8-21</td>
</tr>
<tr>
<td>Figure 8-11</td>
<td>Proposed 0.5 MG Baseball Tank</td>
<td>8-22</td>
</tr>
<tr>
<td>Figure 9-1</td>
<td>Recommended Capital Improvement Projects by Phase</td>
<td>9-7</td>
</tr>
<tr>
<td>Figure 9-2</td>
<td>Recommended Capital Improvement Projects by Diameter</td>
<td>9-8</td>
</tr>
<tr>
<td>Figure 9-3</td>
<td>Recommended Reclaimed Water Service Area</td>
<td>9-16</td>
</tr>
<tr>
<td>Figure 9-4</td>
<td>HDPE Pipe for Reclaimed Water</td>
<td>9-17</td>
</tr>
<tr>
<td>Figure 9-5</td>
<td>Butt-fused reclaimed water HDPE pipe</td>
<td>9-17</td>
</tr>
</tbody>
</table>