Water-level Trends in Aquifers of South Carolina

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South Carolina Department of Natural Resources
Land, Water & Conservation Division
October 10, 2012

South Carolina Ground-Water Monitoring Network

- Collaborative effort between 3 agencies:
  - South Carolina Department of Natural Resources (SCDNR) - **115** wells
  - South Carolina Department of Health and Environmental Control (SCDHEC) - **40** wells
  - United States Geologic Survey (USGS) - **21** wells

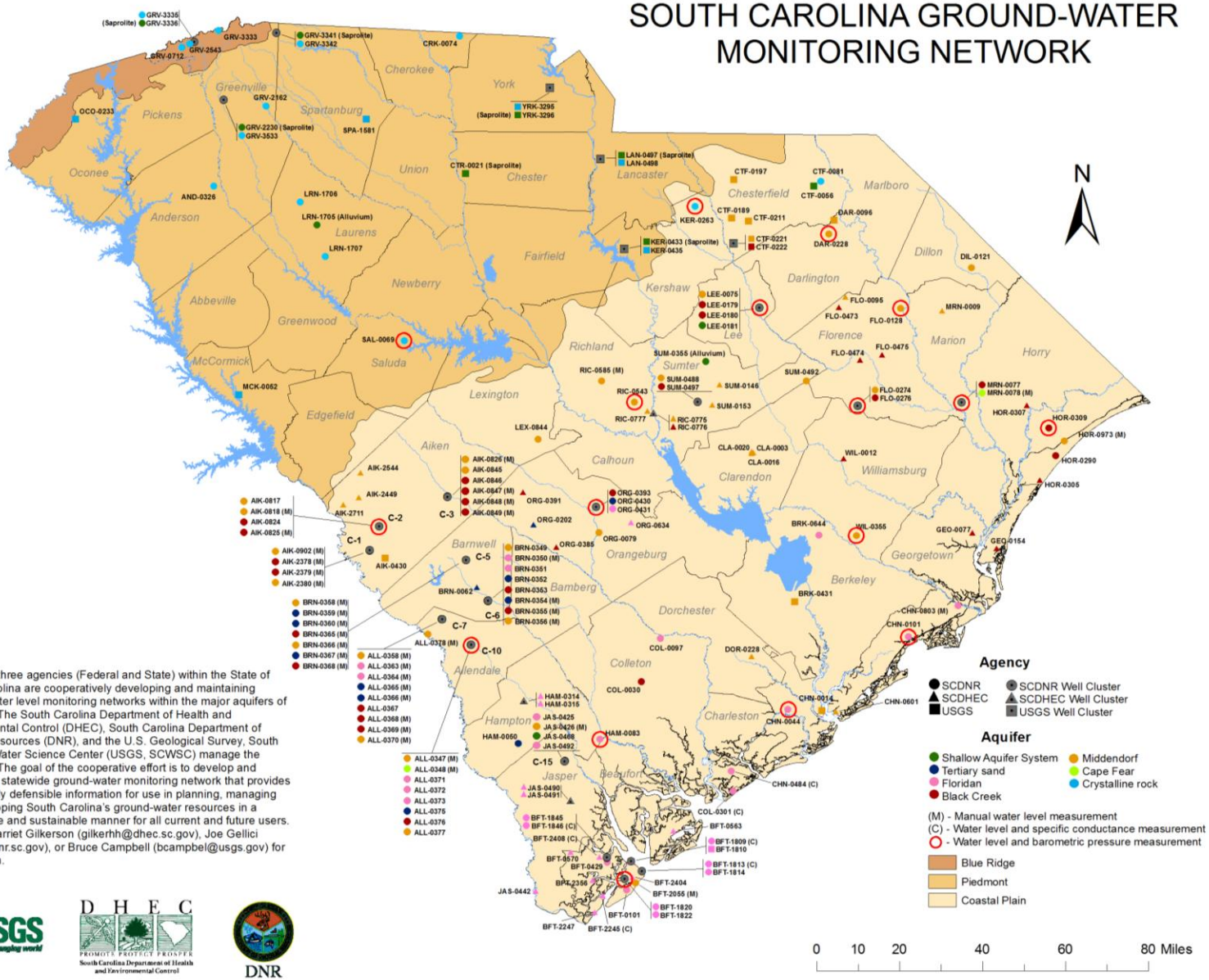
"The goal of this cooperative effort is to develop and maintain a statewide ground-water monitoring network that provides scientifically defensible information for use in planning, managing, and developing South Carolina's ground-water resources in a responsible and sustainable manner for all current and future users."

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

D H E C
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control

USGS
science for a changing world

SOUTH CAROLINA GROUND-WATER MONITORING NETWORK



Currently, three agencies (Federal and State) within the State of South Carolina are cooperatively developing and maintaining ground-water level monitoring networks within the major aquifers of the State. The South Carolina Department of Health and Environmental Control (DHEC), South Carolina Department of Natural Resources (DNR), and the U.S. Geological Survey, South Carolina Water Science Center (USGS, SCWSC) manage the networks. The goal of the cooperative effort is to develop and maintain a statewide ground-water monitoring network that provides scientifically defensible information for use in planning, managing and developing South Carolina's ground-water resources in a responsible and sustainable manner for all current and future users. Contact Harriet Gilkerson (gilkerhh@dhec.sc.gov), Joe Gellici (gellicij@dnr.sc.gov), or Bruce Campbell (bcampbel@usgs.gov) for information.

USGS science for a changing world

D H E C PROMOTE PROTECT PROSPER South Carolina Department of Health and Environmental Control

DNR

Map prepared by the Land, Water & Conservation Division of the South Carolina Department of Natural Resources, September 2012.

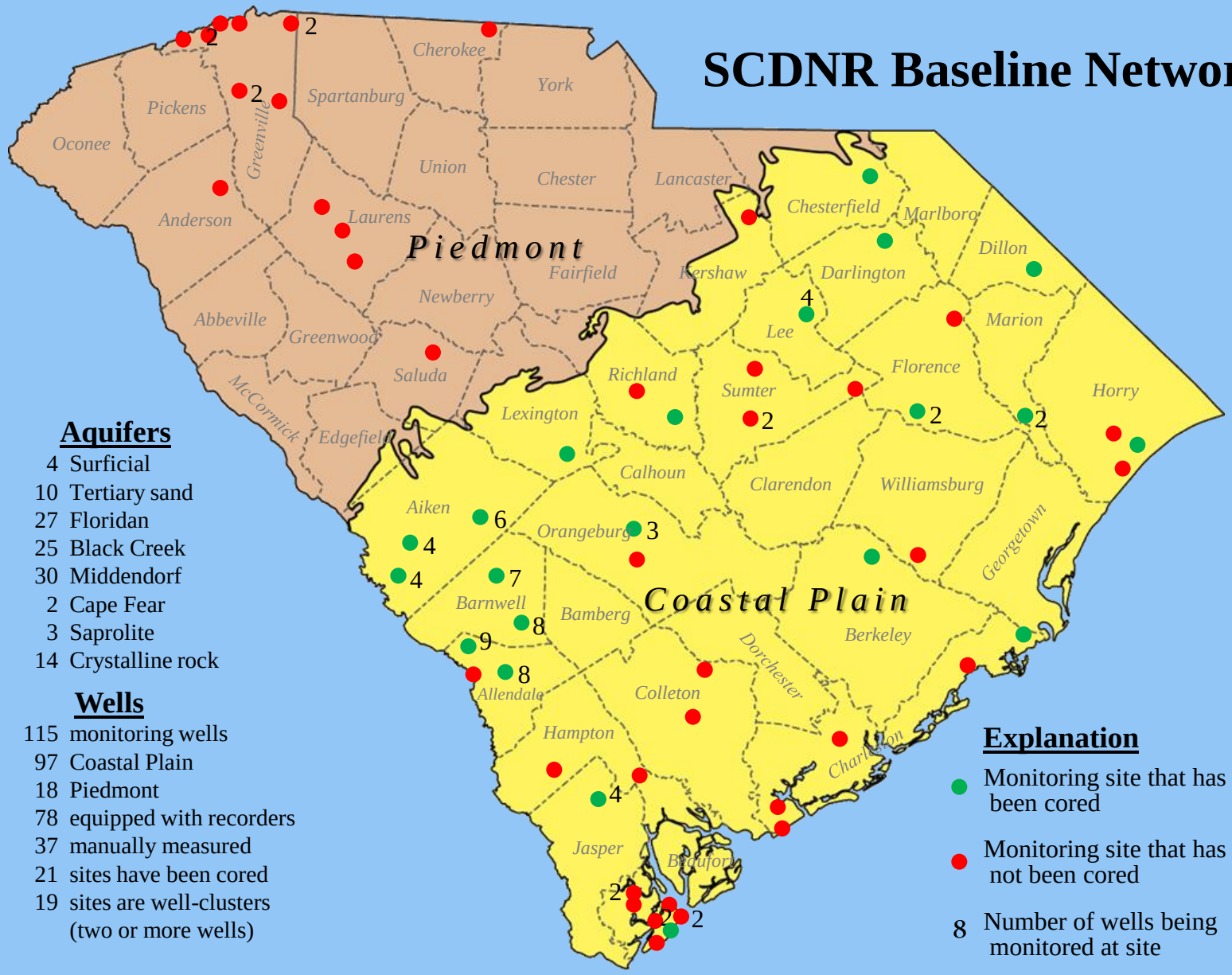
Purpose of Ground-Water Monitoring Network

