Section 8
Future Reclaimed Water Scenario Evaluation

Four different future demand scenarios were established for the reclaimed water system as part of the Long Range Water Resources Plan (LRWRP). As a first step in evaluating these scenarios, skeletonized improvements including new transmission, storage, and pumping facilities were identified to meet the evaluation criteria for the build-out (2060) planning year. Based on the preliminary evaluation, a preferred planning scenario was selected. Additional hydraulic analyses were performed to refine the sizing and phasing of recommended improvements for the preferred scenario.

8.1 Northwest Cary Service Area

Evaluation of each future scenario is discussed below along with proposed build-out improvements for the Northwest Cary service area.

8.1.1 Scenario 1

Scenario 1 represents a baseline for the reclaimed water system. This scenario provides reclaimed water for all existing and future demands for parcels adjacent to existing and already funded reclaimed water lines. Available reclaimed water supply from the NCWRF is greater than the Scenario 1 demands in the Northwest Cary service area. Maximum day peaking factors presented in Section 5.3 were used for the hydraulic evaluation (3.4 for irrigation use, 2.5 for cooling/heating use, 1.0 for toilet flushing use).

Scenario 1 pipeline improvements include construction of the NW Connector, a new section of pipe to complete a loop along Davis Drive to the NW Connector, a new section of pipe to complete a loop along O’Kelly Chapel Road, and improvements to existing pipelines (upsise or parallel) along Weston Parkway, at Louis Stephens Drive/Little Drive/Davis Drive, and in RTP South along Development Drive, as shown in Figure 8-1. The pipe diameters in Figure 8-1 represent pipe replacement size for improvements to existing pipelines. It should be noted that this scenario does not provide redundancy for the NW Connector between Weston Parkway and Davis Drive, which would present operational challenges should this pipe experience a break or need to be removed from service for repairs.

Establishment of a lower pressure zone in the western portion of the system (West pressure zone) is recommended to mirror the potable water pressure zone boundary. The Town anticipates moving the potable water pressure zone boundary to Highway 55. Therefore, Highway 55 was considered the dividing line between the two reclaimed water pressure zones. Two pressure reducing valves (PRVs) would be required to establish the new pressure zone, one along the NW Connector at Highway 55 and one along Green Level Church Road just south of Kit Creek Road. The placement of the second PRV would allow reclaimed water from the Durham County TWWTP to be provided as an emergency backup to the primary pressure zone (Central pressure zone).

The minimum storage volume requirement for this scenario is 1.4 million gallons (MG), as provided in Table 8-1. An existing 1 MG of ground storage is located at the NCWRF. A new 0.25 MG storage tank is proposed near the Thomas Brooks Park. An additional 0.75 MG of storage is proposed in the Central pressure zone, along the NW Connector near Davis Drive.
Table 8-1. Minimum Storage Volume by Scenario (2060 Demands)

<table>
<thead>
<tr>
<th></th>
<th>Scenario 1</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northwest Cary Service Area</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Supply/Demand Equalization¹ (MG)</td>
<td>1.1</td>
<td>3.8</td>
<td>3.8</td>
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<tr>
<td>Reserve² (MG)</td>
<td>0.3</td>
<td>0.6</td>
<td>0.6</td>
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<tr>
<td><strong>Total (MG)</strong></td>
<td>1.4</td>
<td>4.4</td>
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<td><strong>South Cary Service Area</strong></td>
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</tr>
<tr>
<td>Supply/Demand Equalization¹ (MG)</td>
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<td>0.1</td>
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<tr>
<td>Reserve² (MG)</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total (MG)</strong></td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

1) Equalization storage requirement determined by comparing diurnal reclaimed water supply pattern on the minimum wastewater flow day with the 24-hour diurnal demand pattern on the maximum reclaimed water demand day.
2) Reserve storage volume is equal to 2 hours of max month demand.

The Scenario 1 maximum day demand is 5.3 mgd. The required peak hour pumping rate at the NCWRF, as determined from the hydraulic model, is approximately 6.5 mgd, assuming the recommended storage facilities have been implemented. The firm capacity of this station (with one large pump out of service) is 8.5 mgd. Therefore, improvements to the reclaimed water high service pumps are not required for this scenario.

**8.1.2 Scenario 2**

Scenario 2 includes reclaimed water service throughout the entire Town of Cary Urban Service Area. Scenario 2 demands exceed the combined reclaimed water supply from both the NCWRF and SCWRF. A peak demand management program would not be sufficient to allow the existing reclaimed water supply sources to serve the entire Urban Service Area. Without significant quantities of seasonal storage (i.e. quarry-type storage) or purchase of additional reclaimed water from another supplier, it would not be feasible to implement this scenario. A rule-of-thumb commonly used in Florida (which utilizes year-round irrigation) to estimate the maximum extent of a reclaimed water system is that it requires wastewater from four homes to generate enough reclaimed water for one user.

Even with additional supply of reclaimed water, extensive infrastructure would be needed to distribute reclaimed water throughout the entire Urban Service Area. An entirely new distribution system, essentially parallel to the potable distribution system, would need to be constructed to serve the entire Urban Service Area with reclaimed water. The cost of this infrastructure alone would likely make this scenario not feasible.

Since it was determined that Scenario 2 is not a viable option for the future of the Town’s reclaimed water system, no hydraulic evaluation was performed.

