# South Carolina Atlantic Coastal Plain Groundwater Availability Model

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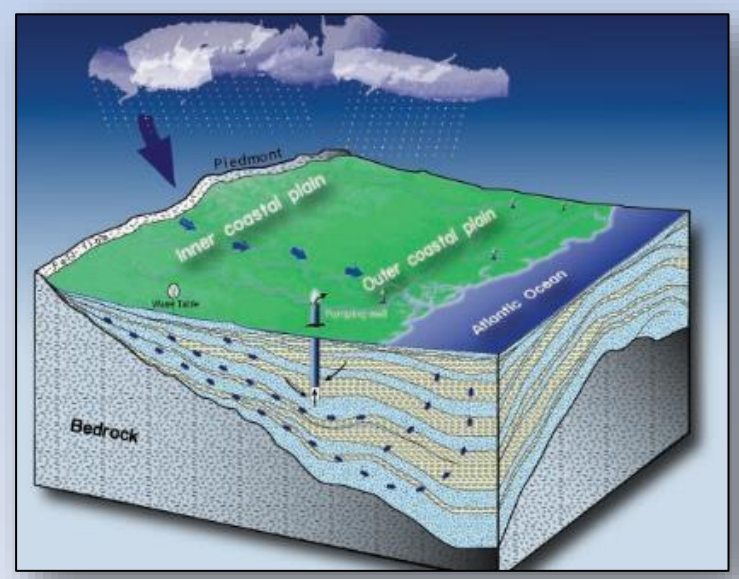
US Geological Survey – South Atlantic Water Science Center

**Alex Butler** - South Carolina Department of Health and Environmental Control

**Joe Gellici** - South Carolina Department of Natural Resources

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# Focus Area Study / SCDNR Model Update

## Combines funding sources:

- Internal USGS Water Census Program / Focus Area Study
- Cooperative funding from South Carolina Department of Natural Resources/USACOE
- Cooperative funding from South Carolina Department of Health and Environmental Control

## 1) Water Census Program / Focus Area Study:

- Internal USGS funding from the SECURE Water Act
- Southeastern Atlantic Coastal Basins of the Carolinas

## 2) SCDNR/US ACOE Project

Funding to expand groundwater model area to include all of the SC Coastal Plain

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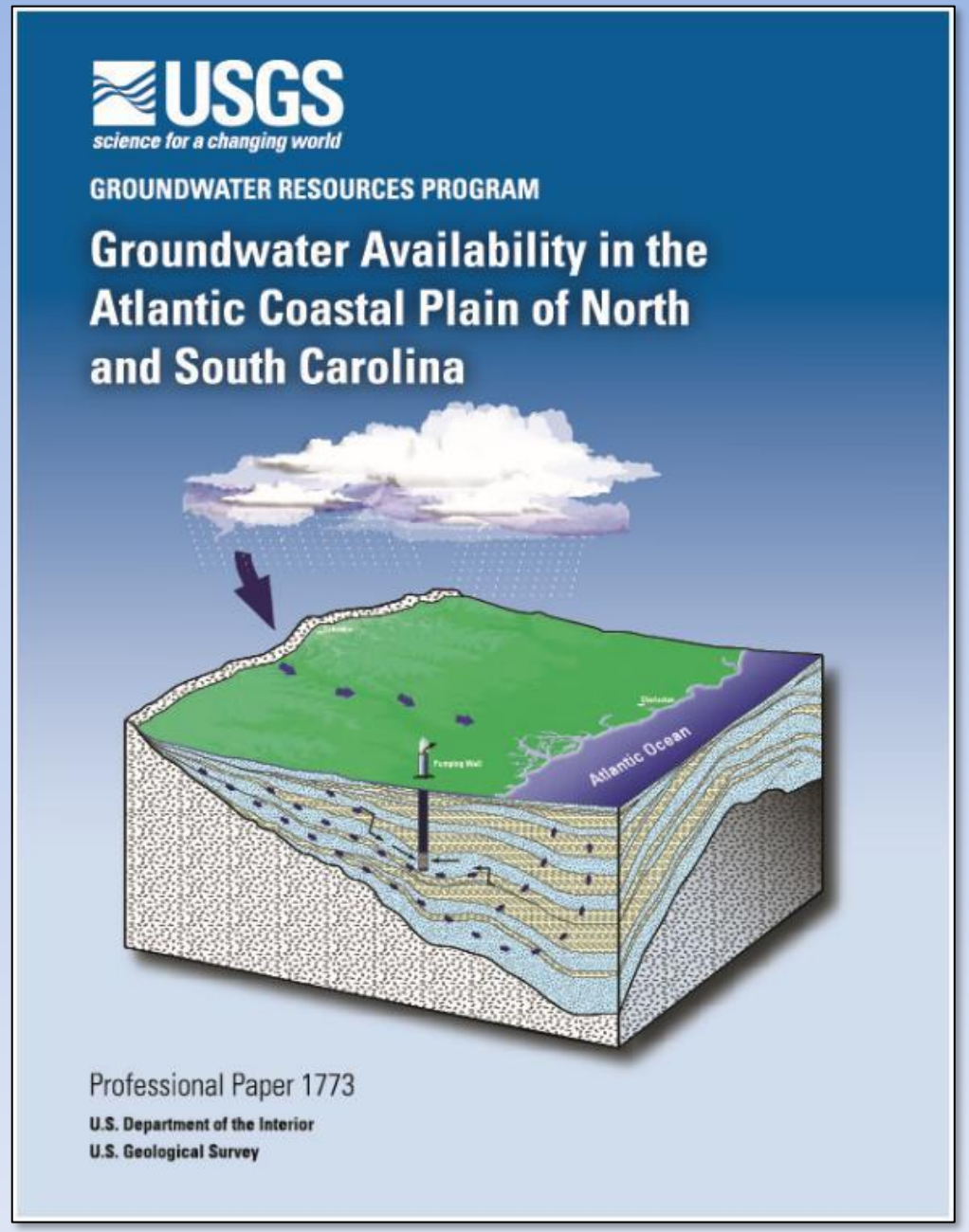
# USGS Groundwater Resources Program

## Groundwater Flow Model of the Atlantic Coastal Plain of NC, SC, eastern GA, southern VA

- Calibrated to 2004 conditions
- Revised hydrogeologic framework
- Analysis of GW monitoring networks
- Climate change predictions

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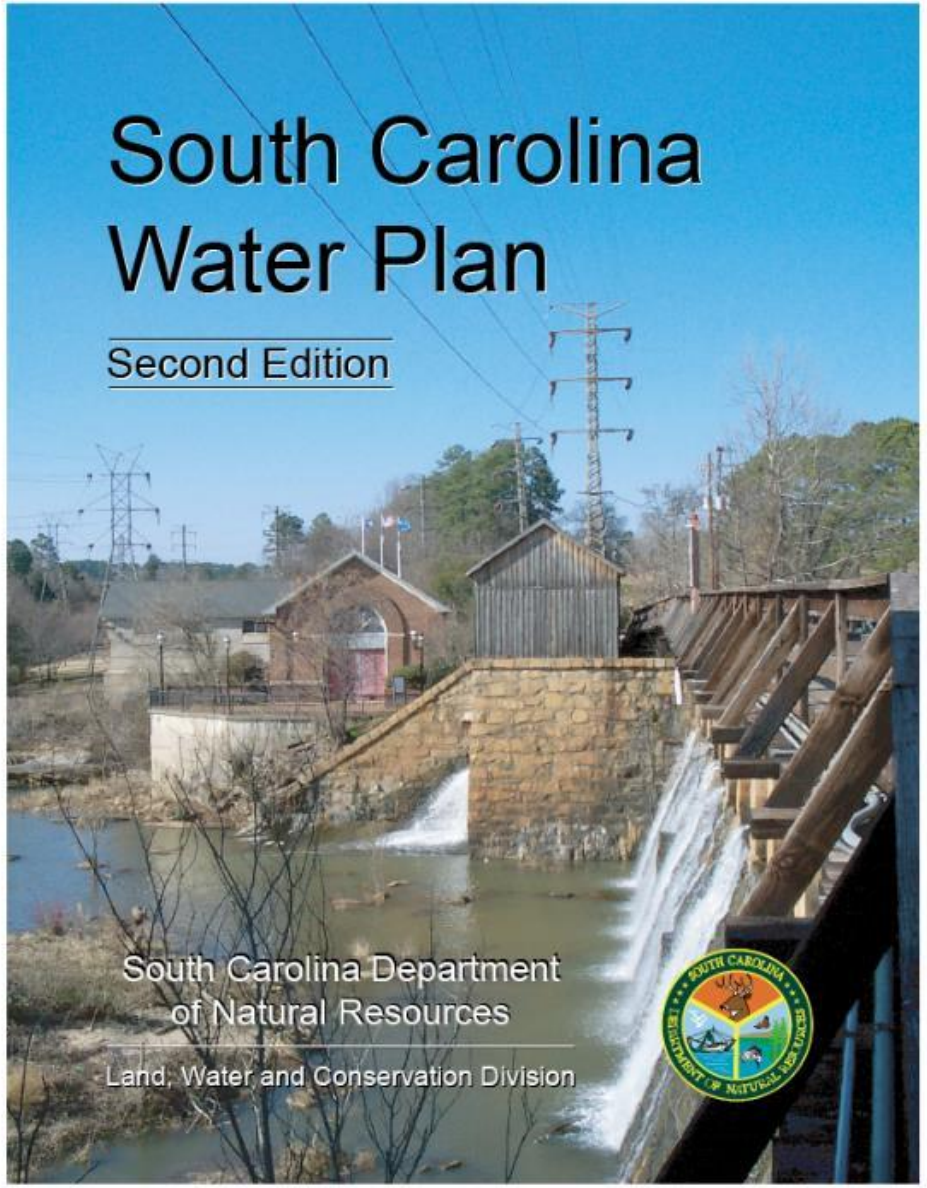
# South Carolina Water Plan