- Establish long-term ground water dataset to support
  - Ground-water management and permitting
  - Drought assessments
  - Identification of long-term trends
  - Ground-water flow modeling
  - Water-level (potentiometric) mapping
  - Evaluation of ground-water availability

SCDNR Baseline Ground-Water Monitoring Network

- 115 wells – most owned by SCDNR
- 78 wells – Equipped with automatic data recorders (ADRs) which record hourly water levels.
- 37 wells – Periodic measurements made every 2-3 months.
- Periods of Record
  - range from several months to over 50 years
  - 10-15 years is typical

SCDNR Baseline Network



Aquifers

4 Surficial
10 Tertiary sand
27 Floridan
25 Black Creek
30 Middendorf
2 Cape Fear
3 Saprolite
14 Crystalline rock

Wells

115 monitoring wells
97 Coastal Plain
18 Piedmont
78 equipped with recorders
37 manually measured
21 sites have been cored
19 sites are well-clusters (two or more wells)

Explanation

Monitoring site that has been cored

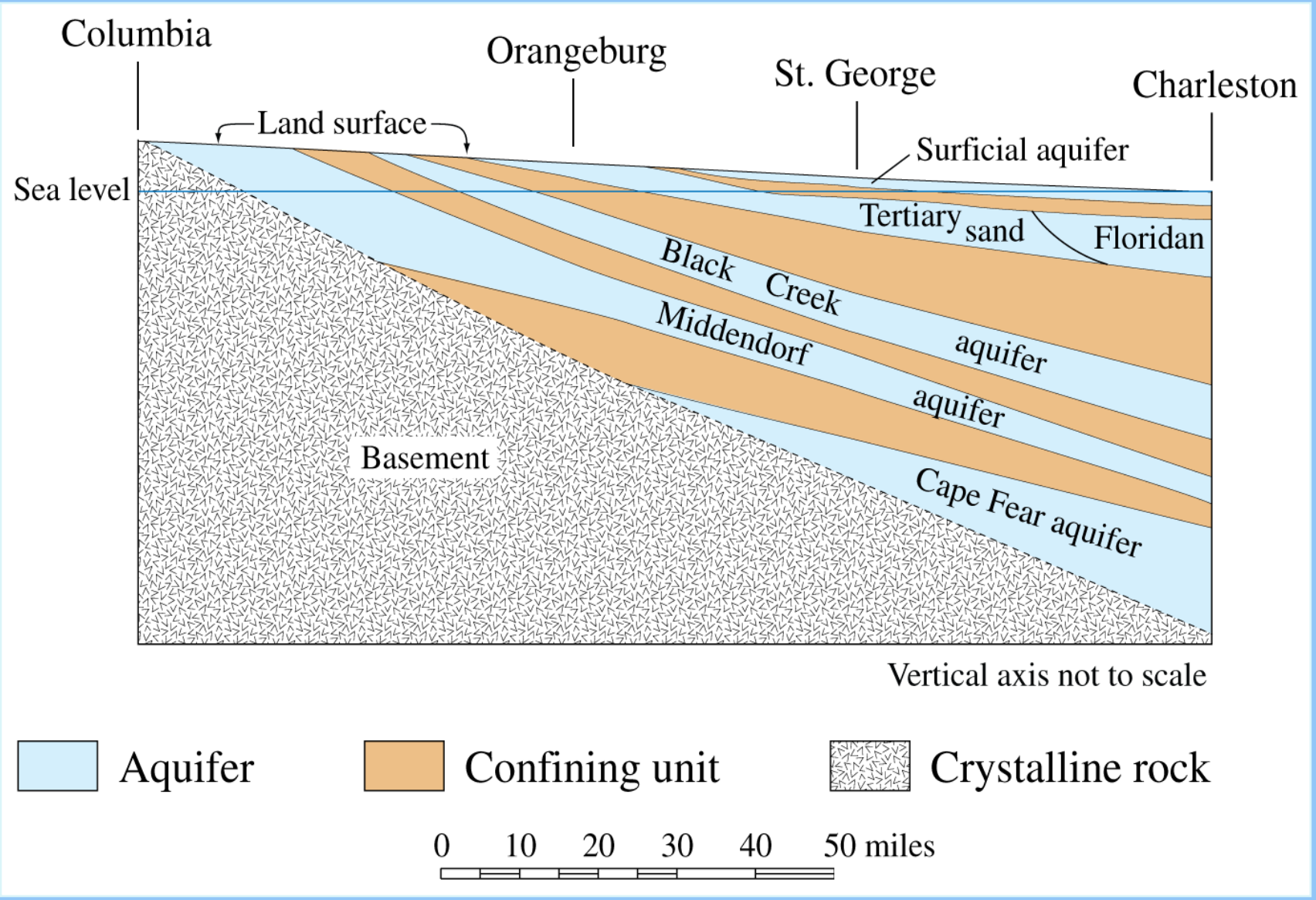
Monitoring site that has not been cored

8 Number of wells being monitored at site

Methods

- Field visits are taken every 2-3 months
  - Manual measurements are recorded
  - ADRs (predominantly of the pressure transducer variety) are downloaded
  - ADRs are calibrated, fixed or replaced as needed
- Manual and downloaded hourly data are checked for quality assurance and quality control and entered into SCDNR database
- Daily average water levels are computed from hourly data and converted to depths below land surface

