Groundwater Sustainable Yield Assessment in Prioritized Aquifers of Georgia’s Coastal Plain Aquifer System

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Aquifers in Georgia

EXPLANATION
Coastal Plain aquifers
- Surficial aquifer system (not a principal aquifer)
- Brunswick aquifer system
- Floridan aquifer system
- Claiborne, Clayton, and Providence aquifers
- Cretaceous aquifer system

Piedmont and Blue Ridge aquifers
- Crystalline-rock aquifers

Valley and Ridge and Appalachian Plateau aquifers
- Paleozoic-rock aquifers

Source: USGS FS 2008-3072
Statewide Groundwater Modeling Efforts

Northwestern Georgia Model

Piedmont and Blue Ridge Water Budgets

Coastal Plain Model

Dougherty Plain Model

Legend:
- Piedmont and Blue Ridge in Crystalline Rock Aquifers
- Valley and Ridge in Panhandle Rock Aquifers
- Dougherty Plain in Upper Floridan Aquifer
- South-Central Georgia Floridan Aquifer Area
- Eastern Coastal Plain Floridan Aquifer Area
- Oolitic Aquifer in Georgia's Coastal Plain
- Cretaceous Aquifer in Georgia's Coastal Plain
- Major Rivers
- Major Roads
- 50 Miles
Prioritized Aquifers in Georgia Coastal Plain

- Upper Floridan Aquifer
- Claiborne Aquifer
- Cretaceous Aquifer
- Groundwater Models
Data Collection and Evaluation

- Over 16,400 pumping wells with a total pumping rate of about 2,075 mgd
- 302 groundwater monitor wells
- Surface water levels measured at 97 stage stations in 20 major rivers and their tributaries
- Rainfall data (1948-2008) at 48 rainfall stations
- Hydrogeologic data for Coastal Plain aquifers
- DEM data
# Pumping Distribution in Regional Model

<table>
<thead>
<tr>
<th>State</th>
<th>Public Water Supply</th>
<th>Industrial</th>
<th>Ag</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>208</td>
<td>237</td>
<td>1145</td>
<td>61</td>
<td>1,651</td>
</tr>
<tr>
<td>Florida</td>
<td>104</td>
<td>52</td>
<td>69</td>
<td>36</td>
<td>261</td>
</tr>
<tr>
<td>Alabama</td>
<td>50</td>
<td>4</td>
<td>14</td>
<td>NA</td>
<td>68</td>
</tr>
<tr>
<td>South Carolina</td>
<td>36</td>
<td>15</td>
<td>28</td>
<td>16</td>
<td>95</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>398</strong></td>
<td><strong>308</strong></td>
<td><strong>1,256</strong></td>
<td><strong>113</strong></td>
<td><strong>2,075</strong></td>
</tr>
</tbody>
</table>

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River and Tributaries in Outcrop Areas

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Model Calibration Criteria

- Average of residuals in groundwater elevations is less than 10 ft
- Standard deviation of residuals is less than 20 ft
- Average of residuals and standard deviation of residuals in vertical heads across aquifers at MW cluster are less than 5 ft and 15 ft, respectively
- Simulated groundwater flow pattern should match observed flow pattern
- There is no spatial bias in residuals
Regional to Sub-Regional Groundwater Model Development Procedures

- Sub-regional model layers
- Finer model grid
- Hydrogeologic properties
- General Head Boundary for sub-regional models
- Well pumping
- River stages
- Recharge
## Summary of Sub-Regional Model Calibrations

<table>
<thead>
<tr>
<th>Model</th>
<th>Model Type</th>
<th>Average of Residuals (feet)</th>
<th>Standard Deviation of Residuals (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Floridan Aquifer</td>
<td>steady-state</td>
<td>0.14</td>
<td>4.33</td>
</tr>
<tr>
<td></td>
<td>transient</td>
<td>-0.22</td>
<td>5.08</td>
</tr>
<tr>
<td>Claiborne Aquifer</td>
<td>steady-state</td>
<td>0.53</td>
<td>3.39</td>
</tr>
<tr>
<td></td>
<td>transient</td>
<td>-0.28</td>
<td>4.82</td>
</tr>
<tr>
<td>Cretaceous Aquifer</td>
<td>steady-state</td>
<td>0.09</td>
<td>2.72</td>
</tr>
<tr>
<td></td>
<td>Transient</td>
<td>-0.39</td>
<td>3.9</td>
</tr>
</tbody>
</table>
Major Sustainable Yield Metrics

- Groundwater level drawdown in the pumped aquifer does not exceed 30 ft over significant areas.
- Groundwater contributions to stream baseflow should not be reduced by more than 40%.
Aquifer storage was not considered (steady-state model was used)

Pumping was increased from the prioritized aquifer while pumping from all other aquifers within the model domain was maintained at the baseline pumping rates

Combinations of increased pumping from existing and simulated new wells were used to model the range of sustainable yields
Sustainable Yield - Claiborne Aquifer in Southwestern Georgia

Existing Pumping = 93 mgd
Low End of SY = 140 mgd
High End of SY = 635 mgd
Simulated Groundwater Level Drawdown in Claiborne Aquifer at High End of Sustainable Yield
Sustainable Yield – Cretaceous Aquifer

Existing Pumping = 219 mgd
Low End of SY = 347 mgd
High End of SY = 445 mgd
Simulated Groundwater Level Drawdown in Cretaceous Aquifer at High End of Sustainable Yield
Sustainable Yield - UFA in Eastern Coastal Plain and South Central Georgia

Existing Pumping = 475 mgd
Low End of SY = 866 mgd
High End of SY = 982 mgd

Legend:
- Regional Georgia EPD Groundwater Model Domain
- South Central Georgia and Eastern Coastal Plain Floridan Aquifer Area
- Claiborne Aquifer
- Floridan Aquifer
- Confined Aquifers
- Crystalline-Rock Aquifers
- Paleozoic-Rock Aquifers
- Major Rivers
- Fall Line

Groundwater Sustainable Yield Assessment in Prioritized Aquifers in Georgia Coastal Plain Aquifer System

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CDM
Simulated Groundwater Level Drawdown in Upper Floridan Aquifer at High End of Sustainable Yield
Summary and Conclusions

- Calibrated groundwater models provide a reasonable representation of Georgia Coastal Plain aquifer system.
- A combination of increasing existing and simulated new well pumping from the prioritized aquifer results in the highest estimates of sustainable yield in the aquifers.
- Based on selected sustainable yield criteria there may be additional groundwater available above existing withdrawals in the Upper Floridan, Cretaceous, and Claiborne aquifers.
- Sustainable yields with simultaneous increasing withdrawals from all of prioritized aquifers will be less than sustainable yields with only individual aquifer withdrawals.
Questions?