South Carolina Department of Natural Resources

**Recommendation:**

*"A comprehensive ground-water flow model of the Coastal Plain should be developed and used to predict the effect of future pumping and to determine optimal well spacing's."*

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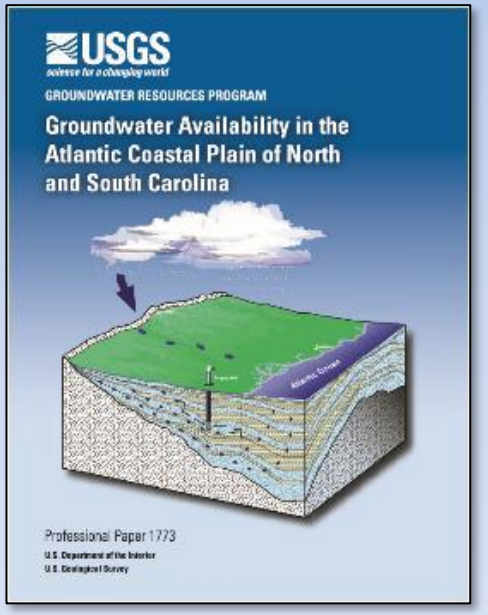
# Groundwater Model Area

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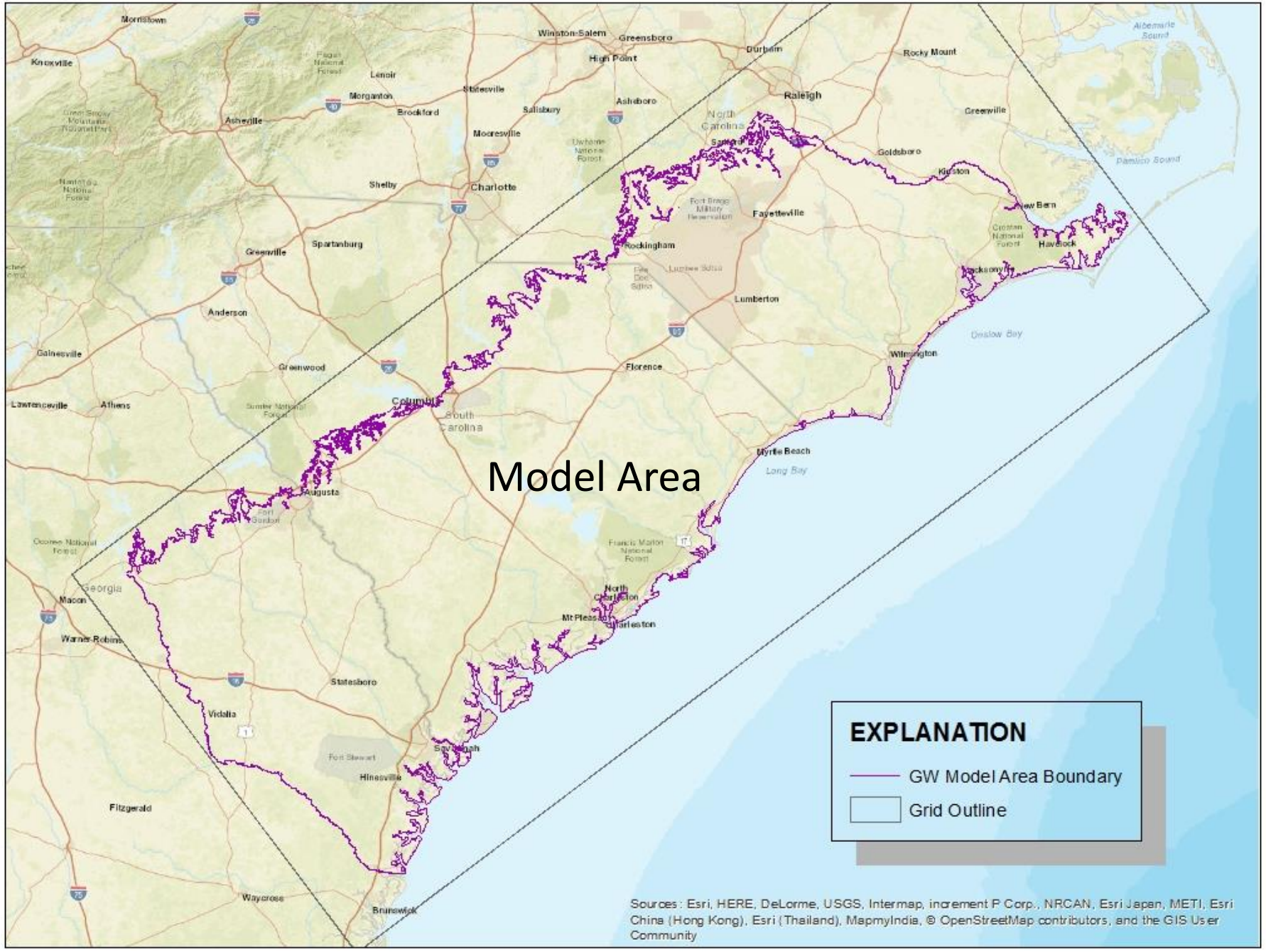

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# Coastal Plain Issues

- Increase in Atlantic Coastal Plain population
- Increased demand on groundwater resources
- Groundwater quality issues
- Increased agricultural withdrawals
- Impact of increased groundwater withdrawals on surface water flows

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# Objectives

- Overall update the 2010 groundwater flow model
- Activating the entire surficial aquifer model layer
- Recharge from SWB Model
- Adding recent groundwater-related data (2005-2015)
- Refine the model grid from 2 x 2 miles to 2,000 x 2,000 ft
- Incorporate a more detailed representation of the Fall Line area
- Incorporate newer MODFLOW packages – Newton Formulation, Multi-Node Well Package
- Re-calibration, and apply the model to a series of scenarios

## New GW Water-Use Data

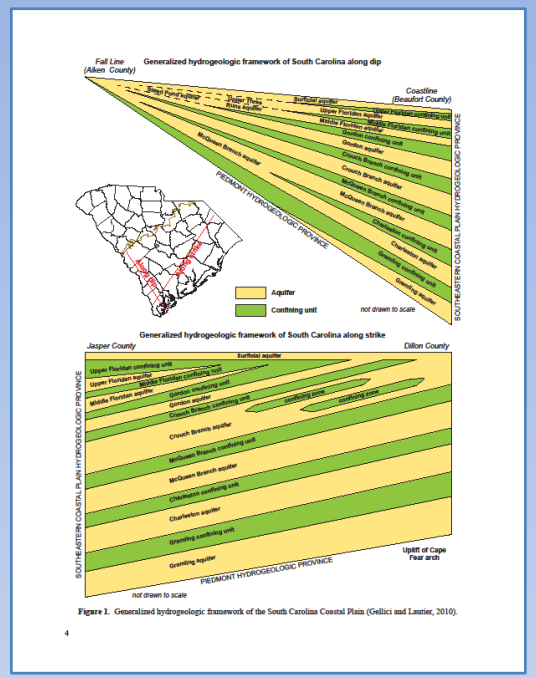


Figure 1. Generalized hydrogeologic framework of the South Carolina Coastal Plain (Gellici and Lautier, 2010).