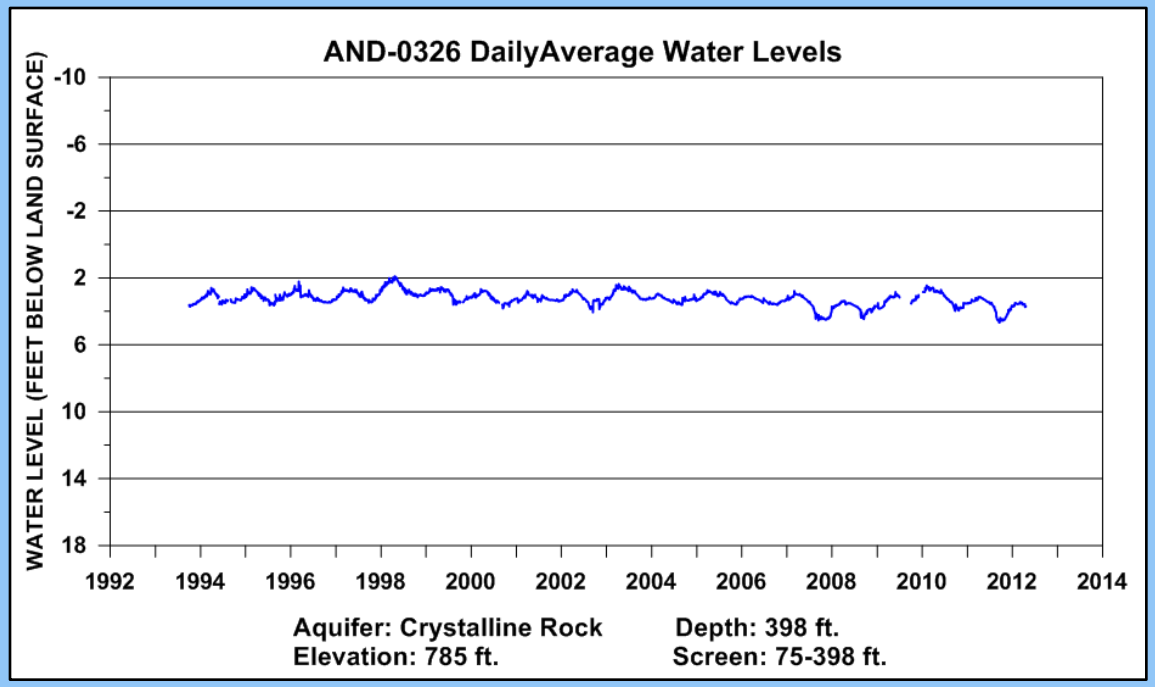
Principal Coastal Plain Aquifers



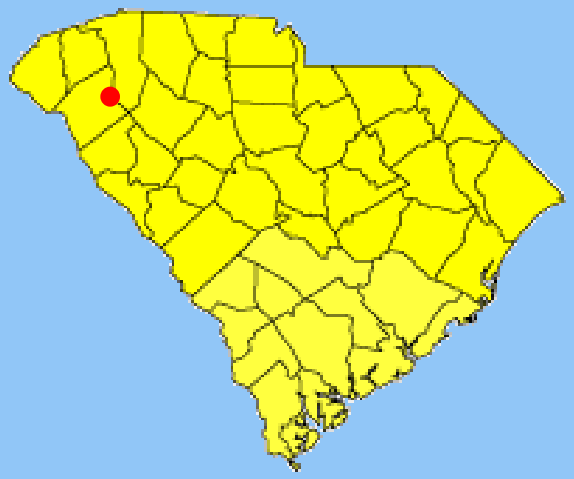
Interpreting Ground-Water Behavior Can Be Challenging:

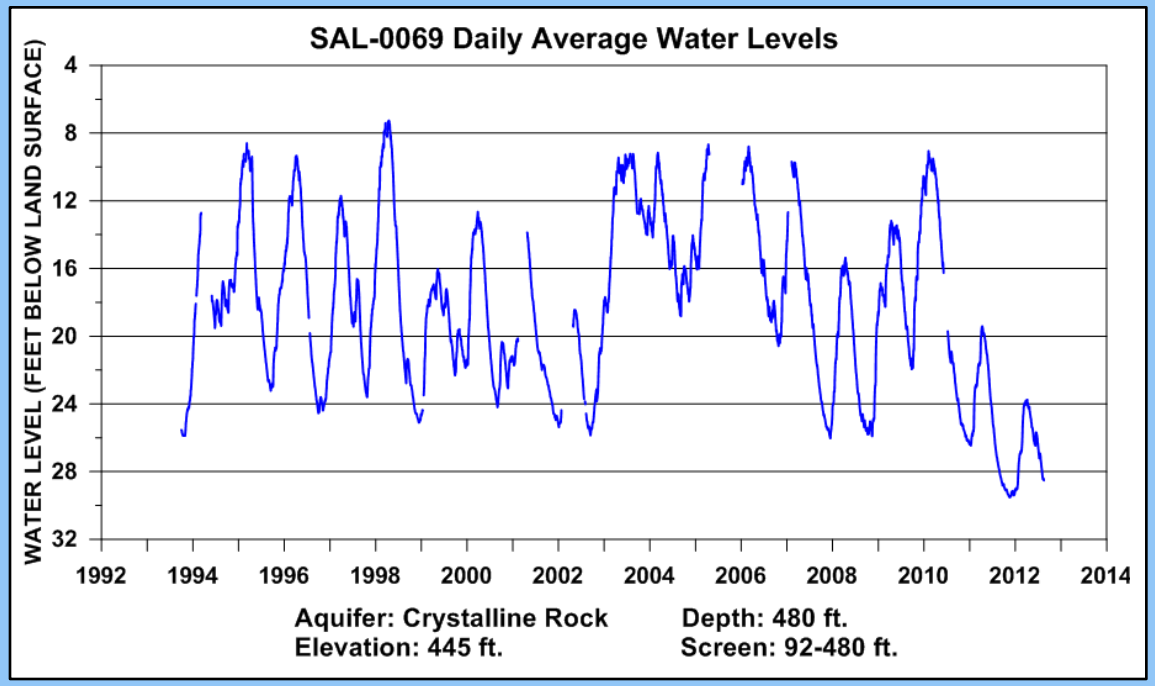
- Some sites have inadequate periods of record from which to evaluate long-term trends.
- Can be difficult to distinguish between the impacts of drought and impacts of pumping.
- Limited spatial distribution of wells.
- Incomplete ground-water use data (historically and currently).