**8.1.3 Scenario 3**

Scenario 3 represents the maximum reclaimed water use within the 2010 adopted reclaimed water service area (defined in Policy Statement 132) as well as the proposed service area adjacent to the NW Connector. Based on the existing maximum day peaking factors (3.4 for irrigation use, 2.5 for cooling/heating use, 1.0 for toilet flushing use), the NCWRF will not be able to supply enough reclaimed water to meet the maximum day demand for Scenario 3. However, if irrigation peaking
Figure 8-1
Northwest Service Area Scenario 1: 2060 (buildout)

Legend
- Customer Demands (2060)
  - Existing Reclaimed Water Meter
  - New Reclaimed Water Meter
- New Infrastructure
  - New Reclaimed Water Tank
  - Pressure Reducing Valve
  - New Reclaimed Water Pipes
    - 6-inch diameter
    - 8-inch diameter
    - 10-inch diameter
    - 12-inch diameter
    - 16-inch diameter
    - 20-inch diameter
- Existing System
  - Existing Reclaimed Water Lines
  - 8 to 10-inch diameter
  - 12-inch diameter
  - 16 to 20-inch diameter
  - 21 to 24-inch diameter
- Scenario 1 Service Area
  - Central Pressure Zone
  - West Pressure Zone
  - County Boundary

No Supply from Durham County

- ~0.25 MG tank at Thomas Brooks Park
- ~0.75 MG tank

Total Maximum Day Demand = 5.3 mgd
Maximum Day Demand Peaking Factors:
- Irrigation = 3.4
- Cooling/Heating = 2.5
- Toilet = 1.0
factors are reduced, it may be possible to extend the system to serve the entire Scenario 3 service area with the available reclaimed water supply at the NCWRF. In the future, a significant peaking factor reduction may be achievable due to technological advances in irrigation efficiency, landscape management practices that require less water, increased use of alternative waters including graywater or stormwater, or other changes in water usage patterns. Therefore, Scenario 3 was evaluated as a future possibility assuming the following peaking factors: 2.3 for irrigation use; 2.5 for cooling/heating use; 1.0 for toilet flushing use. The resulting maximum day demand for the Northwest Cary service area is the same as the supply capacity at the NCWRF for the build-out (2060) planning period.

Scenario 3 pipeline improvements include new transmission/distribution main extensions along existing and planned transportation thoroughfares to serve demands throughout the extent of the service area. Improvements to existing pipelines (upsise or parallel) are required for the transmission mains along the following routes identified on Figure 8-2:

- NCWRF along Weston Parkway to Evans Road
- Louis Stephens Drive/Little Drive/Davis Drive
- RTP South along Development Drive
- Western section of McRimmon Parkway through the Amberly neighborhood.

The pipe diameters in Figure 8-2 represent pipe replacement size for improvements to existing pipelines (the new pipeline and existing pipeline are shown concurrently on the figure).

Establishment of a lower pressure zone in the western portion of the system (West pressure zone) is recommended to mirror the potable water pressure zone boundary. The Town anticipates moving the potable water pressure zone boundary to Highway 55. Therefore, Highway 55 was considered the dividing line between the two reclaimed water pressure zones. Two pressure reducing valves (PRVs) would be required to establish the new pressure zone: one along the NW Connector at Highway 55 and one along Green Level Church Road just south of Kit Creek Road. The placement of the second PRV would allow reclaimed water from the TWWTP to be provided as an emergency backup to the primary pressure zone (Central pressure zone).

The minimum storage volume requirement for this scenario is 4.4 MG, as provided in Table 8-1. An existing 1 MG of ground storage is located at the NCWRF. The following additional storage facilities are recommended:

- Thomas Brooks Park – Approximately 1 MG storage to serve the West pressure zone.
- Highway 54 – Approximately 1.5 MG storage to serve the central portion of the reclaimed water system in the Central pressure zone and serve the West pressure zone. Due to losses in the primary transmission main through the reclaimed water system and topography of the service area, this storage would not be hydraulically effective for the existing North Cary service area (which has the highest elevation in the system) during periods of peak demand.
- NCWRF – Approximately 1 MG additional storage at the NCWRF to supplement the existing one-million-gallon ground tank and proposed distribution system storage facilities as well as serve the existing North Cary service area.
The Scenario 3 maximum day demand is 9.6 mgd assuming peaking factors have been reduced so that the maximum day demand is equal to the available supply. The required peak hour pumping rate at the NCWRF, as determined from the hydraulic model, is approximately 12.0 mgd assuming the recommended storage facilities have been implemented. The firm capacity of this station (with one large pump out of service) is 8.5 mgd. Therefore, improvements to the reclaimed water high service pumps are required for this scenario.

### 8.1.4 Scenario 4

Scenario 4 limits the demand on the reclaimed water system to the maximum available supply from the NCWRF assuming the existing maximum day peaking factors presented in Section 5.3 (3.4 for irrigation use, 2.5 for cooling/heating use, 1.0 for toilet flushing use). Reclaimed water is provided for as much of the 2010 adopted service area and proposed service area adjacent to the NW Connector as is available through 2060. This scenario was developed in two parts. Scenario 4.1 represents the primary portion of the area to be served under Scenario 4. Additional secondary demands that may be added to the reclaimed water system on a first-come, first-served basis are identified under Scenario 4.2. For the hydraulic analysis, all of the Scenario 4.2 areas were included when routing and sizing future reclaimed water pipelines. However, the demands were limited to the supply capacity when evaluating storage and pumping needs. The overall Scenario 4 maximum day demand is the same as for Scenario 3 since both demands are limited by the available supply from the NCWRF; therefore, the overall storage and pumping needs for both scenarios are the same. However, Scenario 3 extends the reclaimed water distribution infrastructure to more customers since it is assumed that the maximum day peaking factors are reduced.

Similar to the previous scenario, Scenario 4 pipeline improvements include new transmission/distribution main extensions along existing and planned transportation thoroughfares to serve demands throughout the extent of the service area. Improvements to existing pipelines (upsizing or parallel) are required for the transmission mains along the following routes shown on Figure 8-3:

- NCWRF along Weston Parkway to Evans Road
- Louis Stephens Drive/Little Drive/Davis Drive
- RTP South along Development Drive
- Western section of McRimmon Parkway through the Amberly neighborhood.

The pipe diameters in Figure 8-3 represent pipe replacement size for improvements to existing pipelines (the new pipeline and existing pipeline are shown concurrently on the figure).

