

# Saltwater Intrusion in the Floridan Aquifer System Near Downtown Brunswick, Georgia

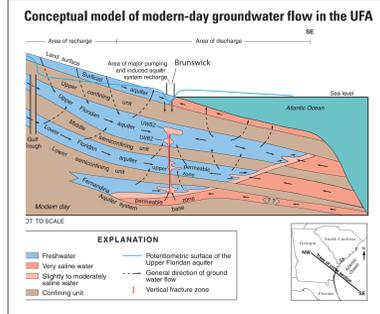
By Gregory S. Cherry and Michael F. Peck

## Introduction

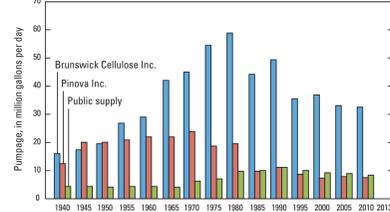
Since 1959, the U.S. Geological Survey cooperative water program (CWP) has been a key component to assess the movement of the chloride plume in the Brunswick area. The current CWP with the Georgia Department of Natural Resources, Environmental Protection Division (GaEPD), and the Brunswick-Glynn County Joint Water and Sewer Commission (JWSC) includes monitoring of groundwater levels and groundwater quality to assess movement of saltwater in the Floridan aquifer system (FAS).

The FAS consists of the Upper Floridan aquifer (UFA) and the Lower Floridan aquifer (LFA), which are composed of mostly Paleocene to Oligocene carbonate rocks that locally include Upper Cretaceous rocks (Miller, 1986; Krause and Randolph, 1989). Locally in southeastern Georgia and in the Brunswick/Glynn County area, the UFA consists of an upper water-bearing zone (UWBZ) and a lower water-bearing zone (LWBZ) identified by Wait and Gregg (1973). Near the city of Brunswick, the LFA is composed of two permeable zones, an early middle Eocene upper permeable zone (UPZ) and a highly permeable limestone of Paleocene and Late Cretaceous age, which includes a deeply buried, cavernous, and saline water-bearing unit known as the Fernandina permeable zone (FPZ) (Krause and Randolph, 1989). Maslia and Prowell (1990) inferred major northeast-southwest-trending faults through the downtown Brunswick area. Hydraulic head gradients caused by pumping in the UFA allow saline water from the FPZ of the LFA to migrate upward into the UFA through a system of faults and conduits.

During October 2014, data collection included synoptic water-level measurements in 49 wells to map the potentiometric surface of the UFA in the Brunswick/Glynn County area, and sampling a total of 52 wells completed in the FAS for chloride concentrations. Results from 32 of the wells sampled indicate the shape of the chloride plume in the UFA near downtown Brunswick has remained relatively unchanged in recent years (Peck and others, 2013). The results from the October 2014 chloride sampling in 21 wells were compared to the previous year (July 2013) and June 2000 to assess changes within the chloride plume area.