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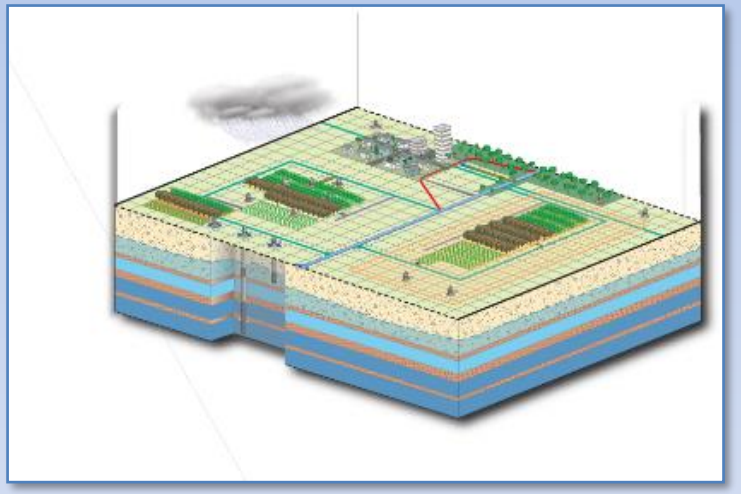
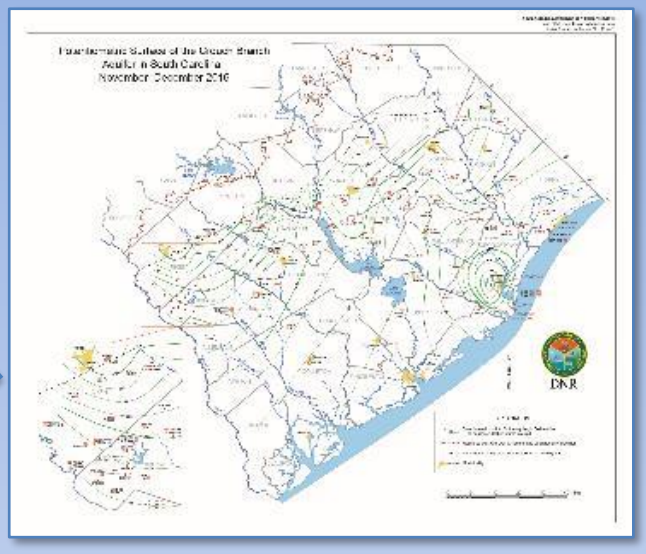
## Framework

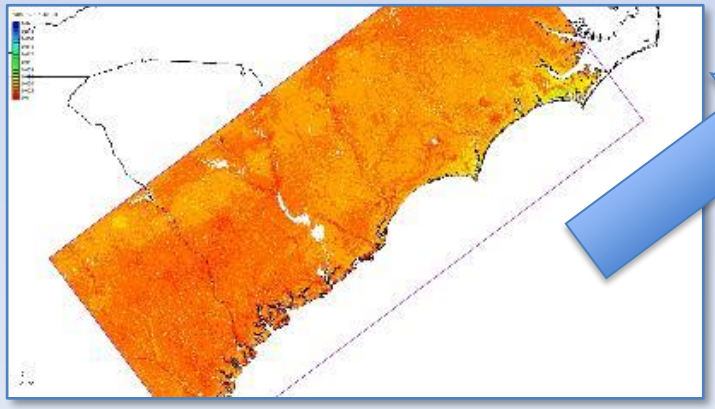
## Groundwater Model






## Potentiometric Maps

## Recharge Model



## Groundwater Levels

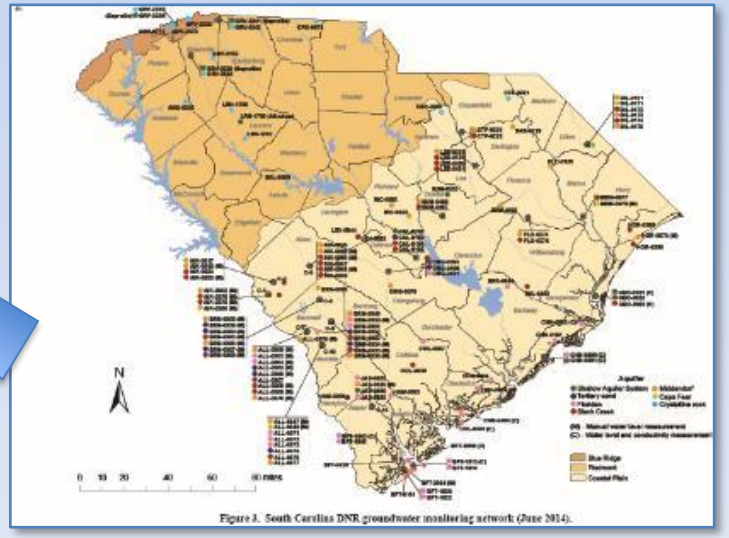


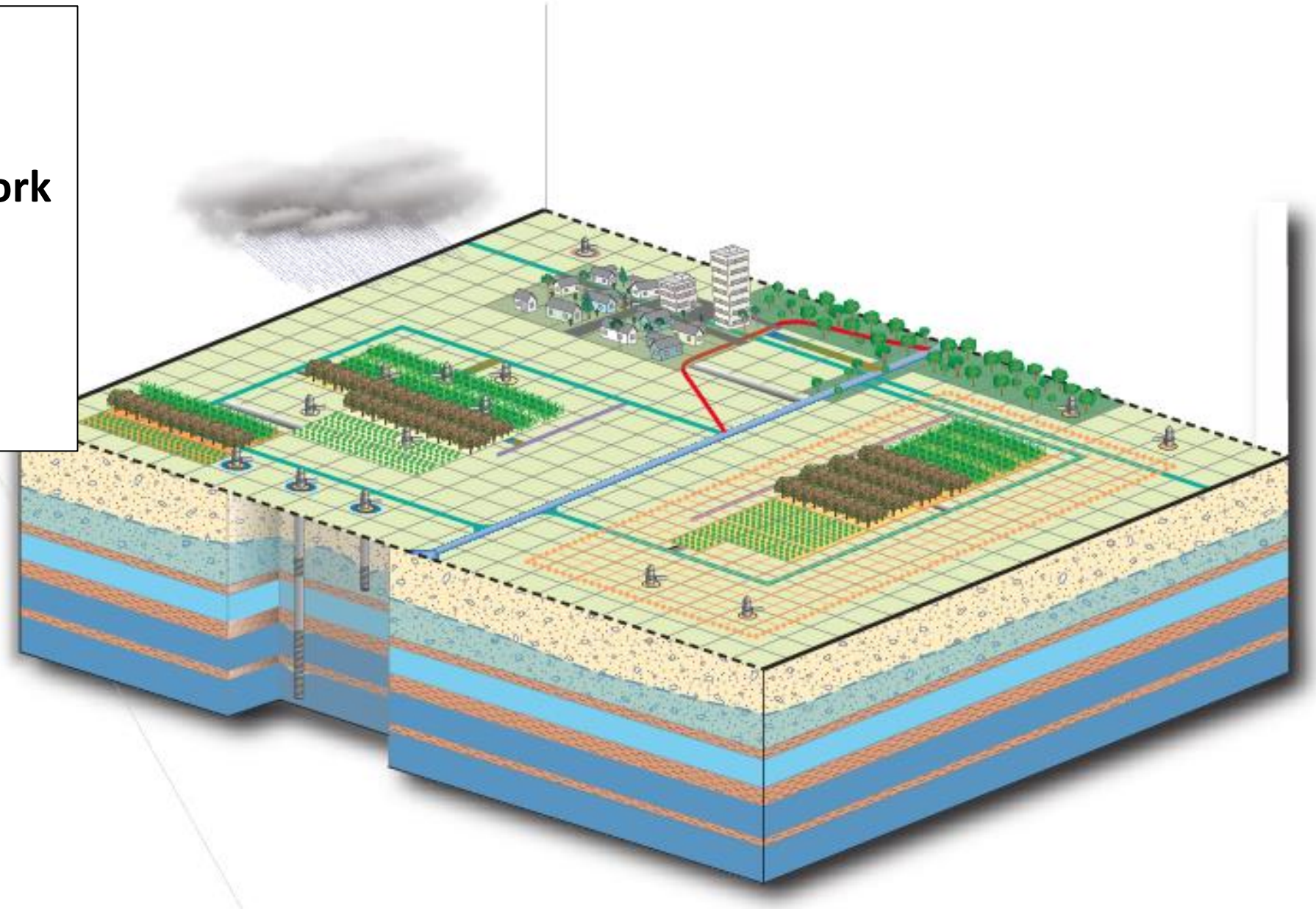

Figure 3. South Carolina DNR groundwater monitoring network (June 2014).

**Primary inputs:**

- Model Grid
- Hydrogeologic Framework
- Aquifer Properties
- Observation Data
- Boundaries
- Wells – Water Use Data