Establishment of a lower pressure zone in the western portion of the system (West pressure zone) is recommended to mirror the potable water pressure zone boundary. The Town anticipates moving the potable water pressure zone boundary to Highway 55. Therefore, Highway 55 was considered the dividing line between the two reclaimed water pressure zones. Two pressure reducing valves (PRVs) would be required to establish the new pressure zone, one along the NW Connector at Highway 55 and one along Green Level Church Road just south of Kit Creek Road. The placement of the second PRV would allow reclaimed water from the TWWTP to be provided as an emergency backup to the primary pressure zone (Central pressure zone).
No Supply from Durham County

No Supply from Durham County

~1.5 MG tank

~1.0 MG tank at Thomas Brooks Park

Existing WW Force Main to be converted to Reclaimed Water

Upgrade Pumping Capacity at NCWRF

Additional Storage at NCWRF (~1.0 MG)

Legend

Customer Demands (2060)
- Existing Reclaimed Water Meter
- New Reclaimed Water Meter

New Infrastructure
- New Reclaimed Water Tank
- Pressure Reducing Valve
- New Reclaimed Water Pipes
  - 6-inch diameter
  - 8-inch diameter
  - 10-inch diameter
  - 12-inch diameter
  - 16-inch diameter
  - 20-inch diameter
  - 24-inch diameter
  - 30-inch diameter

Existing System

- Existing Treatment Plants
- Existing Reclaimed Water Lines
  - 4 to 6-inch diameter
  - 8 to 10-inch diameter
  - 12-inch diameter
  - 16 to 20-inch diameter
  - 21 to 24-inch diameter
- New Reclaimed Water Meter
- New Reclaimed Water Tank
- Pressure Reducing Valve
- New Reclaimed Water Pipes
  - 6-inch diameter
  - 8-inch diameter
  - 10-inch diameter
  - 12-inch diameter
  - 16-inch diameter
  - 20-inch diameter
  - 24-inch diameter
  - 30-inch diameter

Existing Reclaimed Water Lines
- 4 to 6-inch diameter
- 8 to 10-inch diameter
- 12-inch diameter
- 16 to 20-inch diameter
- 21 to 24-inch diameter

Scenario 3 Service Area

Central Pressure Zone

West Pressure Zone

County Boundary

Scenario 3 Service Area

Northwest Service Area Scenario 3: 2060 (buildout)

(Assumes reduction of peaking factors is achieved so demand is equal to available supply)

Figure 8-2

Total Maximum Day Demand = 9.6 mgd

Maximum Day Demand Peaking Factors:
- Irrigation = 2.3
- Cooling/Heating = 2.5
- Toilet = 1.0
~0.5 MG tank at Thomas Brooks Park

No Supply from Durham County

~2.0 MG tank

Legend
Customer Demands (2060)
- Existing Reclaimed Water Meter
- New Reclaimed Water Meter
- Scenario 4: New Reclaimed Water Meter

Existing System
- Treatment Plants
- Existing Reclaimed Water Lines

New Infrastructure
- New Reclaimed Water Tank
- Pressure Reducing Valve
- New Reclaimed Water Pipes
- 6-inch diameter
- 8-inch diameter
- 10-inch diameter
- 12-inch diameter
- 15-inch diameter
- 20-inch diameter
- 24-inch diameter
- 30-inch diameter

Scenario 4 Service Area
- Central Pressure Zone
- West Pressure Zone
- County Boundary

Upgrade Pumping Capacity at NCWRF

Additional Storage at NCWRF (~1.0 MG)

Existing WW Force Main to be converted to Reclaimed Water

Scenario 4
Total Maximum Day Demand = 9.6 mgd
Maximum Day Demand Peaking Factors:
- Irrigation = 3.4
- Cooling/Heating = 2.5
- Toilet = 1.0

Figure 8-3
Northwest Service Area Scenario 4: 2060 (buildout)
The minimum storage volume requirement for this scenario is 4.4 MG, as provided in Table 8-1. An existing 1 MG of ground storage is located at the NCWRF. The following additional storage facilities are recommended. The recommended storage volumes are slightly different from Scenario 3 recommendations due to the geographic distribution of demands within the service area.

- **Thomas Brooks Park** – Approximately 0.5 MG storage to serve the West pressure zone. This storage volume is less than Scenario 3 since less of the overall demand is in the West pressure zone as compared with Scenario 3.

- **Highway 54** – Approximately 2 MG storage to serve the central portion of the reclaimed water system in the Central pressure zone and serve the West pressure zone. Due to losses in the primary transmission main through the reclaimed water system and topography of the service area, this storage would not be hydraulically effective for the existing North Cary service area (which has the highest elevation in the system) during periods of peak demand.

- **NCWRF** – Approximately 1 MG additional storage at the NCWRF to supplement the existing one-million-gallon ground storage tank and proposed distribution system storage, especially for the eastern portion of service area.

The required peak hour pumping rate at the NCWRF is approximately 12.0 mgd. The firm capacity of this station (with one large pump out of service) is 8.5 mgd assuming the recommended storage facilities have been implemented. Therefore, improvements to the reclaimed water high service pumps are required for this scenario.

**8.2 South Cary Service Area**

Evaluation of each future scenario is discussed below along with proposed build-out improvements for the South Cary service area.

**8.2.1 Scenario 1**

Scenario 1 provides reclaimed water for all existing and future demands for parcels adjacent to existing reclaimed water lines. Scenario 1 demands in the South Cary service area are similar to the existing demands, with only a few additional customers added, as shown in Figure 8-4. Therefore, no infrastructure improvements are needed for this scenario.

**8.2.2 Scenario 2**

Scenario 2 includes reclaimed water service throughout the entire Town of Cary Urban Service Area. Since it was determined that Scenario 2 is not a viable option for the future of the Town’s reclaimed water system, no hydraulic evaluation was performed (as discussed in Section 8.1.2).