Water-Level Trends in the Crystalline Rock Aquifer

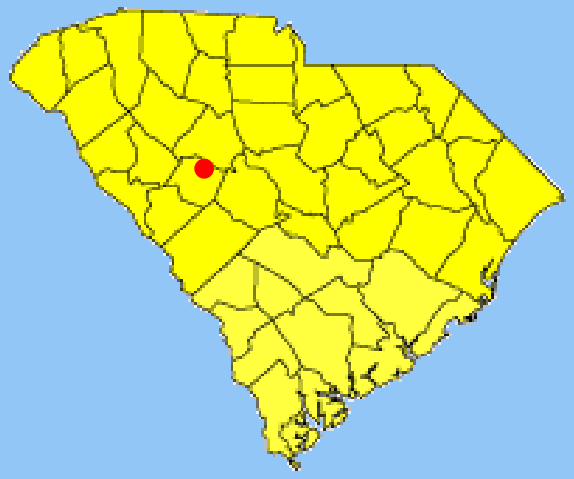


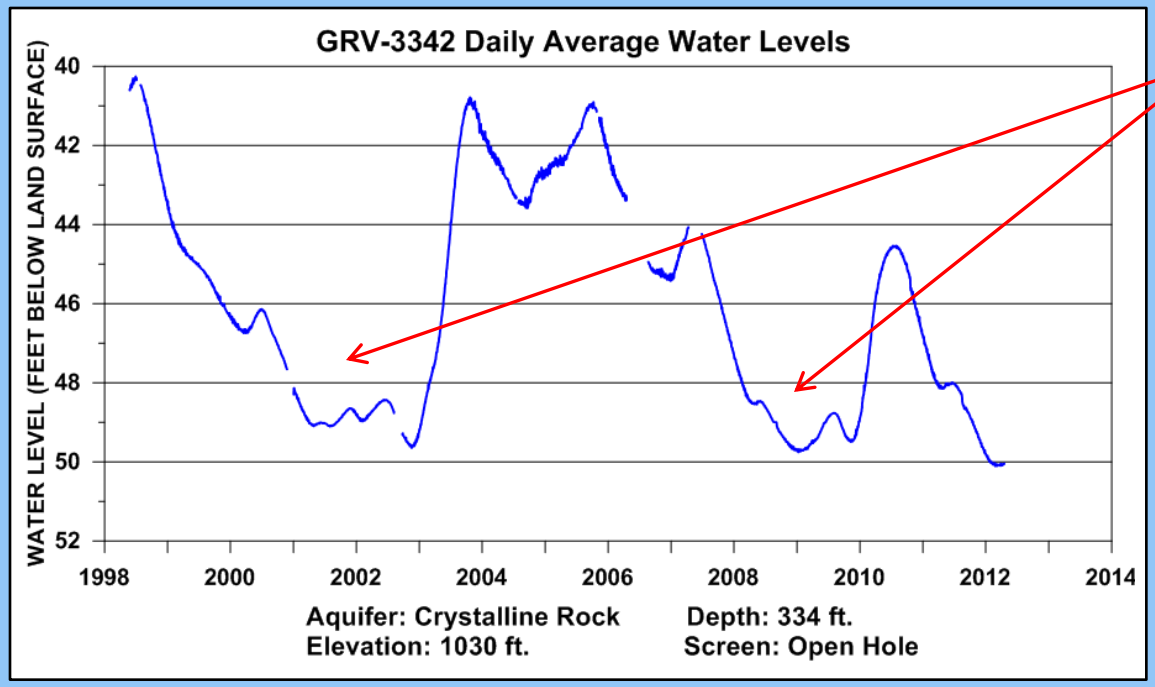
Small seasonal variations



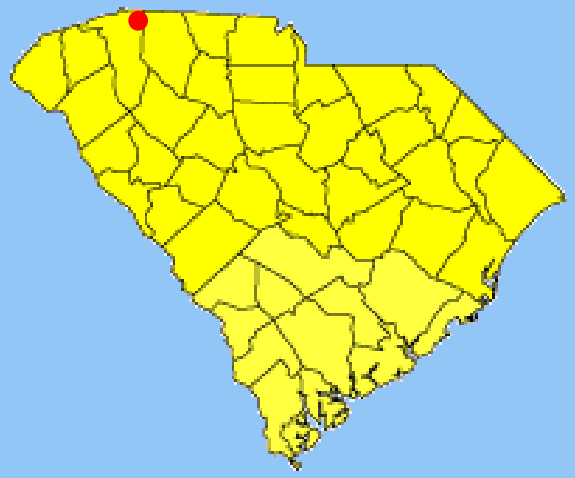


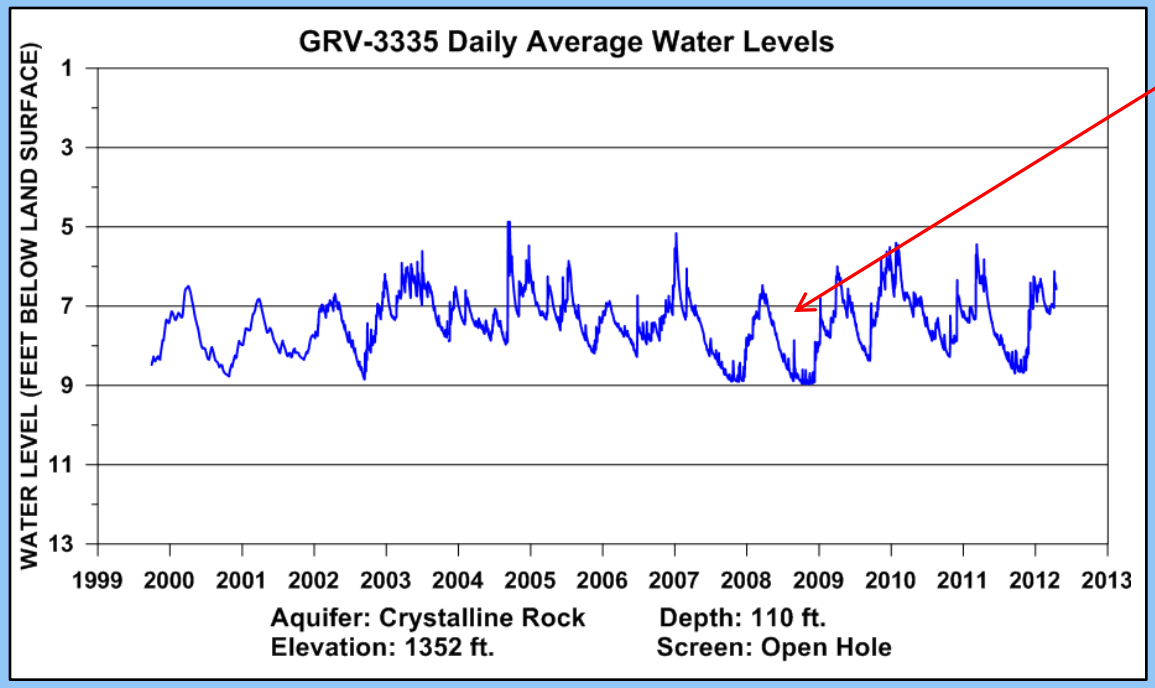
Large seasonal variations



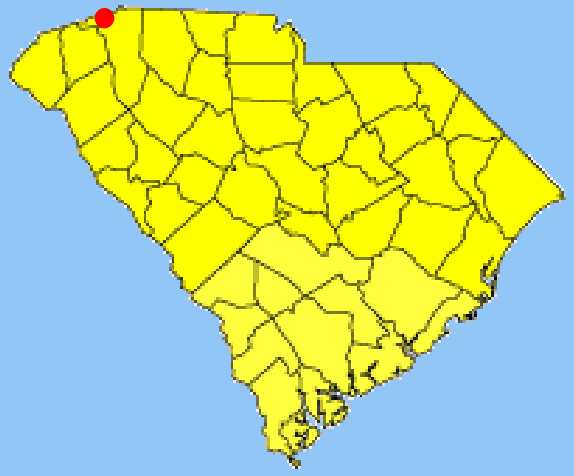


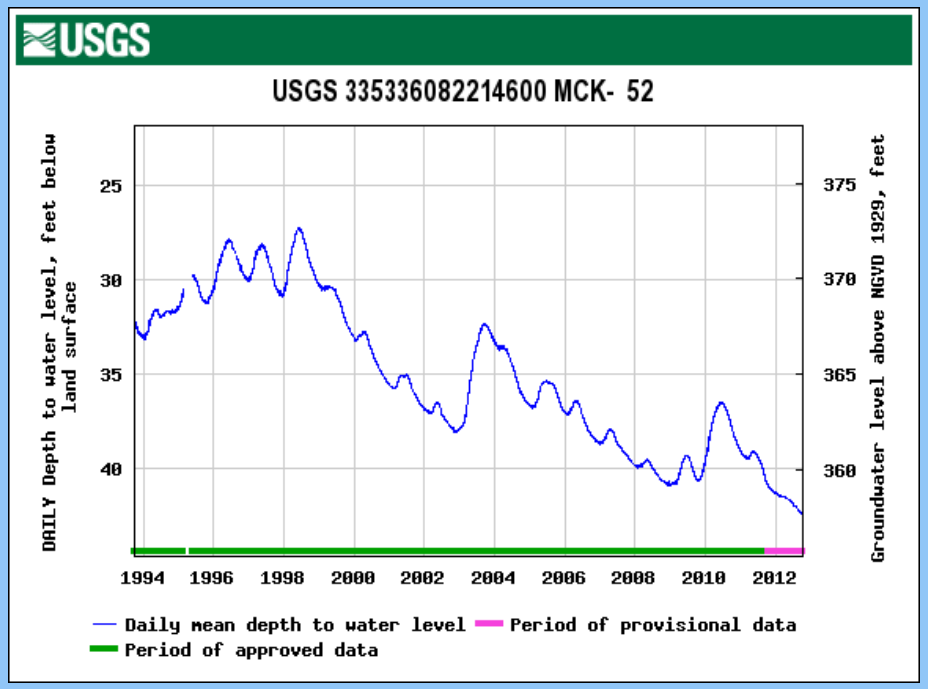
Strong drought signature