**Primary Outputs:**

- Groundwater Levels
- Budgets



# Representative GW Flow Model

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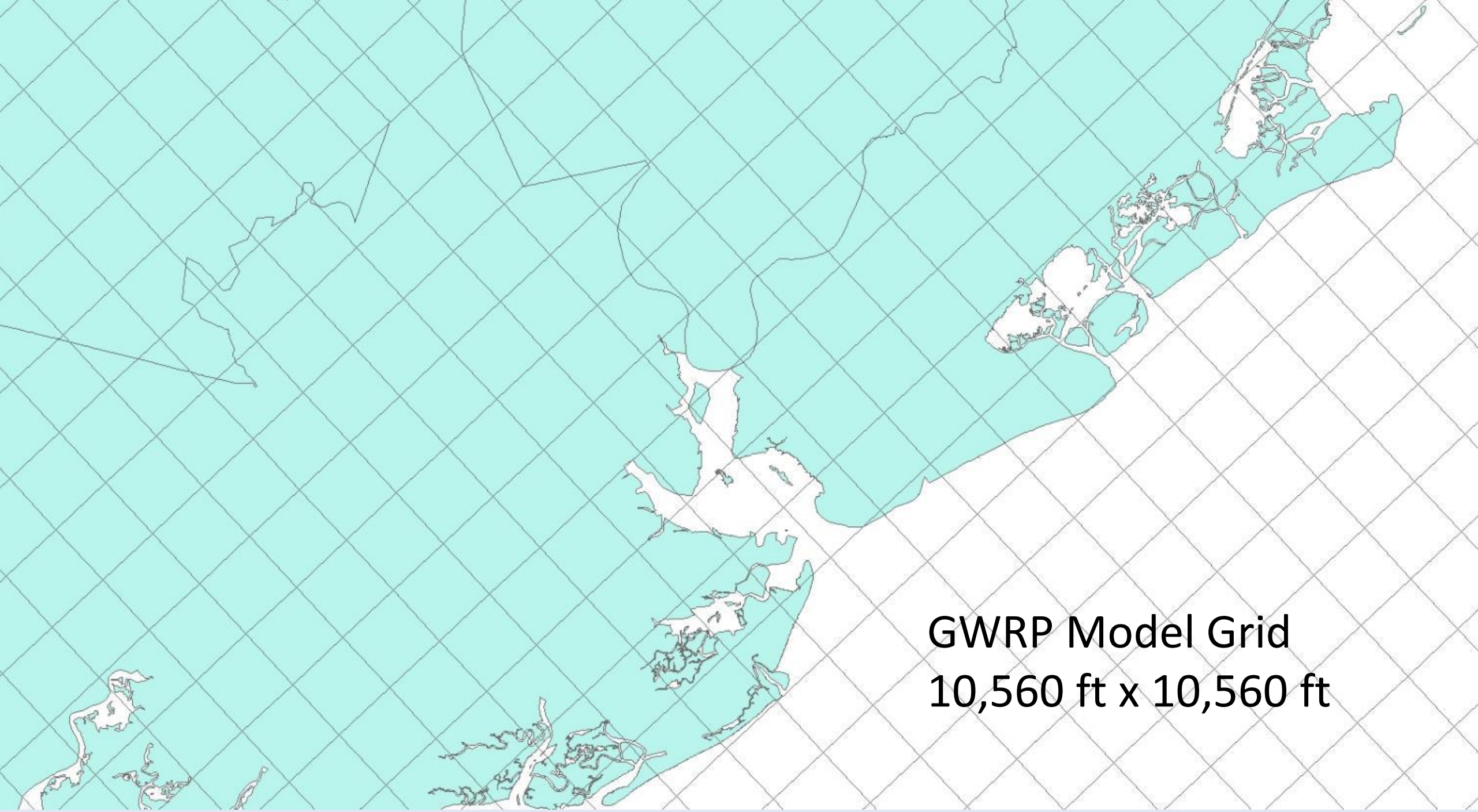
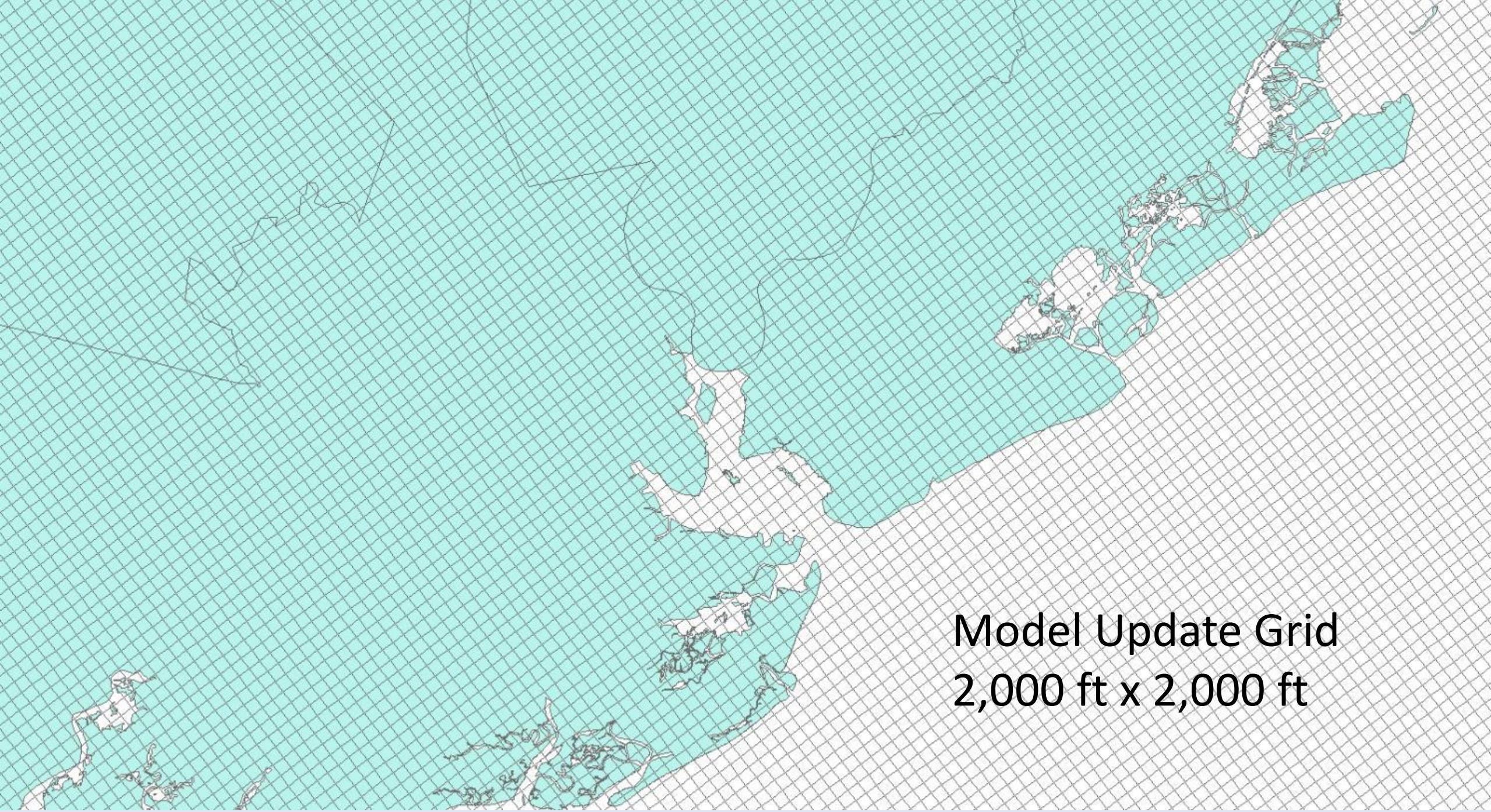
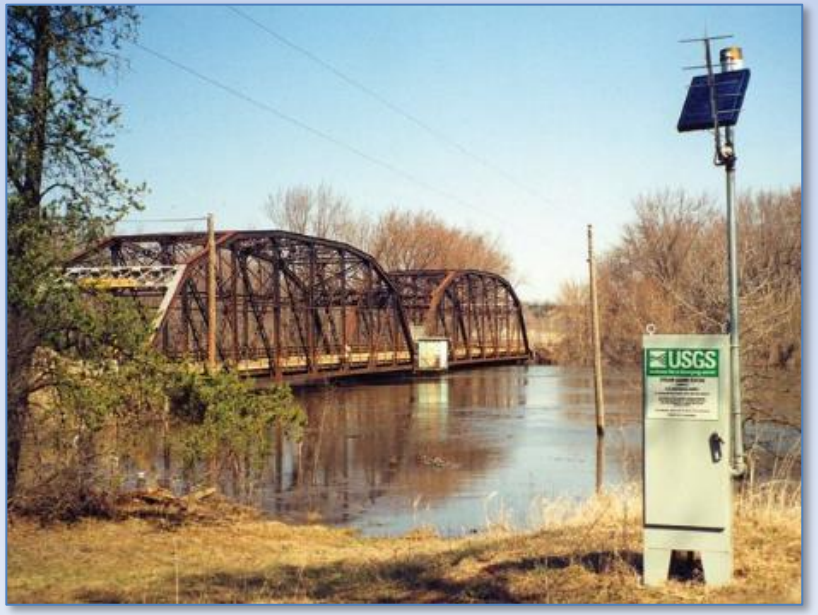