**8.2.3 Scenario 3 and 4**

Scenario 3 includes reclaimed water service to the 2010 adopted South Cary reclaimed water service area (defined in Policy Statement 132). Available reclaimed water supply from the SCWRF is greater than the total Scenario 3 demands in the South Cary service area. Maximum day peaking factors presented in Section 5.3 were used for the hydraulic evaluation (3.4 for irrigation use, 2.5 for cooling/heating use, 1.0 for toilet flushing use). Since the future demands of the entire 2010 adopted South Cary service area can be met without reduction in peaking factor, Scenario 3 is identical to Scenario 4 (defined as limiting demands in the service area to the available supply) for the South Cary reclaimed water system.
Customer Demands (2060)
- Existing Reclaimed Water Meter
- New Reclaimed Water Meter

Existing System
- Treatment Plants

Existing Reclaimed Water Lines
- 4 to 6-inch diameter
- 8-inch diameter
- 12-inch diameter

Scenario 1 Service Area

Scenario 1
Total Maximum Day Demand = 0.6 mgd
Maximum Day Demand Peaking Factors:
- Irrigation = 3.4

Figure 8-4
South Service Area Scenario 1: 2060 (buildout)
Scenario 3 pipeline improvements include new transmission/distribution main extensions along existing and planned transportation thoroughfares to serve demands throughout the extent of the service area. Improvements to existing pipelines (upsize or parallel) are required for the transmission main from the SCWRF along West Lake Road to Optimist Farm Road and west along Optimist Farm Road, as shown in Figure 8-5. The pipe diameters in Figure 8-5 represent pipe replacement size for improvements to existing pipelines.

The minimum storage volume requirement for this scenario is 0.2 MG, as provided in Table 8-1. Since the SCWRF has greater reclaimed water supply capacity relative to the demands, minimal supply/demand equalization storage is required. An existing 0.5 MG of ground storage is located at the SCWRF. However, since the topography of the South Cary service area increases in elevation to the north, with the SCWRF at the lowest elevation, additional storage (approximately 0.5 MG) is recommended in the distribution system to maintain adequate pressure during periods of peak demand in the portion of the service area north of the proposed Highway 540 corridor.

The Scenario 3 and 4 maximum day demand is 1.7 mgd. The required peak hour pumping rate at the SCWRF, as determined from the hydraulic model, is approximately 2.0 mgd, assuming the recommended storage facility has been implemented. The firm capacity of this station (with one large pump out of service) is 0.7 mgd. Therefore, improvements to the reclaimed water high service pumps are required for this scenario.

### 8.3 Preferred Scenario Phasing and Alternatives

Based on the evaluation of the scenarios discussed in Sections 8.1 and 8.2, the following conclusions were made:

- Scenario 1 represents minimal growth of the reclaimed water system and would result in downsizing the 2010 adopted reclaimed water service area.
- Scenario 2 is not feasible for the Town due to supply limitations and extensive infrastructure requirements.
- Scenario 3 over-commits reclaimed water supply from the NCWRF, although this scenario may be realistic depending on trends in future water conservation and water use practices.
- Scenario 4 represents the maximum growth of the reclaimed water system assuming that current water use practices continue into the future. Since Scenario 4 is the most practical approach to maximizing the reclaimed water system based on current information, the Town selected Scenario 4 as the preferred scenario for master planning purposes. However, future funding, the extent of actual development and growth, and economies of reclaimed water use from a customer perspective may make one of the other scenarios more desirable in the future.

The following sections provide detailed evaluation and phasing for Scenario 4.
Upgrade Pumping Capacity at SCWRF

Scenario 3 & 4
Total Maximum Day Demand = 1.7 mgd
Maximum Day Demand Peaking Factors:
Irrigation = 3.4
Cooling/Heating = 2.5
Toilet = 1.0

Figure 8-5
South Service Area Scenario 3 & 4: 2060 (buildout)
8.3.1 Phasing Approach
Scenario 4 recommendations were developed in three phases:

- Phase 1 (implementation by 2020)
- Phase 2 (implementation between 2020 and 2030)
- Phase 3 (implementation between 2030 and 2060).

The planning year demand projections presented in Section 5 account for overall demands within the entire service area. However, in actuality, the reclaimed water infrastructure within the service area will be extended over time, to ultimately reach all potential customers within the service area by buildout (Phase 3). The strategy for extending the reclaimed water system over three phases is discussed below. Hydraulic model simulations were performed for each phase for both maximum day demand conditions as well as summer seasonal demand conditions (average of May through October).

In the future, the Town may wish to revise some of the reclaimed water system phasing to more closely match the planned construction of major transportation thoroughfares when the schedule for transportation improvements is refined. Construction of new reclaimed waterlines in conjunction with roadway construction, where possible, would be advantageous in terms of cost and ease of construction.

8.3.2 Phase 1 (Implementation by 2020)
After 2020, the projected average day reclaimed water demands in the existing West Cary service area will exceed the average day supply of 0.7 mgd from the TWWTP. Therefore, the Town will need to provide reclaimed water from the NCWRF to the West Cary service area to serve projected demands by 2020. Construction of the NW Connector pipeline to bring reclaimed water from the NCWRF to the west is the main focus of the Phase 1 improvements. Town staff indicated that the future section of McCrimmon Parkway between Louis Stephens Drive and Highway 55 may not be constructed within the time frame of Phase 1. The selected route for the NW Connector pipeline runs along this section of future roadway. Therefore, an alternate route along Davis Drive, Little Drive, and O'Kelly Chapel Road was identified to provide a connection between the NW Connector at McCrimmon Parkway and the JLWRP pipeline on Green Level Church Road in Phase 1. No improvements in the South Cary service area are recommended in Phase 1.