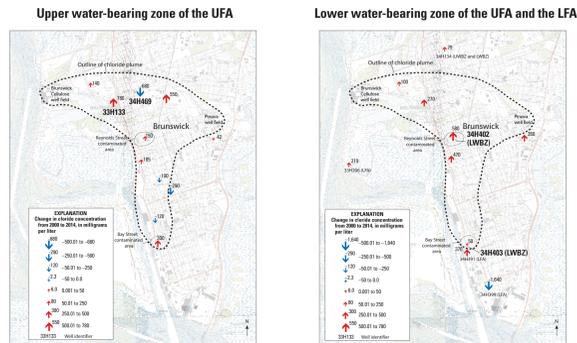
## Groundwater Use



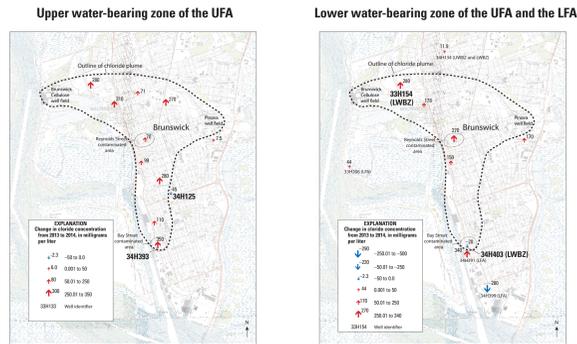
- Groundwater use peaked in the early 1980s with average pumping rates by local industry of 78.3 million gallons per day (Mgal/d) and average pumping for public supply of 9.8 Mgal/d
- During 2010, withdrawal for public supply for Glynn County was 8.4 Mgal/d compared to 9.8 Mgal/d during 1980 despite an increase in population from 54,980 in 1980 to 79,626 in 2010
- Water conservation during late-2011 by Brunswick Cellulose Inc. reduced their demand to 24.8 Mgal/d during 2014 and water demand at Pinova Inc. was lowered to 5.2 Mgal/d during 2013

## Chloride Concentrations in the Floridan Aquifer System

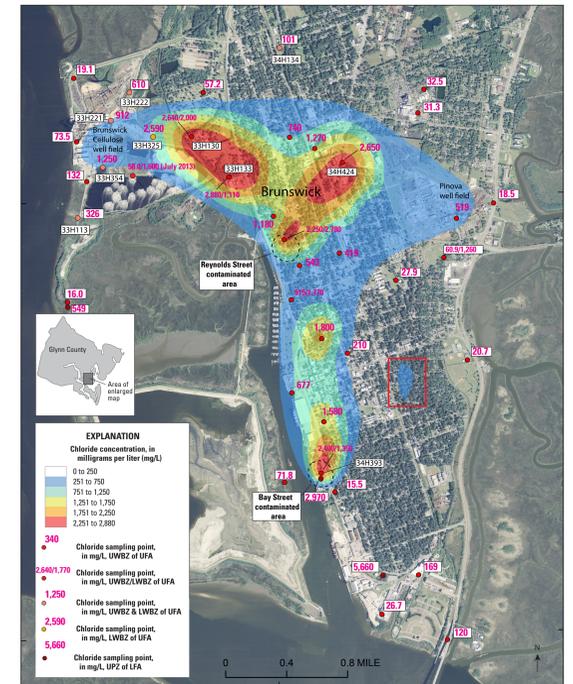
### Change in Chloride Concentration from June 2000 to October 2014