GWRP Model Grid
10,560 ft x 10,560 ft


Model Update Grid
2,000 ft x 2,000 ft

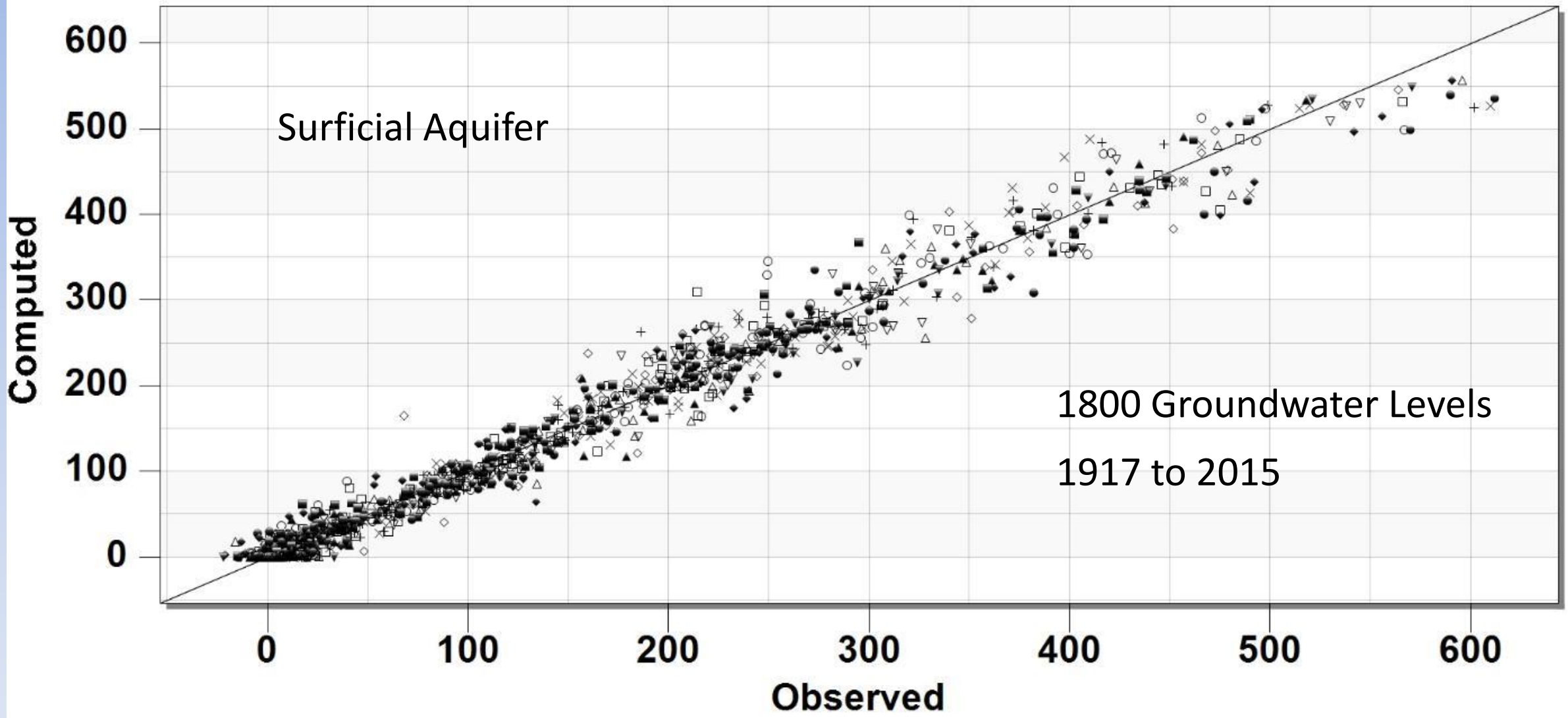
# Model Calibration

- Parameter Estimation (Inverse Modeling)
- About 37,000 Groundwater Levels from 1904-2015
- 1685 Annual Base-Flow Calculations from 46 Stream Gages
  - Period of Gaging: 1930's - 2015
- 16 Model Layers – Aquifers and Confining Units



# Computed vs. Observed Values

## Trans. Head

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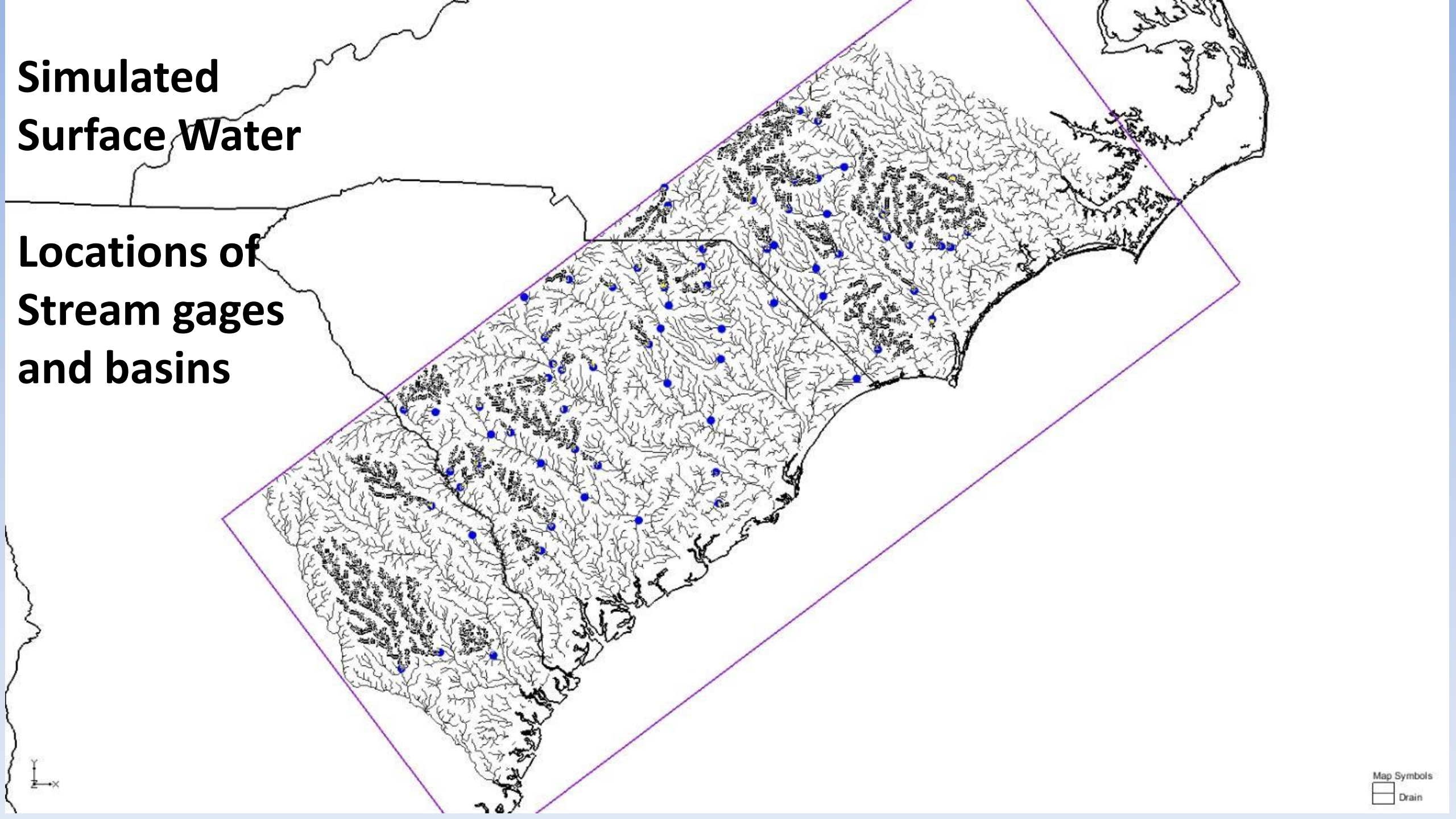
# Simulated Surface Water

# Locations of Stream gages and basins



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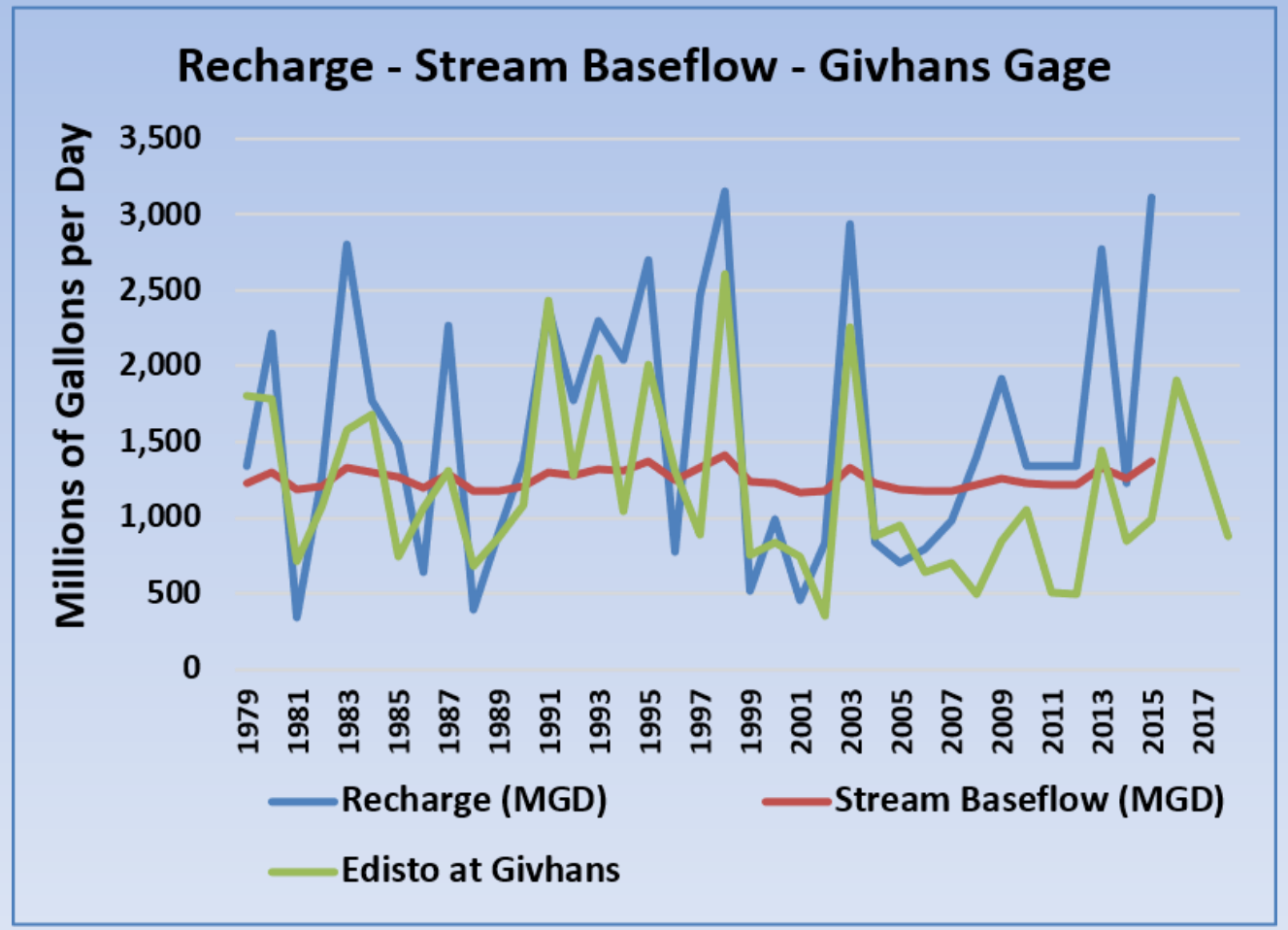
# Edisto Basin