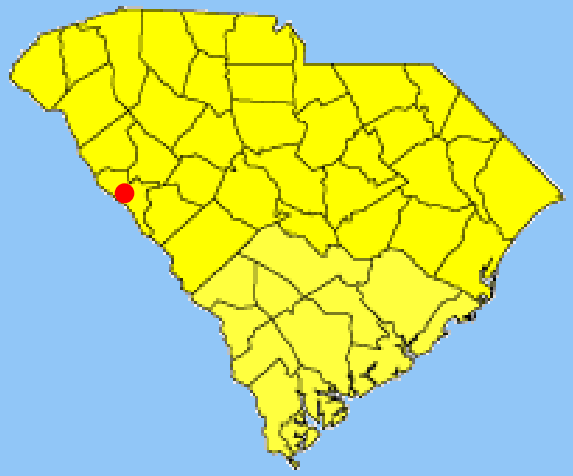




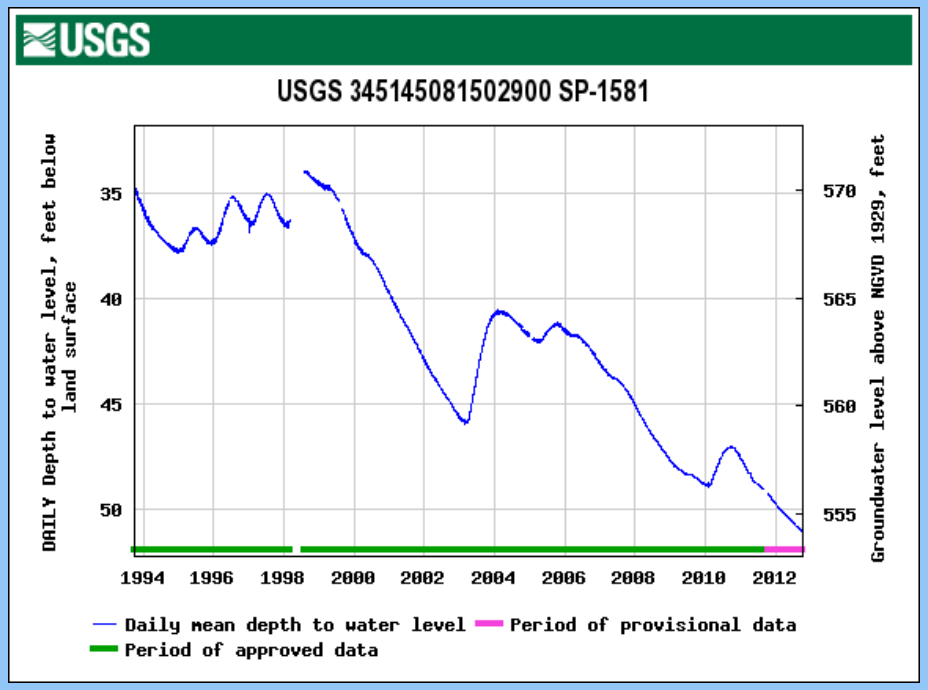
Weak drought signature

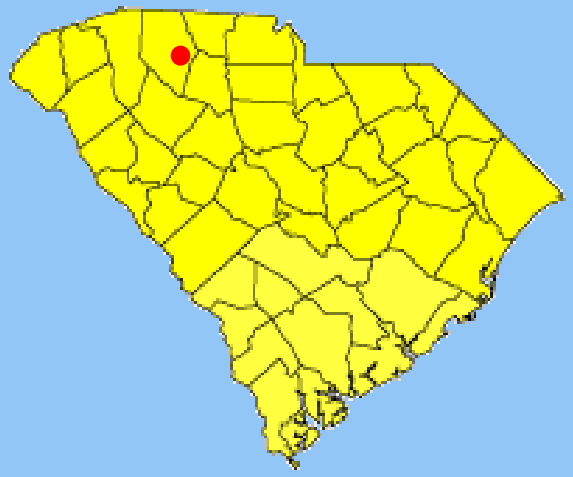




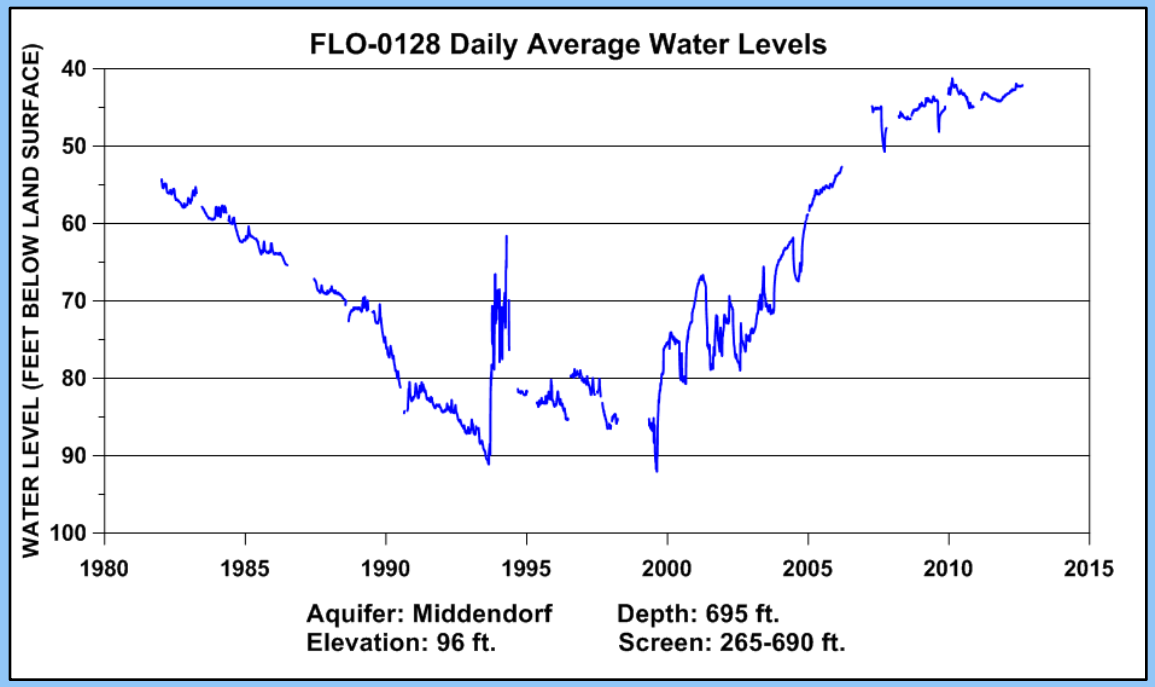


Weak recovery after 1998-2002 and 2007-2008 droughts and overall downward trends

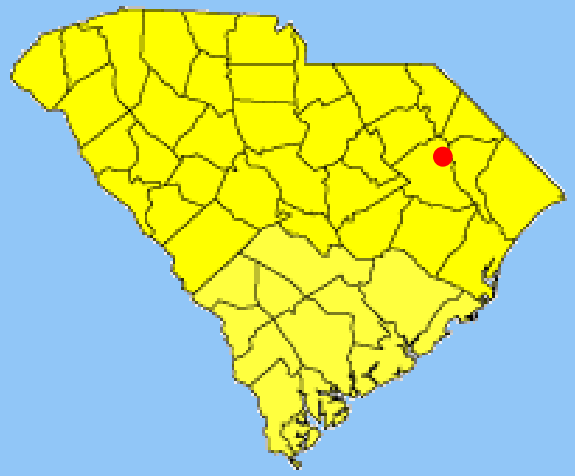


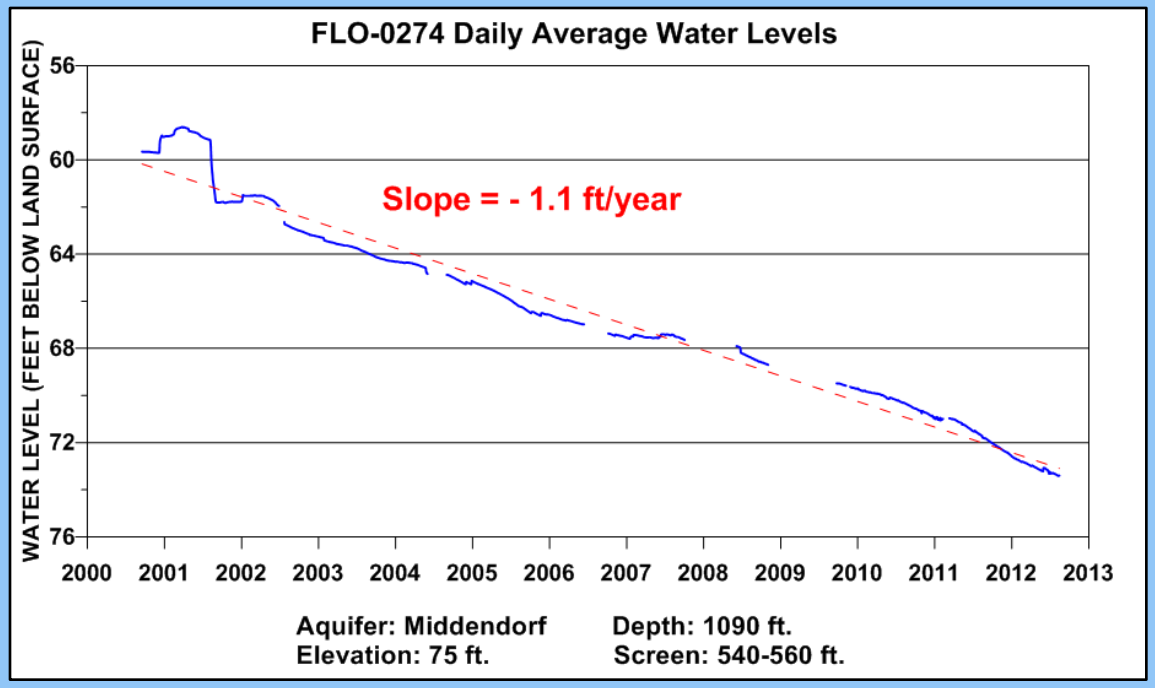