Phase 1 demand projections are presented in Table 8-2. These demands differ from the overall LRWRP demand projections, since only demands for customers directly adjacent to the NW Connector and existing reclaimed water pipelines will be added as well as some retrofit for customer demands in the Amberly and Stonewater neighborhoods.
Table 8-2. Scenario 4 Reclaimed Water Demand Projections by Phase (in mgd)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Demand</th>
<th>Northwest Cary Service Area</th>
<th>South Cary Service Area</th>
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<tr>
<td></td>
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<td>CPZ(^1)</td>
<td>WPZ(^2)</td>
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<td>Phase 1 (2020)</td>
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<td>Summer(^2)</td>
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<td>0.6</td>
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<td></td>
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<td>1.3</td>
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<td>Phase 2 (2030)</td>
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<td></td>
<td>MDD(^3)</td>
<td>3.1</td>
<td>2.4</td>
</tr>
<tr>
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<tr>
<td></td>
<td>Summer(^2)</td>
<td>3.3</td>
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</tr>
<tr>
<td></td>
<td>MDD(^3)</td>
<td>5.7</td>
<td>3.9</td>
</tr>
</tbody>
</table>

1) AAD = Average Annual Demand
2) Summer = May-October Average Seasonal Demand = (1.6 x AAD)
3) MDD = Maximum Day Demand
4) CPZ = Central Pressure Zone. NCWRF demand included in the overall CPZ demand.
5) WPZ = West Pressure Zone.
6) Breakout between CPZ and WPZ is approximate for Phase 3. Actual demand in the pressure zone will depend on which areas of Scenario 4.2 are included in the reclaimed water system.

The following Phase 1 improvements are recommended and identified on Figure 8-6:

- **Transmission/Distribution** – The primary transmission improvements include construction of the NW Connector between Weston Parkway and Davis Drive and a new pipeline on Davis Drive, Little Drive, and O’Kelly Chapel Road to connect the NCWRF and West Cary service area. A 12-inch diameter section of pipeline along Little Drive has already been installed under Highway 540 and another 12-inch diameter section between the railroad and Highway 55 is planned to be installed by a developer. Installation of additional sections to comprise a 16-inch diameter pipeline between McRimmon Parkway and Highway 540 and 12-inch diameter pipeline between Highway 540 and Green Level Church Road will be adequate to meet demands in the West Cary service area through Phase 1. Completion of the NW Connector between Davis Drive and Green Level Church Road is recommended in a future phase. In addition, pipeline looping and improvements in the Amberly/ Stonewater neighborhoods are recommended to address excessive velocity/headloss in the existing 6-inch diameter pipeline.

- **Pressure Zone** – With completion of a pipeline connecting the NCWRF and West Cary service area, PRVs are recommended at the Highway 55 and O’Kelly Chapel Road intersection and just south of the Green Level Church Road and Kit Creek Parkway intersection to establish a reduced pressure zone in the western portion of the service area.

- **Storage** – Distribution system storage at the Thomas Brooks Park/USA Baseball Complex location is recommended to maintain adequate pressure for the USA Baseball Complex and provide emergency storage for the West pressure zone. Storage alternatives are discussed in detail in Section 8.3.5.

- **Pumping** – No pumping capacity improvements are needed at the NCWRF in Phase 1.
Durham County supply discontinued by 2020

PRV & Flow Control Valve

~0.5 MG tank at Thomas Brooks Park

Figure 8-6 Northwest Service Area Scenario 4: Phase 1 (2020) Improvements
Peak hour pressures and pipe velocities for Phase 1 improvements under maximum day demand conditions are presented in Figure F-1 in Appendix F for the Northwest Cary service area. All nodes have peak hour pressures greater than 50 psi and peak hour velocities are less than 5 fps. Maximum node pressures during the summer seasonal demand conditions are presented in Figure F-2 in Appendix F. Due to the topography of the service area, some node pressures exceed 120 psi; however, pressures are not predicted to exceed 140 psi. Individual service connections may require PRVs to reduce pressure at the delivery point.

8.3.3 Phase 2 (Implementation between 2020 and 2030)

Phase 2 adds pipeline looping to both the Northwest and South Cary service areas to provide redundancy in the distribution system as well as extend reclaimed water service to additional areas. Phase 2 demand projections are presented in Table 8-2. Demand projections assume all additional future development through 2030 adjacent to existing and new reclaimed water pipelines is served as well as retrofit for customers adjacent to new reclaimed water pipelines.

The following Phase 2 improvements recommended and identified on Figure 8-7:

- **Transmission/Distribution** – For the Northwest Cary service area, the following new distribution loops are recommended:
  - Along Mason Farm Road and Chapel Hill Road
  - Between Evans Drive and NW Cary Parkway and through the Weston Pointe neighborhood
  - Along the proposed road between Thomas Brooks Park storage and the NW Connector
  - Along Carpenter Fire Station Road through the Cameron Pond and Cary Park neighborhoods
  - Completion of the NW Connector on McCrimmon Parkway between Davis Drive and Green Level Church Road. By 2030, the 12-inch connection on Little Drive and O’Kelly Chapel Road will not be adequate to serve the West pressure zone.

  To avoid excessive velocities and headloss, pipe improvements are recommended for the existing pipeline near the NCWRF on Old Reedy Creek Road.

  For the South Cary service area, new distribution loops are recommended:
  - Along Optimist Farm Road, Pierce Olive Road, a proposed road, and back to Middle Creek Park Avenue
  - Through the Heritage and Woodlands neighborhoods.

- **Storage** – Distribution system storage in the Northwest Cary service area near Highway 54 is recommended to help supply water during peak demand periods and provide emergency storage for the central portion of the reclaimed water system in the Central pressure zone and the West pressure zone. Storage alternatives are discussed in detail in Section 8.3.5.

- **Pumping** – The existing SCWRF reclaimed water pump station will require an upgrade to a 2.0 mgd firm capacity pump station. Storage pumping requirements are discussed in Section 8.3.5.
Peak hour pressures and pipe velocities for Phase 2 improvements under maximum day demand conditions are presented in Figures F-3 and F-4 in Appendix F for the Northwest and South Cary service areas, respectively. All nodes have peak hour pressures greater than 50 psi and peak hour velocities are less than 6 fps. Maximum node pressures during the summer seasonal demand conditions are presented in Figure F-5 and F-6 in Appendix F. Due to the topography of the service areas, some node pressures exceed 120 psi; however, pressures are not predicted to exceed 150 psi. Maximum pressures in the RTP South area are projected to increase slightly due to the change of the pressure zone boundary for this section of the service area. Individual service connections may require PRVs to reduce pressure at the delivery point.

