Analysis of Needs and Sources

October 15, 2008
Presentation Outline

• Purpose
• Existing Raw Water Supply
• Projected Water Demands
• Comparison of Needs and Sources
• Recommendations
• Water Distribution System Analysis
Purpose

• Determine if existing raw water sources are sufficient to meet projected system demands

• Determine if existing distribution system can meet projected demands

• Provide recommendations to meet 20-year capacity requirements

• Prepare for Stage 2 regulation
Overview of Existing Raw Water Sources

• Several raw water sources including
  - Mill Creek Reservoir
  - Rion Quarries
  - Sand Creek
  - “Upper Reservoir”
Overview of Existing Raw Water Sources
Mill Creek Reservoir

- Primary source for the Town’s water system
- Various zones or “pools”
Mill Creek Reservoir

- Intake structure:
  - Intake 1 – located at bottom of Municipal Pool
  - Intake 2 – located in Sediment Pool
  - Intake 3 – located at bottom of intake structure
Existing Raw Water Sources

- Upper Reservoir
  - Recharge source for Mill Creek Reservoir
  - 15’ higher than Mill Creek Reservoir
Existing Raw Water Sources

- Rion Quarries
  - Water can be pumped directly to Mill Creek Reservoir
- Sand Creek
  - 420 gpm (0.6 MGD) pump station
  - Piping to WTP or Upper Reservoir
Raw Water Transmission

- 4.0 MGD pump station
- Pipes ranging from 8- to 16-inches in diameter
- Reliable capacity of 3.1 MGD
## Source and Recharge Capacities

<table>
<thead>
<tr>
<th>Water Source</th>
<th>Storage Volume (MG)</th>
<th>Pumping Capacity</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Supply</td>
<td>Recharge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(gpm) (MGD)</td>
<td>(gpm) (MGD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill Creek Reservoir</td>
<td>473 310</td>
<td>2,150 3.1</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mun. Pool (405'–398' MSL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sed. Pool (398’ – 389’ MSL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rion Quarry No. 1</td>
<td>260</td>
<td>-</td>
<td>1,100 – 1,500</td>
<td>1.6 – 2.2</td>
<td></td>
</tr>
<tr>
<td>Rion Quarry No. 2</td>
<td>195</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Upper Reservoir</td>
<td>100</td>
<td>-</td>
<td>1,400 – 2,800</td>
<td>2.0 – 4.0</td>
<td></td>
</tr>
<tr>
<td>Sand Creek</td>
<td>-</td>
<td>420 0.61</td>
<td>420</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,338</td>
<td>2,150 3.1</td>
<td>2,920 – 4,720</td>
<td>4.21 – 6.81</td>
<td></td>
</tr>
</tbody>
</table>
Potential Water Sources

- **Broad River**
  - Recharge and/or raw water supply
  - Considered by DHEC to have acceptable quality for producing drinking water

- **Interconnection with City of Columbia**
  - Treated water supply
  - Already meets drinking water standards

- **New Reservoir on Horse Creek**
  - Raw water supply
Demand Projections

- The following planning periods were established:
  - Short-Range (2006-2011)
  - Intermediate-Range (2012-2016)
  - Long Range (2017-2026)

- The following design flows were determined:
  - Average Day Demand – average annual demand
  - Maximum Day Demand – max 24 hour demand for the year
  - Peak Month Demand – peak monthly average production
Existing and Future Service Areas

- Existing service area estimated by applying 1,000’ buffer to water lines
- Future service area estimated using projected annex areas for Town of Blythewood and City of Columbia (provided by Richland County)
- City of Columbia 48” water line determined extent of Winnsboro service area
- Service area broken down into census tracts
## Distribution System Demand