**All Simulated**
**3,143 Square miles**
**2,011,352 Acres**

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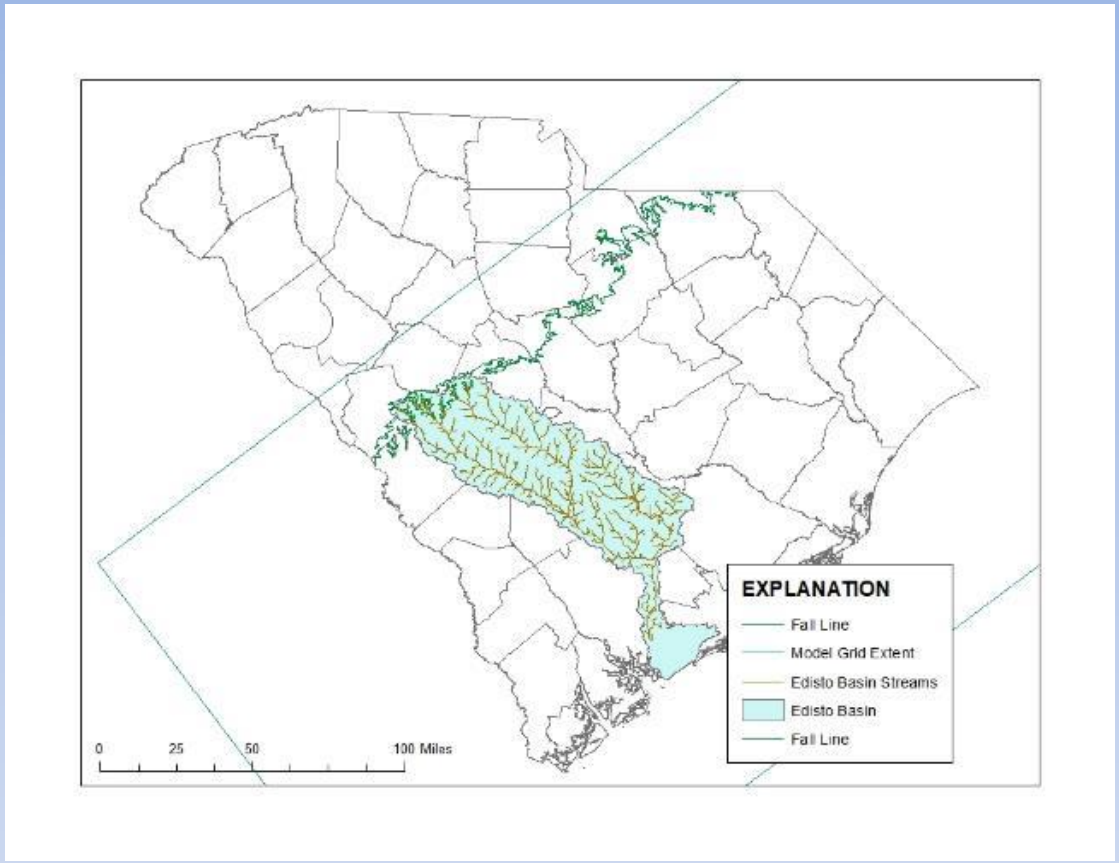
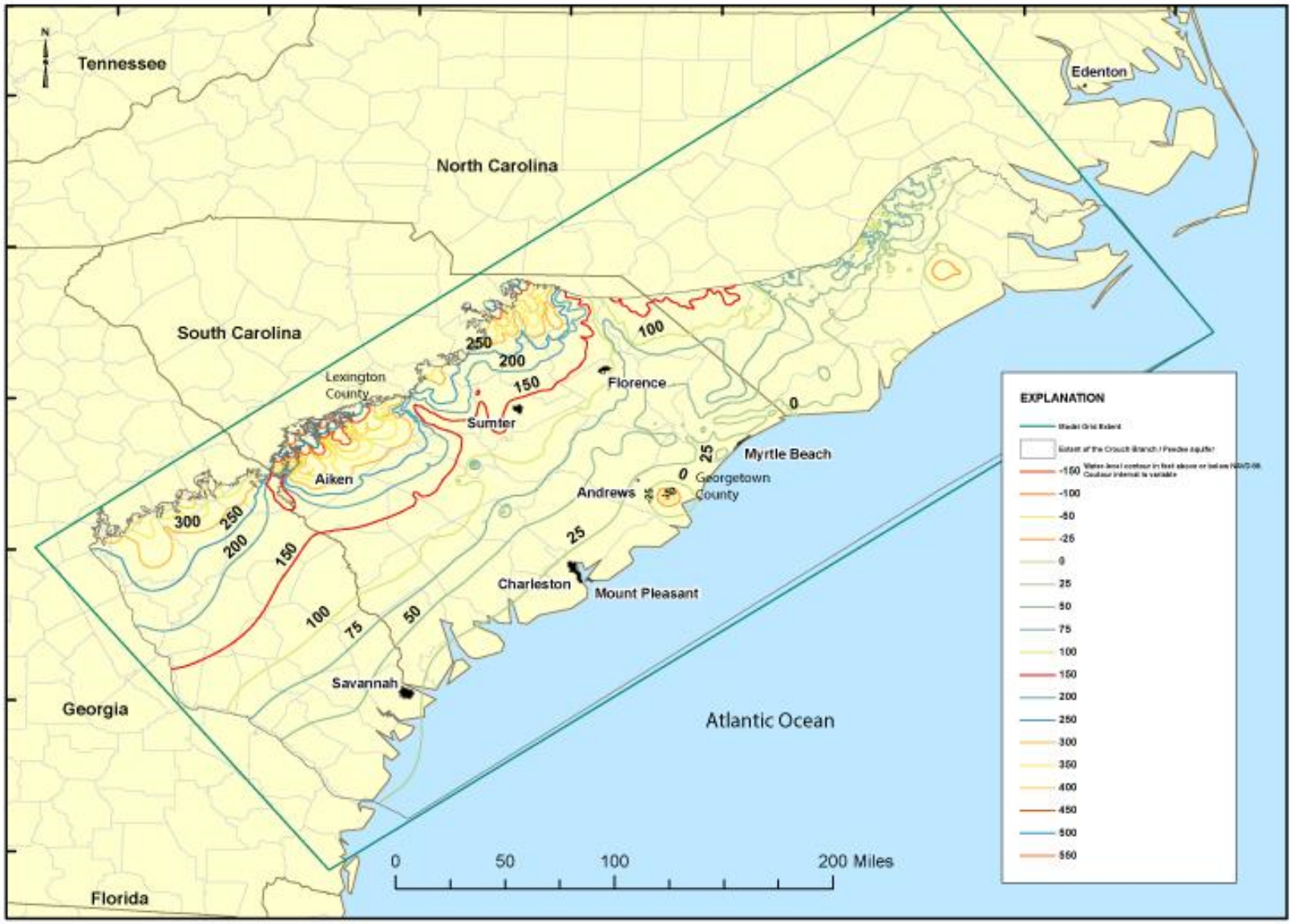