### 8.3.4 Phase 3 (Implementation between 2030 and 2060)

Phase 3 includes the remaining recommended transmission/distribution main extensions along existing and planned transportation thoroughfares to serve demands throughout the extent of the Northwest and South Cary service areas. Phase 3 demand projections are presented in Table 8-2. Demand projections assume all additional future development through 2060 adjacent to existing and new reclaimed water pipelines is served as well as retrofit for customers adjacent to new reclaimed water pipelines.

The following Phase 3 improvements are recommended and identified on Figure 8-8:

- **Transmission/Distribution** – For the Northwest Cary service area, new distribution loops are recommended primarily in the following areas:
  - In the eastern-most portion of the service area along Harrison Avenue and near SAS
  - Along existing and proposed transportation thoroughfares throughout north and central Morrisville
  - From RTP South through the Breckenridge neighborhood
  - In the central and southern portion of the West pressure zone.

To avoid excessive velocities and headloss, pipe improvements are recommended for the existing transmission main along Weston Parkway and in RTP South along Development Drive.

The existing 16-inch diameter wastewater force main located along Green Level Church Road, which is anticipated to be converted to a reclaimed waterline, is also included in the Phase 3 improvements. This pipeline could be implemented sooner assuming there is sufficient demand for reclaimed water in the vicinity of the pipeline.

For the South Cary service area, new distribution loops are recommended along existing and proposed transportation thoroughfares throughout the northern and eastern portion of the service area. To avoid excessive velocities and headloss, pipe improvements are recommended for the existing transmission main from the SCWRF along West Lake Road to Optimist Farm Road and west along Optimist Farm Road.

- **Storage** – Additional storage in the Northwest Cary service area at the Highway 54 site is recommended as peak demands increase in the central portion of the reclaimed water system in the Central pressure zone and the West pressure zone. Additional storage is also recommended at the NCWRF to supplement distribution system storage. Storage requirements are discussed in Section 8.3.5.
Northwest Service Area Scenario 4: Phase 2 (2030) Improvements

Legend
- Customer Demand Point
- Treatment Plants
- Existing Reclaimed Water Lines
- New Infrastructure
  - Phase 2 (2030)
    - Storage Tank
    - Pressure Reducing Valve
    - Reclaimed Water Lines
  - Phase 1
    - Storage Tank
    - Pressure Reducing Valve
    - Reclaimed Water Lines

Reclaimed Water Service Area
- Central Pressure Zone (620 ft)
- West Pressure Zone (560 ft)
- South Cary Service Area
- County Boundary

Upgrade Pumping Capacity at SCWRF
Additional 1.0 MG Storage & Upgrade Pumps

Upgrade Pumping Capacity at NCWRF

Additional Storage at NCWRF (1.0 MG)

Existing WW Force Main to be converted to Reclaimed Water

Legend
- Customer Demand Point
- Treatment Plants
- Existing Reclaimed Water Lines
- New Infrastructure
- Phase 3 (2060)
- Storage Tank
- New Reclaimed Water Lines
- Phase 1 & 2
- Pressure Reducing Valve
- Reclaimed Water Lines

Reclaimed Water Service Area
- Central Pressure Zone (620 ft)
- West Pressure Zone (560 ft)
- South Cary Service Area
- County Boundary

Figure 8-8
Northwest Service Area Scenario 4: Phase 3 (2060) Improvements

Northwest Cary Service Area

South Cary Service Area
Distribution system storage is recommended in the South Cary to maintain adequate pressure during periods of peak demand in the portion of the service area north of the proposed Highway 540 corridor.

- **Pumping** – Pumping upgrades are required at the NCWRF to provide a firm capacity of 12.0 mgd. This can be accomplished by replacing the existing two small (150 hp) pumps with two new 300 hp pumps. Storage pumping requirements are discussed in Section 8.3.5.

Peak hour pressures and pipe velocities for Phase 3 improvements under maximum day demand conditions are presented in Figures F-7 and F-8 in Appendix F for the Northwest and South Cary service areas, respectively. Modeled nodes generally have peak hour pressures greater than 50 psi. However, two nodes along Harrison Avenue, which are located at the highest elevation in the Northwest service area, have peak hour pressures between 45 and 50 psi. Similarly, peak hour pressures for the node at the intersection of Pierce Olive Road and Holly Springs Road in the South Cary service area are between 45 and 50 psi. Improvements are not recommended to increase pressures for the few future customers in these areas. However, the Town should consider the pressure range at these high elevation locations when planning to extend reclaimed water service to customers in these areas. Lower pressures at the point of delivery may be mitigated by increasing the service connection pipe size to minimize headloss.

Peak hour velocities are less than 5 fps in both service areas. Maximum node pressures during the summer seasonal demand conditions are presented in Figure F-9 and F-10 in Appendix F. Due to the topography of the service areas, some node pressures exceed 120 psi; however, pressures are not predicted to exceed 150 psi. Individual service connections may require PRVs to reduce pressure at the delivery point.

### 8.3.5 Storage Alternatives

The general reclaimed water storage requirements are provided in the previous sections. However, additional analysis was performed to determine the appropriate sizing, phasing, and type of storage. **Table 8-3** summarizes the minimum storage volume by phase for Scenario 4.

<table>
<thead>
<tr>
<th></th>
<th>NorthWest Cary Service Area</th>
<th>South Cary Service Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phase 1</td>
<td>Phase 2</td>
</tr>
<tr>
<td>Supply/Demand Equalization¹ (MG)</td>
<td>0.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Reserve² (MG)</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total (MG)</strong></td>
<td>1.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>

1) Equalization storage requirement determined by comparing diurnal reclaimed water supply pattern on the minimum wastewater flow day with the 24-hour diurnal demand pattern on the maximum reclaimed water demand day.

2) Reserve storage volume is equal to 2 hours of max month demand.
**Thomas Brooks Park Baseball Tank**

The Town expressed desire for a “signature” elevated sphere-shaped tank at the Thomas Brooks Park/USA Baseball Training Complex that would be painted to look like a baseball. Based on pressure requirements through the USA Baseball field irrigation system, the minimum operating level of the tank should be a hydraulic grade line (HGL) elevation of 515 feet.