<table>
<thead>
<tr>
<th>Estimated Demand (MGD)</th>
<th>2006</th>
<th>2011</th>
<th>2016</th>
<th>2021</th>
<th>2026</th>
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</thead>
<tbody>
<tr>
<td>Residential – Fairfield County</td>
<td>0.56</td>
<td>0.59</td>
<td>0.59</td>
<td>0.60</td>
<td>0.61</td>
</tr>
<tr>
<td>Residential – Richland County</td>
<td>0.10</td>
<td>0.58</td>
<td>0.69</td>
<td>0.82</td>
<td>0.98</td>
</tr>
<tr>
<td>Commercial/Industrial</td>
<td>0.67</td>
<td>0.72</td>
<td>0.76</td>
<td>0.81</td>
<td>0.86</td>
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<tr>
<td>Wholesale</td>
<td>0.44</td>
<td>0.48</td>
<td>0.51</td>
<td>0.55</td>
<td>0.58</td>
</tr>
<tr>
<td>Average Day Demand</td>
<td>1.8</td>
<td>2.4</td>
<td>2.6</td>
<td>2.8</td>
<td>3.0</td>
</tr>
<tr>
<td>Peak Month Demand</td>
<td>2.1</td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Max Day Demand</td>
<td>2.7</td>
<td>4.2</td>
<td>4.6</td>
<td>5.0</td>
<td>5.5</td>
</tr>
</tbody>
</table>
Peak Month Demands

- The State Primary Drinking Water Regulations (SPDWR) state (SC DHEC):
  - Submit PER when peak month demand exceeds 80% of rated capacity
  - Submit plans and specs when peak month demand exceeds 90% of rated capacity
Projected Peak Month Demands vs. Existing Capacity

- Estimated Annualized Avg Day Production (Annual Production / 365)
- Estimated Peak Monthly Average (Assuming Normal Weather Patterns)
- Potential Worst Case Peak Monthly Average (Assuming Drought Conditions)

DHEC Rated Capacity = 3.1 MGD
90% of Rated Capacity = 2.79 MGD
80% of Rated Capacity = 2.48 MGD
Projected Max Day Demands vs. Existing Capacity

- Current Actual Plant Capacity = 3.1 MGD
- Est Worst Case Max Day (Assuming Drought Conditions)
- Estimated Max Day (Assuming Normal Weather Patterns)
• Real world demands of customers (Max Day) will require more system capacity before DHEC will (Peak Month).

• Assuming worst-case (i.e., drought) conditions:
  – The actual treatment capacity of 4.0 MGD could be exceeded between 2011 to 2016.
  – The DHEC-rated treatment capacity of 3.1 MGD could be exceeded in 2008.
Comparison of Needs and Sources

• Safe Yield Analysis
  – Updated original reservoir model
  – Maximum daily demand – 4.0 MGD
  – Evaluated data including:
    • Evaporation Data
    • Reservoir Inflow
    • Precipitation
    • Reservoir Outflow
Comparison of Needs and Sources

• Safe Yield Analysis (cont.)
  – Results: Storage volume and recharge capacity sufficient under certain conditions:
    • Use of Sediment Pool
    • Destratification System
    • Drought Management Plan
Comparison of Needs and Sources

Winnsboro Reservoir Model with Pumped Inflow (3.5MGD) Applied During the Months of May-September for the Entire Study at 4MGD Demand

Storage (Ac. ft.)

Month/Year

Elev. 390.0
Elev. 398.0
Elev. 405.0
Elev. 414.0

Elev. 414.0
Elev. 405.0
Elev. 398.0
Elev. 390.0

Model Output at 4MGD Demand
## Comparison of Needs and Sources

- **Raw Water Transmission System**
  - Theoretical maximum capacity of 4.0 MGD
  - Reliable capacity of 2.3 to 3.0 MGD