**Recharge (MGD)**
**Mean – 1,221**
**Max – 3,151 (1998)**
**Min – 344 (1981)**

**Stream Baseflow (MGD)**
**Mean – 1,254**
**Max – 1,407 (1998)**
**Min – 1,169 (2001)**

# Simulated 2015 GW levels for the Crouch Branch/Peedee aquifer

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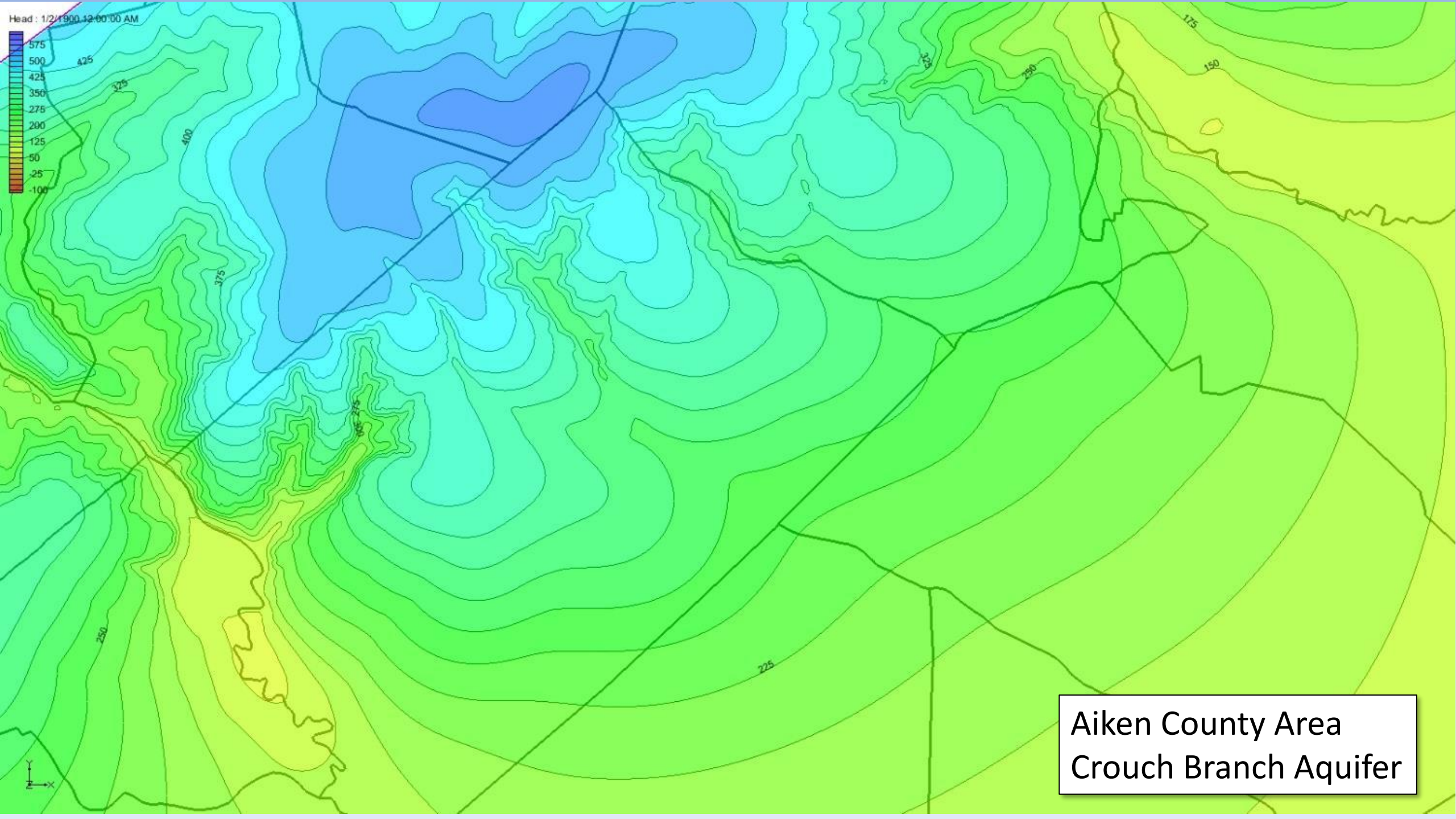
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Aiken County Area
Crouch Branch Aquifer

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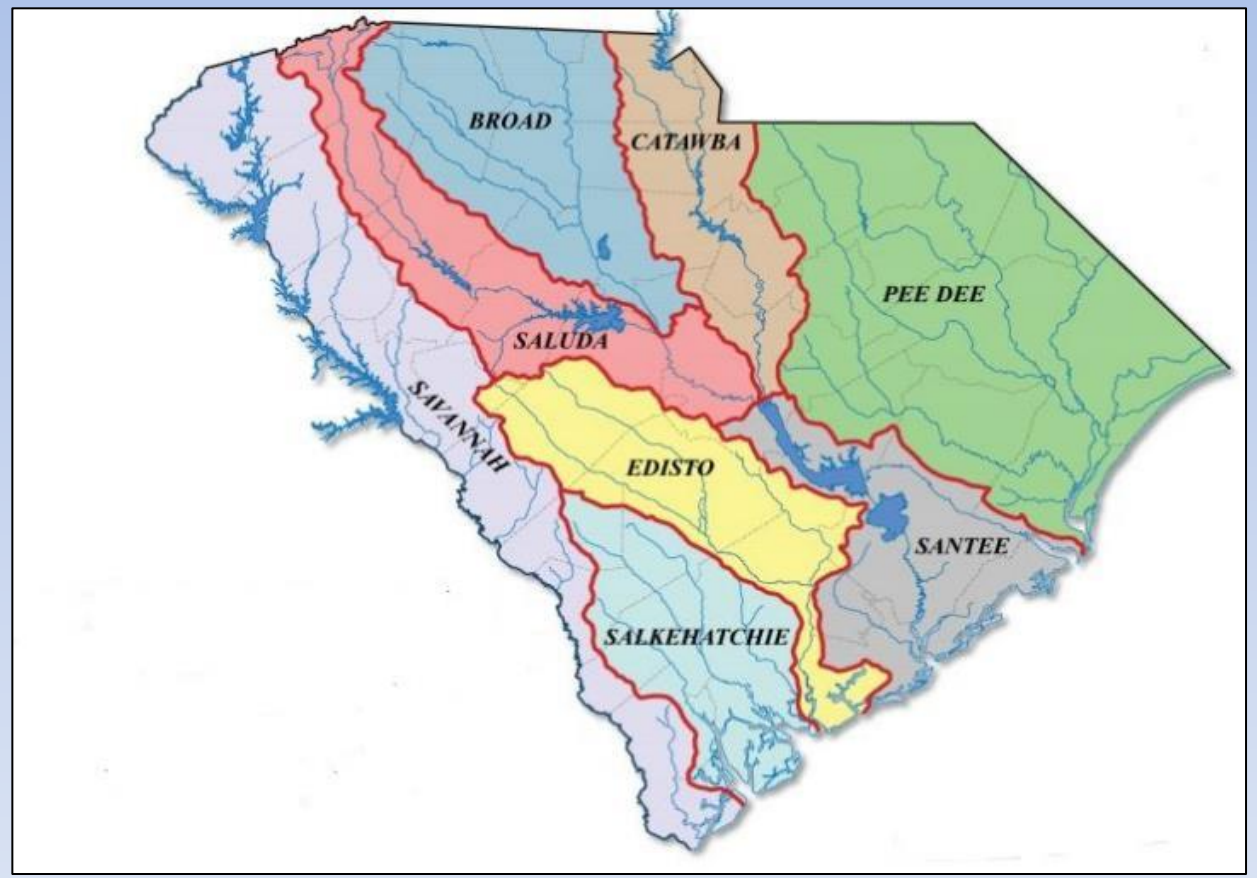
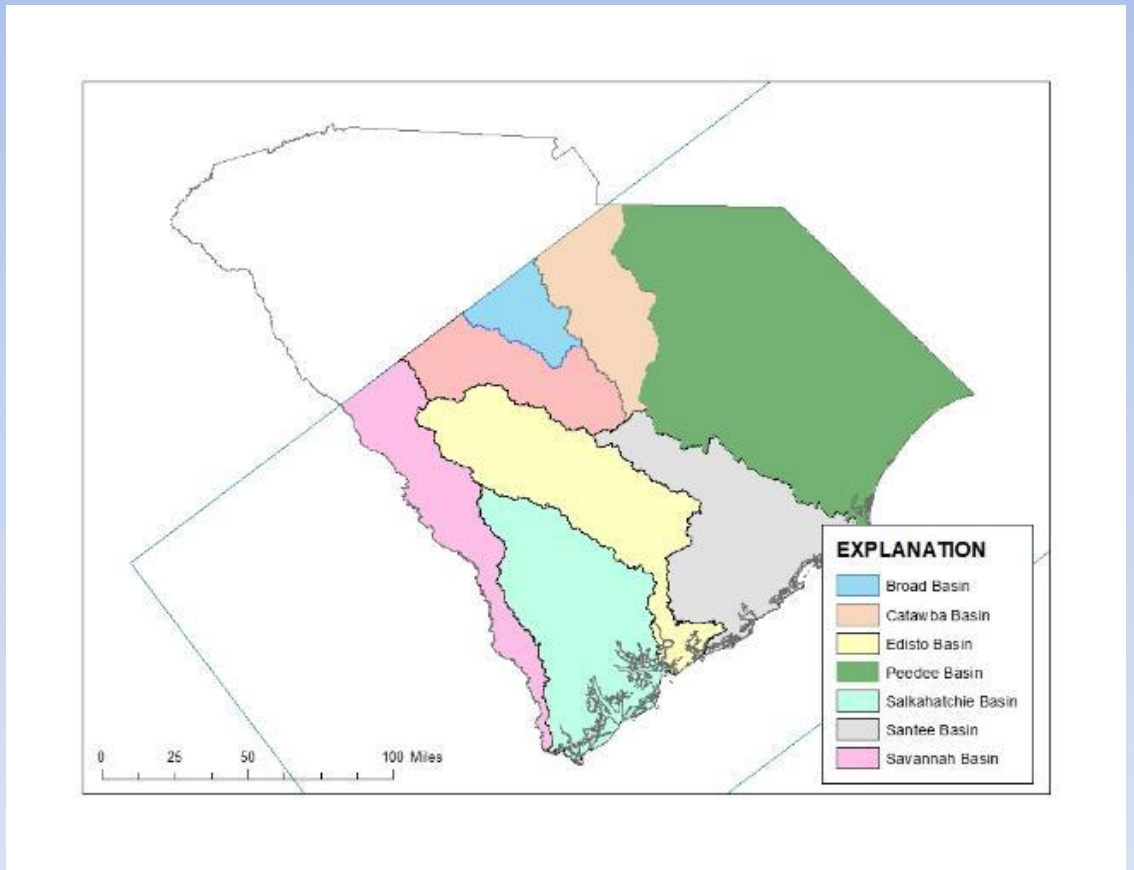
# SC River Basins