Preliminary schematics for tank geometry were obtained from CB&I. Tank volumes of both 0.75 MG and 0.25 MG were simulated in the hydraulic model to determine how the elevated tank would operate during different demand conditions. Figure 8-9 shows the simulated 0.75 MG tank levels over a 24-hour period for Phase 1 and Phase 3 demands for both maximum day and summer seasonal average demand conditions. **Figure 8-10** presents a similar plot for a smaller 0.25 MG tank. Since reclaimed water demands in the West pressure zone fluctuate significantly both seasonally and over the planning horizon of the master plan, the elevated tank does not achieve adequate turnover during lower demand periods.

Decreasing the size of the tank does not help significantly with turnover during periods of low demand since the HGL through the West pressure zone does not decrease enough during periods of low demand to allow the tank to drain. Additionally, a 0.25 MG tank would empty completely during peak demand periods. Due to the elevation at the proposed tank location, tank geometry, and requirement for a minimum operating water level elevation of 515 feet, the elevated tank would be over 200 feet tall, which would require Federal Aviation Administration (FAA) approval for construction.

Several alternatives were identified to improve the effectiveness of storage at the Thomas Brooks Park:

1) Install a ground storage tank with booster pump at this location instead of an elevated tank. This would allow control over the tank fill/drain cycles to avoid water quality issues, but would add operational cost of another pump station.

2) Install an elevated tank at a lower height with booster pumps to pump out of the storage facility. This would decrease the overall height of the tank and allow for control over the fill/drain cycles while still maintaining the signature baseball aesthetic.

3) Add a flow control valve in conjunction with the PRV into the West pressure zone to allow operators to limit flow into the West pressure zone during periods of low demand to induce turnover of the elevated tank and then increase flow into the pressure zone to fill the tank. During winter, when demands are very low, the tank would need to be removed from service to avoid water quality issues.

Ultimately, the Town selected the third option as the preferred storage alternative for this site. An elevated storage volume of 0.5 MG was selected to balance the near-term and ultimate storage volume needed in the West pressure zone. As demands increase in the future, additional storage in the Central pressure zone would be available to supplement the elevated baseball storage in the West pressure zone. **Figure 8-11** shows a preliminary schematic of the proposed 0.5 MG baseball tank. Since this tank will exceed 200 feet in height, the Town should investigate the FAA regulations prior to proceeding with design. The Town’s sign ordinances should also be considered with respect to the baseball tank.
0.75 MG Baseball Tank
(Sphere-shaped; 45 ft head range; Low Water Level=515 ft; High Water Level=560 ft)

- Blue: Phase 1 - Seasonal Avg Demand (May-Oct)
- Orange: Phase 1 - Max Day
- Green: Phase 3 - Seasonal Avg Demand (May-Oct)
- Red: Phase 3 - Max Day

Figure 8-9
Model-Simulated Tank Levels for 0.75 MG Baseball Tank

0.25 MG Baseball Tank
(Sphere-shaped; 45 ft head range; Low Water Level=515 ft; High Water Level=560 ft)

- Blue: Phase 1 - Seasonal Avg Demand (May-Oct)
- Orange: Phase 1 - Max Day
- Green: Phase 3 - Seasonal Avg Demand (May-Oct)
- Red: Phase 3 - Max Day

Figure 8-10
Model-Simulated Tank Levels for 0.25 MG Baseball Tank
Figure 8-11
Proposed 0.5 MG Baseball Tank

Source: CB&I
Based on the tank geometry, the overflow elevation of the tank, and hence the HGL elevation of the West pressure zone, is 560 feet. Therefore, the PRVs for the West pressure zone should be set accordingly.

A flow control valve is recommended along the primary pipeline connecting the NCWRF with the West Cary service area to limit flow into the West pressure zone during periods of low demand. In Phase 1, a flow control valve is recommended with the PRV at Highway 55 and O’Kelly Chapel Road. Once the NW Connector is implemented in Phase 2, a second flow control valve is recommended with the PRV at Highway 55 and McRimmon Parkway. The flow throttling range for the valves is 0.5 to 3.0 mgd, depending on the demand conditions. Table 8-4 lists the maximum combined flow setting for the valves while the baseball tank is draining as simulated in the hydraulic model for various demand conditions. The valves should be equipped with SCADA operation capabilities to allow remote control by operators.

Annual shut-down of the baseball tank will also be required in the winter.

### Table 8-4. Modeled Flow Control Valve Settings for Baseball Tank Operations

<table>
<thead>
<tr>
<th>Phase ¹</th>
<th>Demand ²</th>
<th>Maximum Flow Setting while Tank is Draining (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Summer</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>MDD</td>
<td>n/a ³</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Summer</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>MDD</td>
<td>3.0</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Summer</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>MDD</td>
<td>n/a ³</td>
</tr>
</tbody>
</table>

1) For Phase 1, flow control is through the valve at O’Kelly Chapel Road; for Phase 2, flow control is through the valves at McRimmon Parkway & O’Kelly Chapel Road.
2) Summer = May-October Average Seasonal Demand; MDD = Maximum Day Demand
3) Flow throttling is not required for tank operations for Phase 1 MDD or Phase 3 MDD

### Highway 54 Storage Tank

Storage in the Central pressure zone was preliminarily located along Highway 54 near Watkins Road. This site was selected to be hydraulically effective for as much of the Central pressure zone as possible since it is located along a ridgeline and there appears to be undeveloped land in the vicinity. However, due to losses in the primary transmission main through the reclaimed water system and the topography of the service area, the Highway 54 storage site would not be hydraulically effective for the eastern-most portion of the Northwest Cary service area, which has the highest elevation in the system, during periods of peak demand.

Initially, elevated storage was considered for the Highway 54 location in the Central pressure zone. Since the highest elevations in the Northwest Cary service area are located near the NCWRF, the pumping control strategy modeled at the NCWRF targets a constant pressure on the discharge side of the pumps (approximately 120 psi) to maintain adequate pressure to the highest elevation nodes in the distribution system near Harrison Avenue. Therefore, the reclaimed water high service pumps...
would not be directly controlled by the levels in the elevated tank. This could result in turnover issues in an elevated tank at Highway 54 during lower demand periods similar to the baseball tank.