Water-Level Trends in the Middendorf Aquifer

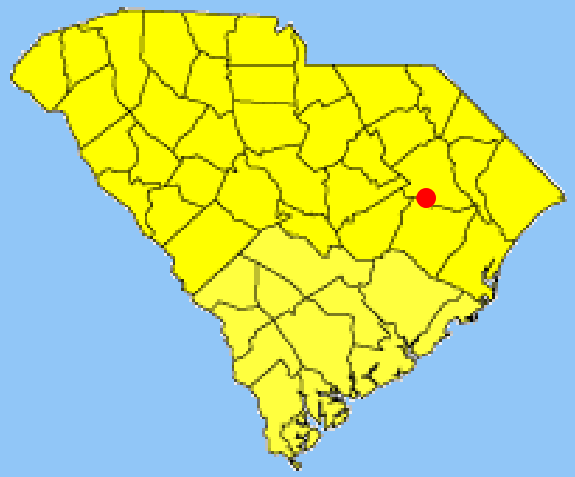


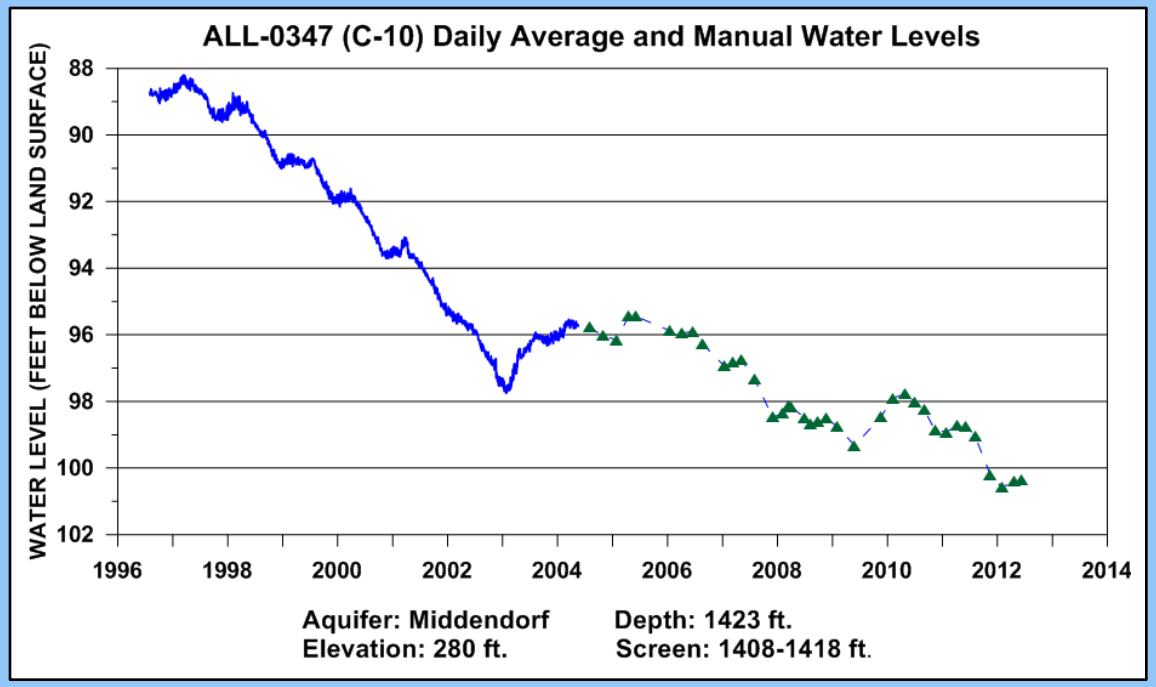
Significant recovery after City of Florence supplemented ground-water supply with Pee Dee River

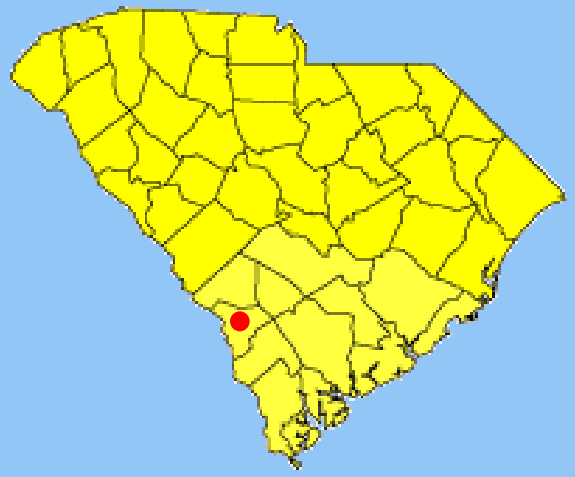




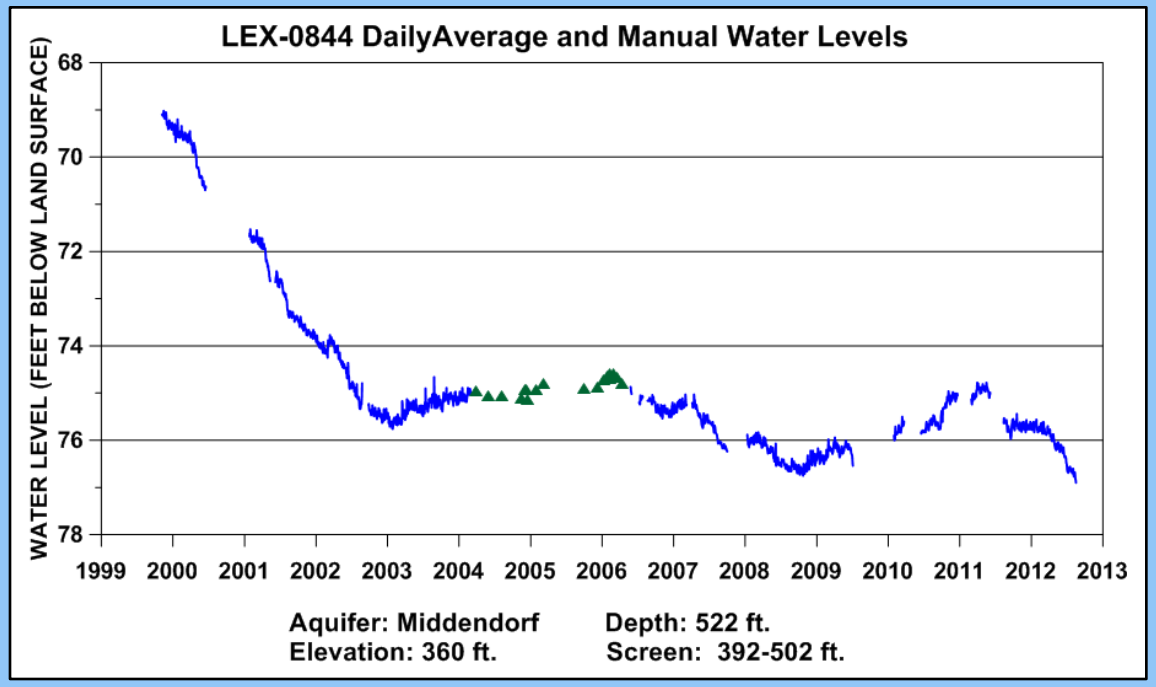
Steady decline over past 10 years likely due to municipal pumping