<table>
<thead>
<tr>
<th>Pumps Operational</th>
<th>Mill Creek Station</th>
<th></th>
<th></th>
<th></th>
<th>Sand Creek Station</th>
<th></th>
<th></th>
<th></th>
<th>Total System Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discharge (gpm)</td>
<td>MGD</td>
<td>Pump Head (ft)</td>
<td>psi</td>
<td>Discharge (gpm)</td>
<td>MGD</td>
<td>Pump Head (ft)</td>
<td>psi</td>
<td>MGD</td>
</tr>
<tr>
<td>1 Mill Creek</td>
<td>2464</td>
<td>3.55</td>
<td>344</td>
<td>149</td>
<td>526</td>
<td>0.76</td>
<td>110</td>
<td>48</td>
<td>3.55</td>
</tr>
<tr>
<td>2 Mill Creek</td>
<td>2831</td>
<td>4.08</td>
<td>411</td>
<td>178</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.08</td>
</tr>
<tr>
<td>1 Sand Creek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2424</td>
<td>3.49</td>
<td>347</td>
<td>150</td>
<td>0.76</td>
</tr>
<tr>
<td>1 Mill Creek +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>232</td>
<td>0.33</td>
<td>168</td>
<td>73</td>
<td>3.83</td>
</tr>
<tr>
<td>1 Sand Creek</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.76</td>
</tr>
<tr>
<td>2 Mill Creek +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2831</td>
<td>4.08</td>
<td>411</td>
<td>178</td>
<td>0.00</td>
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<tr>
<td>1 Sand Creek</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>76</td>
</tr>
</tbody>
</table>

*System capacity does not consider practical constraints, such as exceeding design working pressure and condition of existing pipes. Actual capacity may be considerably lower.*

**Notes:**
- Mill Creek Pumps (4 stage) Shut off head = 480 ft (208 psi)
- Sand Creek Pumps (4 stage) Shut off head = 174 ft (75 psi)
## Transmission System Improvements

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Preliminary Estimate of Cost</th>
<th>Transmission Capacity (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Partial replacement of 8 and 10 inch pipes with 16-inch DIP</td>
<td>$1,435,000</td>
<td>3.99</td>
</tr>
<tr>
<td>1b</td>
<td>Partial replacement of 8- and 10-inch pipes with 18-inch DIP</td>
<td>$1,639,400</td>
<td>4.02</td>
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<tr>
<td></td>
<td>Full replacement of all 8-inch and Partial replacement of 10-inch with 16-inch DIP</td>
<td>$1,691,800</td>
<td>4.94</td>
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<tr>
<td>2</td>
<td>Full replacement of 8- and 10-inch pipes with 12-inch DIP</td>
<td>$2,059,800</td>
<td>5.19</td>
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<tr>
<td>3a</td>
<td>Full replacement of 8- and 10-inch pipes with 16-inch DIP</td>
<td>$2,880,320</td>
<td>7.88</td>
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<tr>
<td>3b</td>
<td>Full replacement of 8- and 10-inch pipes with 18-inch DIP</td>
<td>$3,290,580</td>
<td>8.97</td>
</tr>
<tr>
<td>3c</td>
<td>Full replacement of 8- and 10-inch pipes with 18-inch DIP</td>
<td>$3,290,580</td>
<td>8.97</td>
</tr>
</tbody>
</table>
Water Treatment Plant Capacity

• Treatment capacity of 4.0 MGD
• Increase capacity between 2011 and 2016
• Options to increase capacity:
  – Upgrade existing treatment process units
  – Purchase capacity from City of Columbia
Short Term Recommendations

- Upgrade Raw Water Transmission Lines
- Use of Sediment Pool
- Destratification System
- Drought Management Plan
Stratification of a reservoir can produce poor water quality conditions such as Mn spikes.

Reservoir mixing can reduce problems caused by stratification.
Gentle aeration mixes water near water plant intake
Mixing Reduces Mn Spikes

Lake Whelchel: Location A
5/6/04

Lake Whelchel: Location A
5/11/04

Concentration (mg/L)
Depth in Reservoir (ft)
Mn
Fe
Intermediate Recommendations (2011-2016)

• Evaluate sedimentation in Mill Creek Reservoir to determine when dredging of the reservoir will be necessary

• Increase WTP capacity
Long Range Recommendations (2017-2026)

- Construct connection to Parr Reservoir
Potential Problem:

• Existing system cannot provide projected demands (including Red Gate Farms, University Club, and Rimer Pond Road developments)
• Available fire flow in University Club is less than 500 gpm.

Solutions:

• Construct a 12-inch line from Center Creek Road to the Blythewood Tank. Additional improvements may also be needed, such as pump station upgrades and other water line improvements.
• Loop University Club with a 6” water line (approximately 780 feet).
Blythewood Evaluation

Blythewood Tank Performance – Proposed Demands
Blythewood Evaluation

Blythewood Elevated Tank Performance – With Piping Improvements