In addition, hydraulic analysis indicates that the hydraulic grade line at this location changes over the planning period due to the phasing of transmission improvements and looping. Therefore, an elevated tank is not hydraulically effective at this site without provisions for pumping due to the hydraulic grade line changes. Finally, an elevated tank at this location would be greater than 220 feet in height, which could present a significant issue with FAA regulations due to its proximity to the Raleigh Durham International airport.

For these reasons, a ground storage/re-pump facility is recommended to provide flexibility in operation with hydraulic grade line changes in the system and responding to changes in water demand of the service area. The selected tank site is within the Town of Morrisville. If the Town wants the tank to be located within the Town of Cary municipal boundary, it may be possible to select another suitable site.

Approximately 1.0 MG of storage is needed at this location in Phase 2 and an additional 1.0 MG of storage needed in Phase 3. It is recommended that a 2.0 MG tank be constructed in Phase 2 and only a portion of the volume used until demands increase. The ground storage pumps for Phase 2 should be sized to provide a firm capacity of approximately 1,800 gpm at a total dynamic head (TDH) of 200 feet (two 1,800 gpm pumps, one with variable frequency drive). The pumps should be replaced with new larger pumps (or an additional pump should be added) for Phase 3 to provide a firm capacity of approximately 3,600 gpm at a total dynamic head (TDH) of 200 feet. When constructing the pump station, consideration should be given to the space required to install additional pump(s) required to meet the pumping capacity in Phase 3.

**West Lake Storage**

The topography of the South Cary service area increases in elevation to the north, with the SCWRF at the lowest elevation. In order to maintain adequate pressures during periods of peak demand as the reclaimed water system expands north of the proposed Highway 540 corridor in Phase 3, additional elevated storage was evaluated near West Lake Road and Floresta Drive. A 0.5 MG storage volume is recommended in Phase 3.

To maintain node pressures greater than 50 psi in the north portion of the service area, the minimum operating level of the tank should be a hydraulic grade line elevation of 585 feet. Based on topography at the proposed tank location, the overall height of the tank would be approximately 175 feet. To fill the tank, the new reclaimed water high service pumps at the SCWRF (firm capacity of 1,400 gpm) would need to operate at a higher head than the current operations. This results in pressures of 135 to 140 psi at the discharge side of the pumps (compared with current pressure around 120 psi). However, as the elevation increases to the north outside of the SCWRF, excessive pressures are not expected in the distribution system. The Town may consider installing PRVs for new individual reclaimed water connections that are expected to be in areas that might experience high pressures. It is recommended that the SCWRF reclaimed water pumps be controlled by the level in the West Lake storage tank. During periods of lower demand, the pumping at the SCWRF can be decreased or turned off, allowing the system demands to be satisfied from the water in the storage tank. Operating in this manner will help maintain water quality in the tank since the volume of storage is large compared with seasonal demand.
Summary
The following is a summary of the storage facilities recommended in each phase.

- **Phase 1** - Thomas Brooks Park Baseball Tank (0.5 MG)
- **Phase 2** - Highway 54 Ground Storage Re-Pump Facility (2 MG)
- **Phase 3** - NCWRF Ground Storage (1 MG); Additional pumping capacity at Highway 54 Ground Storage Re-Pump Facility; West Lake Elevated Storage (0.5 MG)

Table 8-5 provides a summary of the minimum required and recommended storage volumes by phase and service area in comparison with the service area demands. Storage recommendations are based on maximum day demand conditions. However, due to the nature of the peaking factors associated with the reclaimed water system, the recommended storage volume is large in comparison with the average annual demand or summer seasonal demands. To maintain water quality and decrease water age in the storage facilities, particularly during summer seasonal and average annual demand conditions, the following operational measures are recommended:

- Install a flow control valves on the Little Drive/O'Kelly Chapel Road pipeline and the NW Connector (McCrimmon Parkway) at Highway 55 to control flow into the West pressure zone to improve operations of the Thomas Brooks Park Baseball Tank. The valves should be throttled to limit flow into the West pressure zone during peak hours to allow the tank to drain. The valves can be opened to allow the tank to fill during off-peak hours. Table 8-4 lists the maximum combined flow setting for the valves while the baseball tank is draining as simulated in the hydraulic model for various demand conditions. This tank should be removed from service in the winter when demands are minimal.

- Operate the Highway 54 Ground Storage Facility with a lesser volume (i.e. do not fill the entire tank volume), as dictated by system demand conditions, to minimize water age in the tank. The tank may be removed from service in the winter when demands are minimal.

- Operate the SCWRF reclaimed water pumps based on the level in the West Lake Elevated Tank. Flow from the plant should be stopped/reduced so demand is met from storage, allowing the storage tank to empty. The pumping is then restarted/increased to refill the tank.
Table 8-5. Summary of Recommended Storage

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northwest Cary Service Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Required Storage Volume¹ (MG)</td>
<td>1.0</td>
<td>1.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Total Recommended Storage² (MG)</td>
<td>1.5</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Average Annual Demand (mgd)</td>
<td>1.2</td>
<td>1.9</td>
<td>3.3</td>
</tr>
<tr>
<td>Summer Seasonal Demand (mgd)</td>
<td>1.8</td>
<td>2.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Maximum Day Demand (mgd)</td>
<td>3.3</td>
<td>5.5</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>South Cary Service Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Required Storage Volume¹ (MG)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Total Recommended Storage² (MG)</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Average Annual Demand (mgd)</td>
<td>0.3</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Summer Seasonal Demand (mgd)</td>
<td>0.4</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Maximum Day Demand (mgd)</td>
<td>0.5</td>
<td>1.0</td>
<td>1.7</td>
</tr>
</tbody>
</table>

1) Minimum required storage volume from Table 8-3.
2) Total recommended storage includes existing storage at the NCWRF and SCWRF.