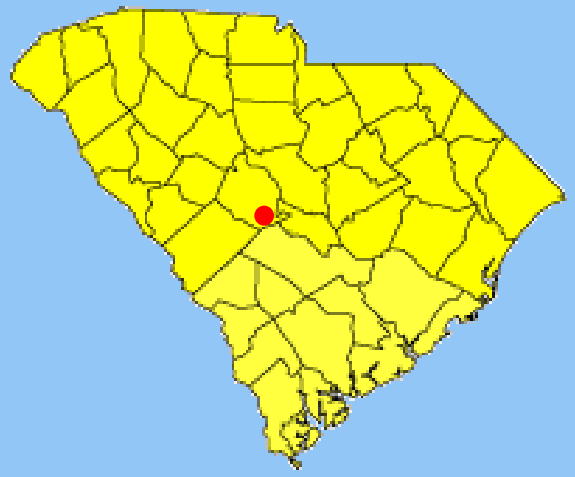


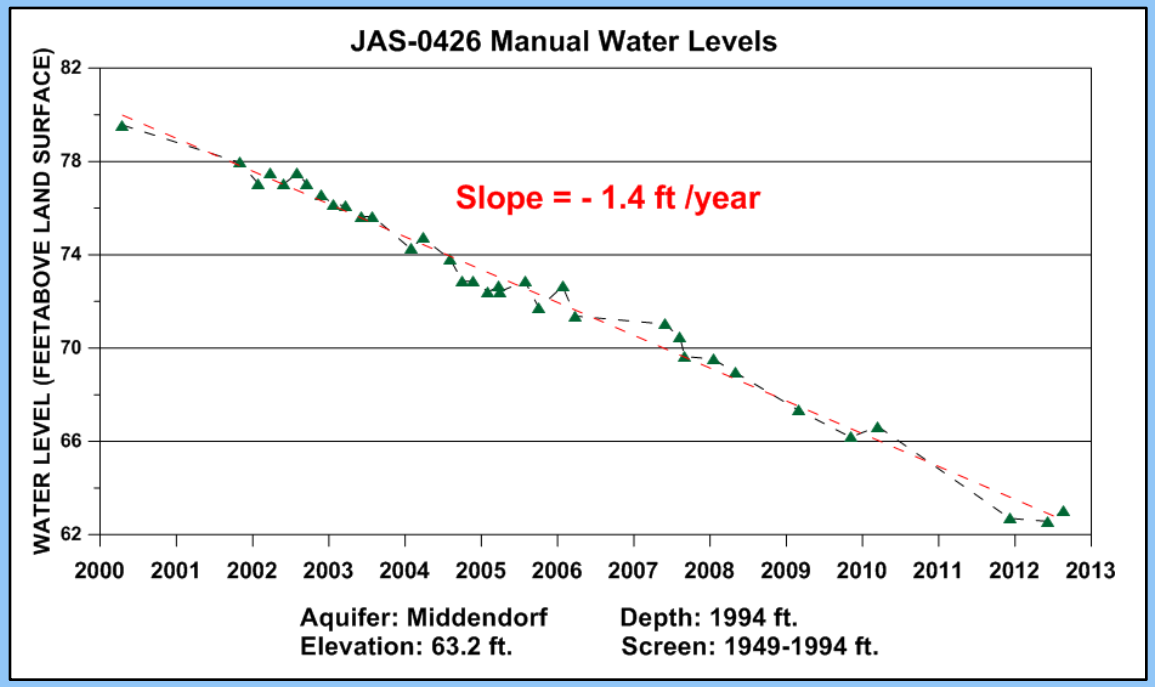




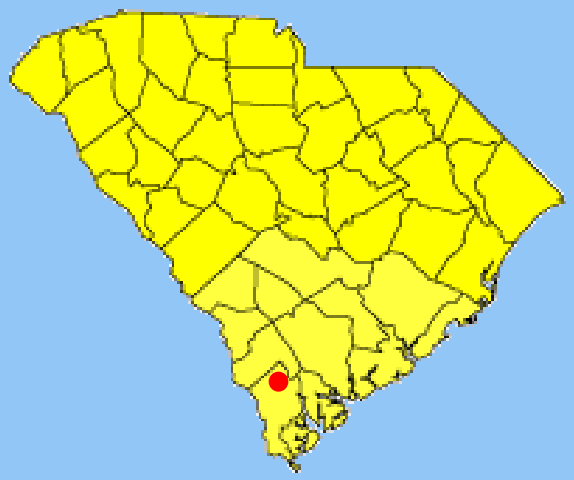
Little to no recovery after 1998-2002 drought

