

Section 3

Review of Existing Regional Groundwater Flow Models

To support development of groundwater flow models for determination of the range of sustainable yields in the prioritized aquifers in Georgia, existing groundwater models that overlap the Coastal Plain of Georgia were reviewed and evaluated. The hydrogeological parameters used in these existing models were evaluated and incorporated in the regional Georgia Coastal Plain groundwater model discussed in Section 5 of this report. This section presents an overview of the existing models that contributed to the regional model.

3.1 Inventory of Existing Models

There are seven public domain groundwater flow models that either encompass the Coastal Plain of Georgia or include a portion of the Study Area, as noted in **Table 3-1**. The extents of these regional groundwater flow models are shown on **Figure 3-1**. A discussion of each model follows.

Table 3-1 Inventory of Public Domain Regional Groundwater Flow Models

Model Name	Citation	Area and Aquifers Modeled
USGS Southeastern Coastal Plain Clastic Aquifer System Model	Faye, R.E. and G.C. Mayer, 1996. USGS Professional Paper 1410-F.	Southeast Coastal Plain Clastic aquifers in Georgia and parts of Florida, Alabama, and South Carolina
SJRWMD Northeast Florida Model	Birdie, T.R., Burger, P., Huang, C., and D. Munch, 2008. SJRWMD Special Publication SJ2008-SP26.	Surficial and Floridan Aquifer Systems in Northeast Florida and Southeast Georgia
SRWMD North Florida/South Georgia Model	Schneider, J.W, Upchurch, S.B., Chen, J. and C. Cain, 2008. SRWMD.	Surficial, Intermediate, and Floridan Aquifer Systems in North Florida and South-Central Georgia
USGS Mega Model	Sepúlveda, N., 2002. USGS Water Resources Investigations Report 02-4009.	Intermediate and Floridan Aquifer Systems in Peninsular Florida
USGS Upper Floridan Aquifer Suwannee River Basin Model	Planert, M., 2007. USGS Scientific Investigations Report 2007-5031.	Upper Floridan Aquifer in North-Central Florida and South Georgia (Suwannee River Basin)
USGS Coastal Georgia Model	Payne, D.F., Rumman, M.A., and J.S. Clarke, 2005. USGS Scientific Investigations Report 2005-5089.	Surficial, Intermediate, and Floridan Aquifer Systems in Coastal Georgia and parts of South Carolina and Florida
USGS Upper Floridan Aquifer Model for Tallahassee, Florida	Davis, J.H. and B.G. Katz, 2007. USGS Scientific Investigations Report 2007-5070.	Upper Floridan Aquifer in Northwest Florida and Southwest Georgia

3.2 USGS Southeastern Coastal Plain Clastic Aquifer System Model for Georgia

The Coastal Plain Clastic Aquifer System (CPCAS) model was developed by the USGS using the MODFLOW code (Faye and Mayer, 1996). The model is a six-layer representation of the clastic deposits portion of the Coastal Plain Aquifer System in Georgia. The model layers are as follows:

- Layer 1 - The carbonate-based Upper Floridan Aquifer-Barnwell Aquifer as a constant (specified) head boundary;
- Layer 2 - Tallahatta-Gordon Aquifer;
- Layer 3 - Clayton-Ellenton Aquifer;
- Layer 4 - Providence Sand-Peedee Aquifer;
- Layer 5 - Eutaw-Midville Aquifer; and
- Layer 6 - Upper Atkinson-Upper Tuscaloosa Aquifers.

The confining units between the various aquifers are implicitly modeled as vertical leakance (i.e., no thickness and vertical hydraulic conductivity is specified for the confining units). The base of the model corresponds either to the base of Coastal Plain sediments or to the top of the middle Atkinson confining unit. Western and eastern model boundaries were simulated as a line of specified-head or zero flow, depending on aquifer and location. This coarse grid, steady-state model encompasses an area of approximately 60,000 square miles of the Coastal Plain of Georgia and contiguous parts of Alabama, South Carolina, and Florida.

This model was used to evaluate spatially extensive groundwater flow within major clastic aquifers of the Georgia sub-region. More specifically, this model was used to obtain a quantitative description of conditions of predevelopment (circa 1900) and modern (1980) sub-regional groundwater flow.

3.3 SJRWMD Northeast Florida Model

The Northeast Florida Groundwater Flow model was developed by the St. Johns River Water Management District (SJRWMD) (Birdie et al., 2008). The model consists of four layers in descending order:

- Layer 1 - Surficial aquifer;
- Layer 2 - Upper Floridan Aquifer;
- Layer 3 - Lower Floridan Aquifer; and
- Layer 4 - Fernandina Permeable Zone.

The base of the model corresponds to the sub-Floridan confining unit. The intermediate confining unit and the middle Floridan semi-confining unit are not modeled as layers, but are instead represented using vertical leakance. All four model layers are active layers with groundwater levels responding to pumping and flow. This coarse grid, steady-state model encompasses an area of approximately 11,560 square miles of northeast Florida and southeast Georgia. The model grid consists of uniform orthogonal elements with dimensions of 1 mile by 1 mile.

This model is used by the SJRWMD for water supply planning purposes and is also used in support of issuance of Consumptive Use Permits (CUPs).