# Truncated River Basins

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# Groundwater Flow Model Limitations

- Based on limited data
- Simplification of the actual groundwater flow system
- Can limit the ability of the model to predict actual hydraulic conditions over time
- Accuracy and prediction capabilities of this model are affected by the finite-difference discretization, boundary conditions, hydraulic properties, and observations used in the model calibration
- Groundwater withdrawals simulated in the model underrepresent actual historical water use because pumping rates less than 3 million gallons per month are not required to be reported to the State agencies and, therefore, are unknown.

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# Proposed Groundwater Modeling Scenarios by USGS

Jimmy Clark
Matt Petkewich
Greg Cherry

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# Groundwater Scenarios

Predevelopment Groundwater Use
- Remove withdrawals and simulate levels prior to gw development
- Recharge rates from SWB model
- Focused on Edisto Basin

Current Groundwater Use
- Simulates current groundwater conditions from 2015-2065

Permitted Groundwater Use
- 2015-2065 simulation
- Maximum permitted pumping rates (Coastal Plain)
- Average historical (1979-2015) recharge rates

Business-as-Usual Water-Demand
- 2015-2065 simulation
- Assumes normal climate and moderate population/economic growth
- Average historical recharge

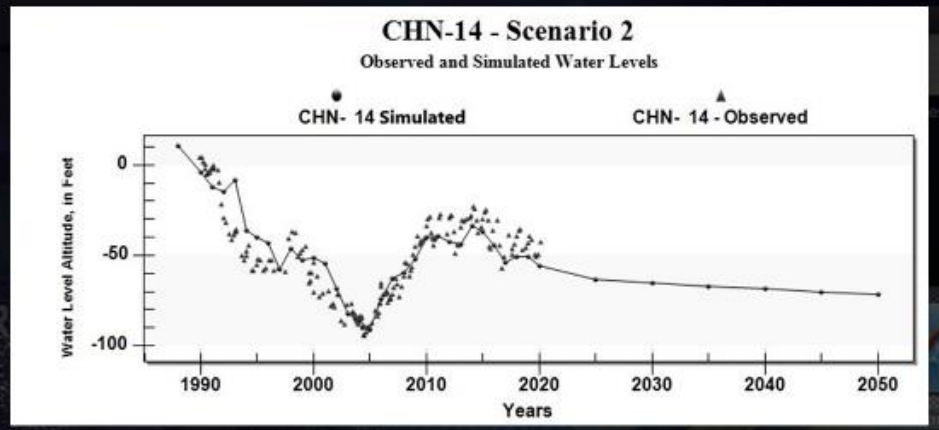
High Water-Demand Projection
- 2015-2065 simulation
- Assumes hot/dry climate and high population/economic growth
- Average historical recharge

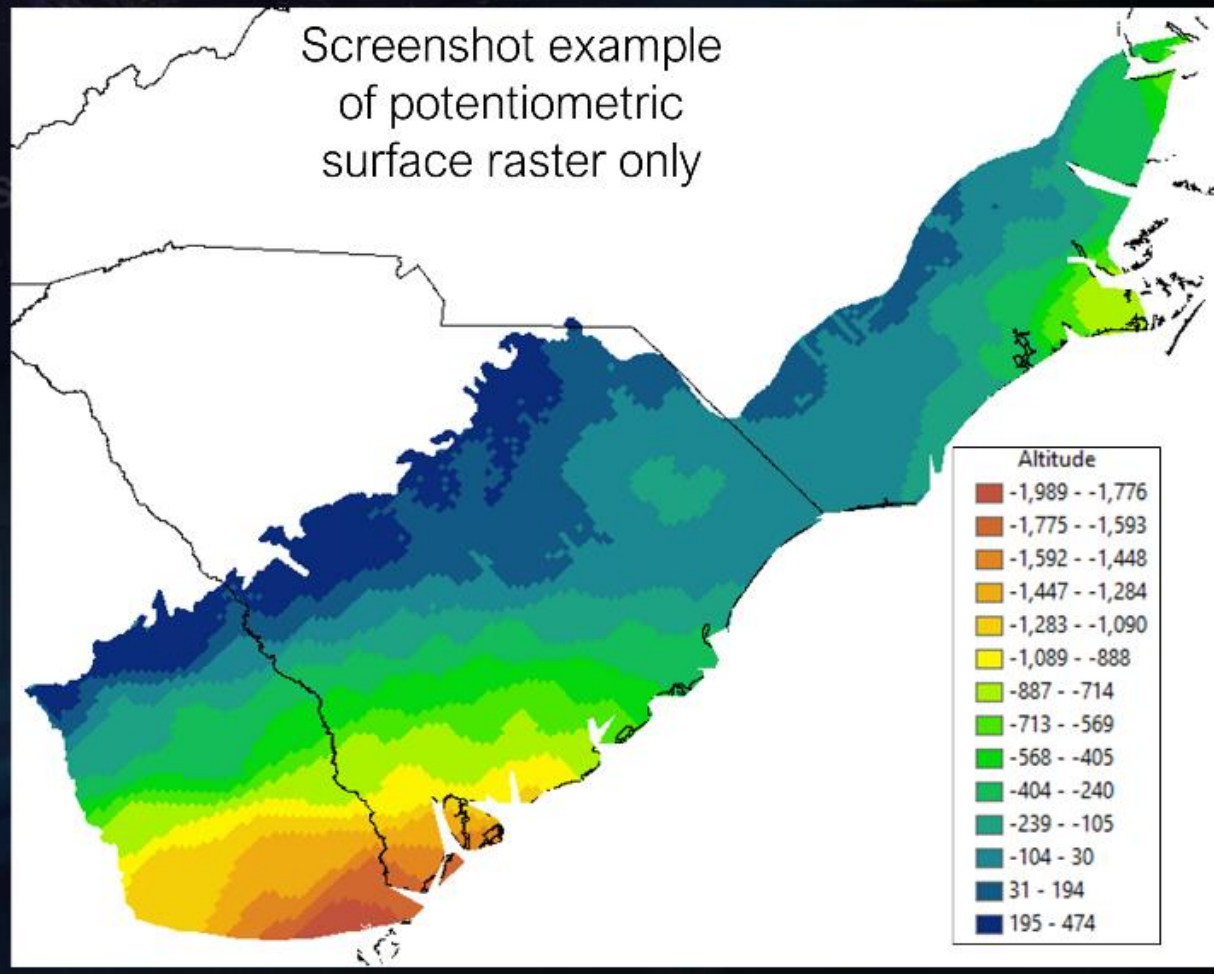
Potential Additional Scenarios
- Availability
- Management strategies

# Deliverables

Meetings
- Presentations of scenario results
  - Plots
  - Potentiometric surface figures (raster)

Publications
- Data Release(s)
  - Model inputs, outputs, and metadata



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# Summary

- Revised and Updated SC Coastal Plain GW model
- Addition of new data
- Recharge model and data
- Surficial aquifer actively simulated
- Model limitations
- Planned scenarios

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# Questions?


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**Greg Cherry**
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# July 21 RBC Field Trip

## Canoeing and CWS Intake Visit

# July 21 RBC Field Trip

- Meet: 8:30am on July 21st at Colleton State Park leave by 9am.
- Depart the Park and travel by shuttle to Simmons Boat Landing.
- 6 miles trip by river to Weeks Landing (across the river from the state park). The trip will take around 2.5 – 3 hrs. depending on river level.
- **Bring**: Sunscreen, snacks, water, bug spray, dry bag, some experience paddling on a river, change of clothes.
- **Provided:** PFD, Paddles, boats, transportation.
- Following lunch at the Park, RBC members will drive to visit the Charleston Water System intake at Givhans Ferry.

# Next Edisto RBC Meeting

## Wed, Aug 18 – Regular RBC Meeting
## Preliminary Agenda

### Informational Topics

| | |
|---|---|
| • Updated Surface Water Scenario Results | CDM Smith |
| • Initial Groundwater Scenario Results | USGS / DNR |

### RBC Discussion

| | |
|---|---|
| • Discussion of Groundwater Performance Measures | USGS / DNR / DHEC |