### Change in Chloride Concentration from July 2013 to October 2014

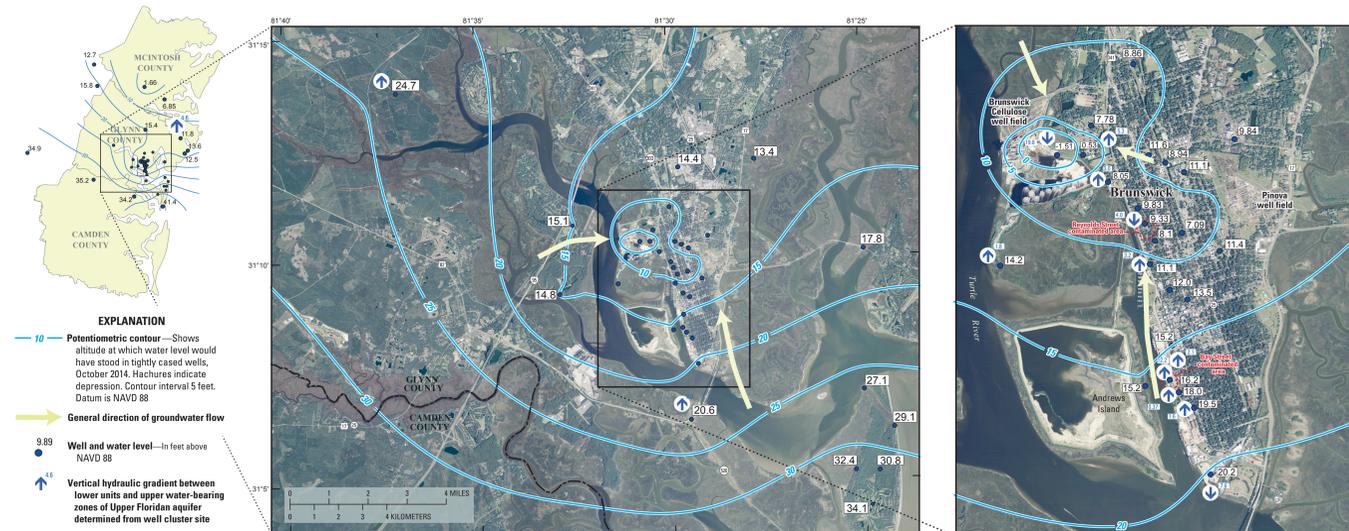


### October 2014



- During October 2014, the mapped chloride plume shows concentrations in the UWBZ of the UFA were greater than 2,250 mg/L (red zone) in wells 33H133 (2,880 mg/L), 34H424 (2,650 mg/L), 33H130 (2,640 mg/L), and 34H393 (2,400 mg/L)
- Chloride concentrations in four Brunswick Cellulose Inc. production wells (33H113, 33H221, 33H222, and 33H354) open to both the UWBZ and LWBZ ranged from 326 mg/L (33H113) to 1,250 mg/L (33H354), which indicates poor water quality in the LWBZ of the UFA
- Well 34H134 open to the UWBZ and LWBZ of the UFA had a chloride concentration of 101 mg/L during October 2014, which was an increase of 78 mg/L from the sample collected during June 2000 (see poster at this conference by Hamrick and Cherry "Monitoring Saltwater Contamination in the Upper Floridan Aquifer, Brunswick, Georgia")

## Groundwater Flow in the Upper Floridan Aquifer and Vertical Movement in the Floridan Aquifer System



- The potentiometric-surface for the UWBZ of the UFA during October 2014 shows the continued presence of a cone of depression caused by pumping near Brunswick
- Maximum upward hydraulic head gradient of 12.2 feet was determined between the FPZ of the LFA and the UWBZ of the UFA within the Bay Street contaminated area
- Three well cluster sites located near the Bay Street contaminated area had upward hydraulic head gradients between the LWBZ and UWBZ of the UFA during October 2014 and ranged from 0.37 to 2.1 feet
- Three of four well cluster sites located near the Reynolds Street contaminated area had upward hydraulic head gradients

- between the LWBZ and UWBZ of the UFA during October 2014 and ranged from 3.0 to 5.3 feet
- A steep downward hydraulic head gradient of 19.8 feet was observed during October 2014 between the UWBZ and LWBZ of the UFA 0.3 mile east the Brunswick Cellulose well field

- Comparison of 11 chloride samples collected during June 2000 and October 2014 in wells open to the UWBZ of the UFA indicate a maximum increase of 780 mg/L (well 33H133) and a maximum decrease of -680 mg/L (34H469) with a mean increase of 92 mg/L
- Comparison of 7 chloride samples collected during June 2000 and October 2014 in wells open to the LWBZ of the UFA indicate general increases ranging from 50 mg/L (well 34H403) to 580 mg/L (34H402) with a mean increase of 258 mg/L
- Comparison of 11 chloride samples collected during July 2013 and October 2014 in wells open to the UWBZ of the UFA indicate a maximum increase of 350 mg/L (well 33H393) and a maximum decrease of -45 mg/L (well 34H125) with a mean increase of 166 mg/L
- Comparison sets of 7 chloride samples collected during July 2013 and October 2014 in wells open to the LWBZ of the UFA indicate a maximum increase of 280 mg/L (well 33H154) and a maximum decrease of -20 mg/L (well 34H403) with a mean increase of 143 mg/L

## References

Krause, R.E., and Randolph, R.B., 1989, Hydrology of the Floridan aquifer system in southeast Georgia and adjacent parts of Florida and South Carolina: U.S. Geological Survey Professional Paper 1403-D, 65 p., 18 pl.

Maslia, M.L., and Prowell, D.C., 1990, Effects of faults on fluid flow and chloride contamination in a carbonate aquifer system: Journal of Hydrology, v. 115, nos. 1-4, p. 1-49. (Also available at <http://pubs.usgs.gov/publication/70016336>.)

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Wait, R.L., and Gregg, D.O., 1973, Hydrology and chloride contamination of the principal artesian aquifer in Glynn County: Georgia Department of Natural Resources Hydrologic Report, 93 p.