3.4 SRWMD North Florida/South Georgia Model

Developed by consultants under contract to the Suwannee River Water Management District (SRWMD) (Schneider et al., 2008), the North Florida Groundwater Flow Model consists of five active layers in descending order:

- Layer 1 - Surficial aquifer;
- Layer 2 - Intermediate aquifer system and confining unit;
- Layer 3 - Upper Floridan Aquifer;
- Layer 4 - Middle semi-confining unit; and
- Layer 5 - Lower Floridan Aquifer.

The base of the model corresponds to the sub-Floridan confining unit. This coarse grid, steady-state model encompasses an area of approximately 25,000 square miles in northern Florida and southern Georgia. The model grid consists of uniform orthogonal elements with dimensions of 5,000 feet by 5,000 feet.

This model is used by the SRWMD for water supply planning purposes and CUP evaluations.

3.5 USGS Mega Model for Florida

The USGS Mega Model was developed for peninsula Florida and southern Georgia by the USGS (Sepúlveda, 2002) using the MODFLOW code. The model consists of four layers in descending order:

- Layer 1 - Surficial aquifer;
- Layer 2 - Intermediate aquifer system and confining unit;
- Layer 3 - Upper Floridan Aquifer; and
- Layer 4 - Lower Floridan Aquifer.

The top layer (model layer 1) consists of specified-head cells simulating the surficial aquifer system as a source-sink layer. The base of the model corresponds to the sub-Floridan confining unit. This coarse grid, steady-state model encompasses approximately 40,800 square miles of peninsular Florida and southern Georgia. The model grid consists of uniform orthogonal elements with dimensions of 5,000 feet by 5,000 feet.

This model was developed for the purpose of testing the conceptual understanding of the regional groundwater flow system of the intermediate aquifer system and the Floridan Aquifer System within the peninsular portion of Florida. It was also intended that the peninsular Florida model would support sub-regional groundwater modeling.

3.6 USGS Upper Floridan Aquifer Suwannee River Basin Model

A groundwater flow model was developed for Upper Floridan Aquifer in the Suwannee River basin in north-central Florida and south Georgia by the USGS (Planert, 2007) using the MODFLOW code. The model consists of a single active layer simulating the Upper Floridan Aquifer. This coarse grid, steady-state model encompasses an area of approximately 9,950 square miles of north Florida and south Georgia. The model grid consists of uniform orthogonal elements with dimensions of 5,000 feet by 5,000 feet.

This model was used to evaluate the groundwater and surface water interactions between the Upper Floridan Aquifer and the major streams of the Suwannee River Basin.

3.7 USGS Coastal Georgia Model

A groundwater flow model was developed for coastal Georgia and adjacent parts of South Carolina and Florida by the USGS (Payne et al., 2005) using the MODFLOW code. The model consists of seven active layers:

- Layer 1 - Surficial aquifer (constant heads);
- Layer 2 - Confining unit;
- Layer 3 - Brunswick Aquifer;
- Layer 4 - Upper Floridan Aquifer confining unit;
- Layer 5 - Upper Floridan Aquifer;
- Layer 6 - Lower Floridan Aquifer confining unit; and
- Layer 7 - Lower Floridan Aquifer.

The base of the model corresponds to the sub-Floridan confining unit. This coarse grid, steady-state model encompasses an area of approximately 42,155 square miles of coastal Georgia and adjacent parts of South Carolina and Florida. The model is horizontally discretized using irregular grid spacing, with elements ranging in dimensions from 4,000 feet by 5,000 feet to 16,500 feet by 16,500 feet.

This model was used to quantitatively describe conditions of predevelopment (pre-1900) and modern (1980 and 2000) sub-regional groundwater flow.

3.8 USGS Upper Floridan Aquifer Model for Tallahassee, Florida

A groundwater flow model was developed for northwest Florida (Tallahassee, Florida area) and south central Georgia by the USGS (Davis and Katz, 2007) using the MODFLOW code. The model consists of four layers in descending order:

- Layer 1 - Surficial aquifer;
- Layer 2 - Intermediate confining unit;
- Layer 3 - Upper portion of the Upper Floridan Aquifer; and
- Layer 4 - Lower portion of the Upper Floridan Aquifer.

The Upper Floridan Aquifer has been simulated with two layers even though the aquifer acts as a single water-bearing unit within the Study Area. The Upper Floridan Aquifer is bounded below by low-permeability sediments, represented in the model as a no-flow boundary. This coarse grid, steady-state model encompasses approximately 11,000 square mile area of northwest Florida and south-central Georgia. The model grid consists of non-uniform orthogonal elements. The largest cells are 10,290 feet by 10,290 feet; the smallest cells are 400 feet by 400 feet.

Groundwater from the Upper Floridan Aquifer is the sole source of water for Tallahassee, Florida, and the surrounding area. The City of Tallahassee currently operates 28 water-supply wells; 26 are distributed throughout the area, and 2 are located in Woodville, Florida. This model was used by the USGS to define the contributing areas for 26 of the City's water supply wells.

3.9 Summary

There are several published regional groundwater flow models of the Floridan Aquifer System or the Coastal Plain Clastic Aquifer System that cover either the Coastal Plain of Georgia or portions of the Coastal Plain of Georgia. Most of the models were developed using MODFLOW and were used for water supply planning purposes. No one model includes both the entire Coastal Plain carbonate (Floridan Aquifer System) and clastic aquifer system in Georgia.