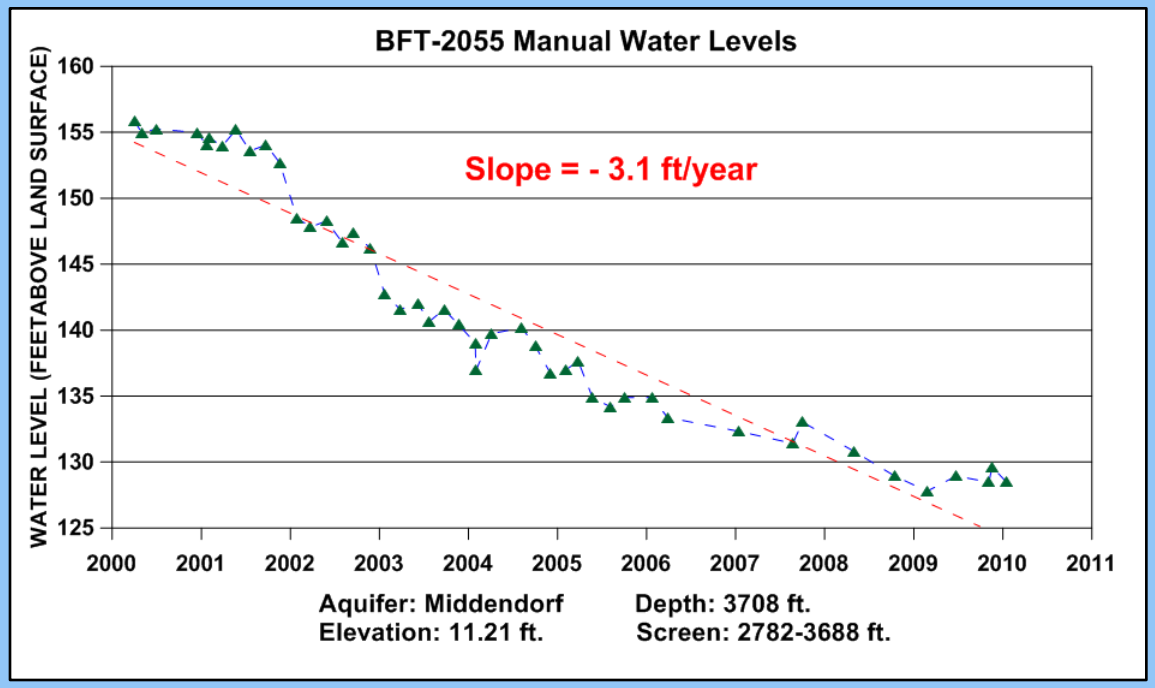




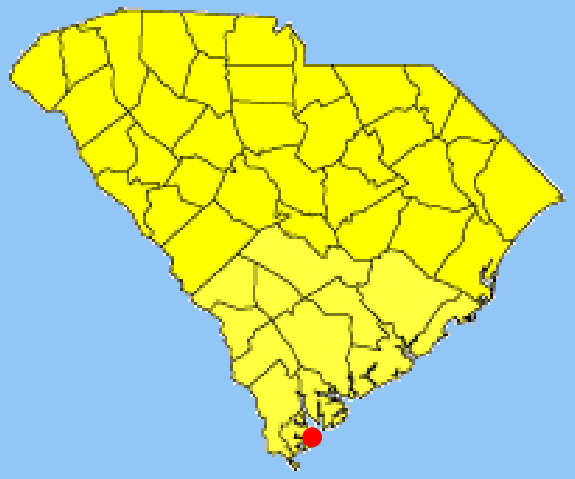


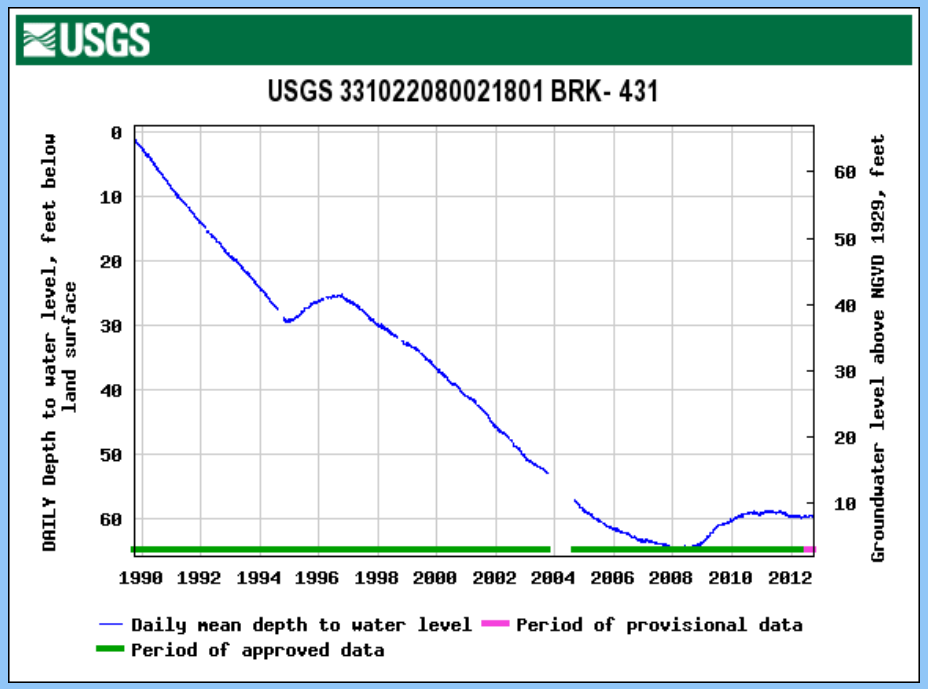
Cause of decline uncertain

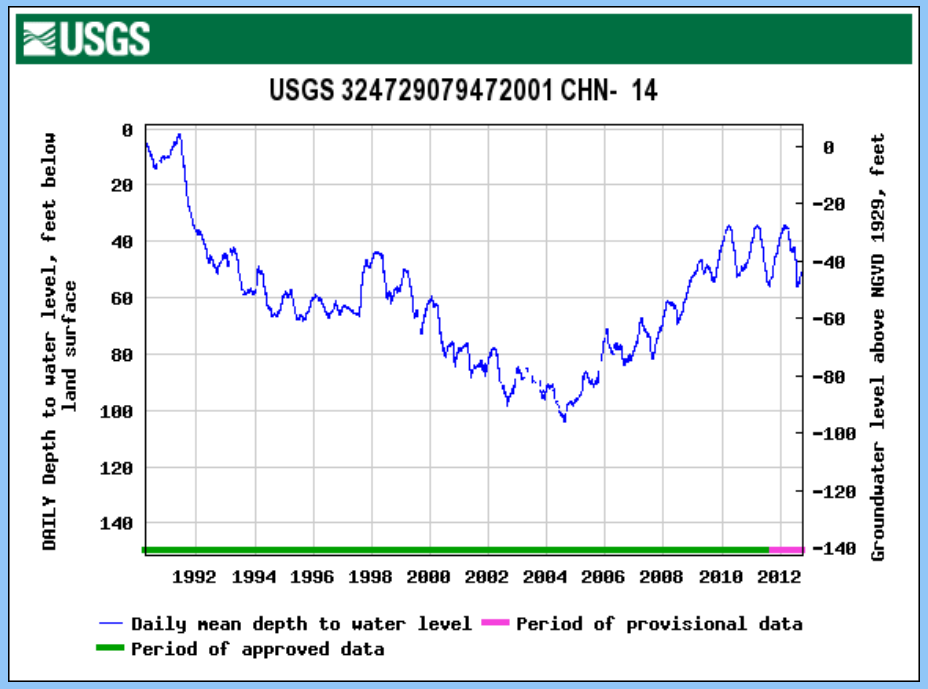


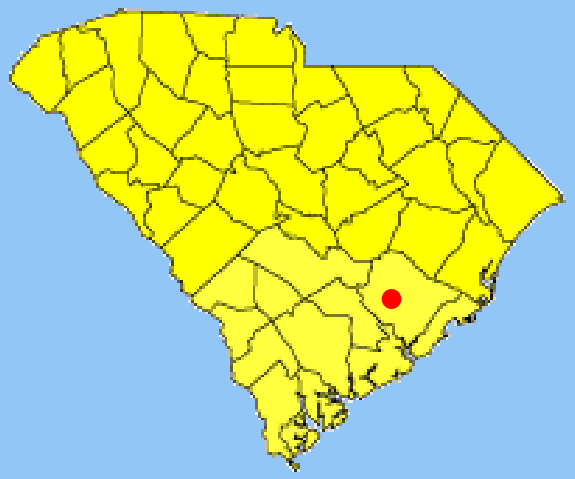


Decline likely due to pumping on Hilton Head

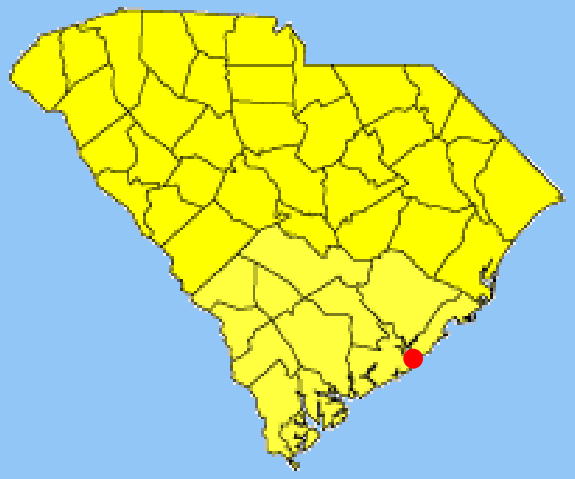


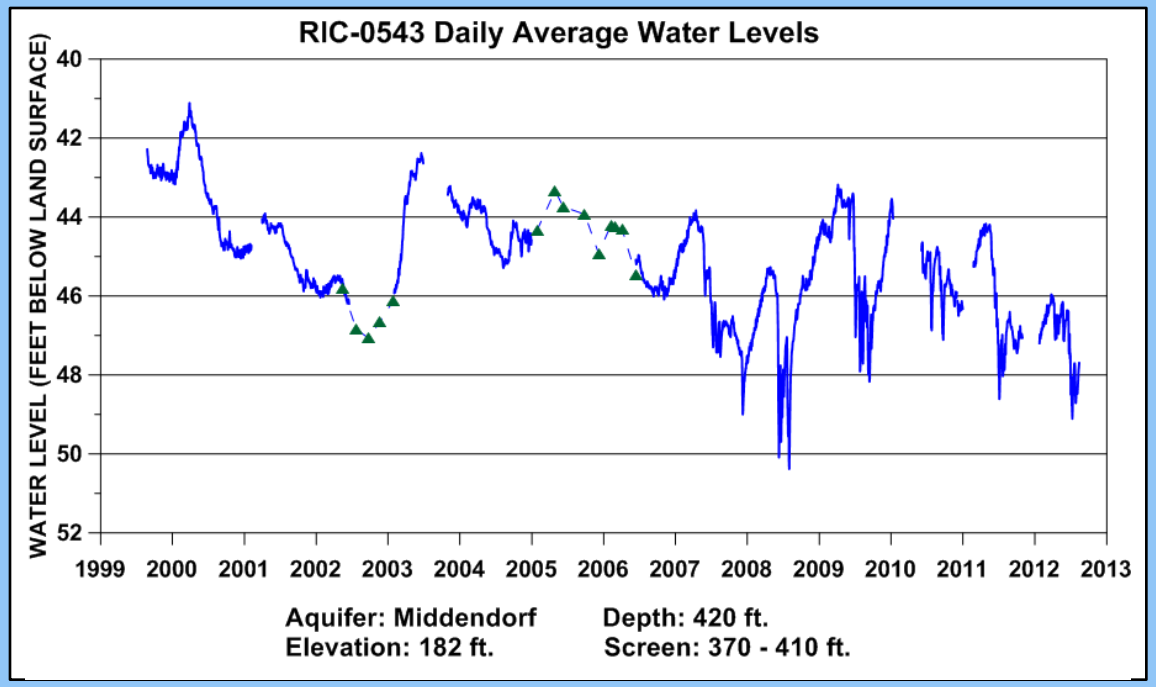


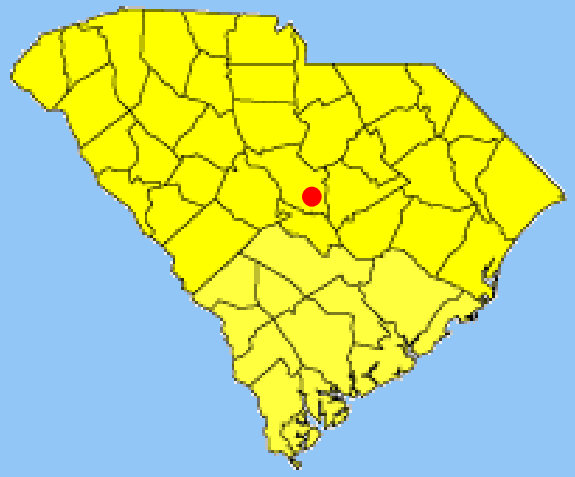




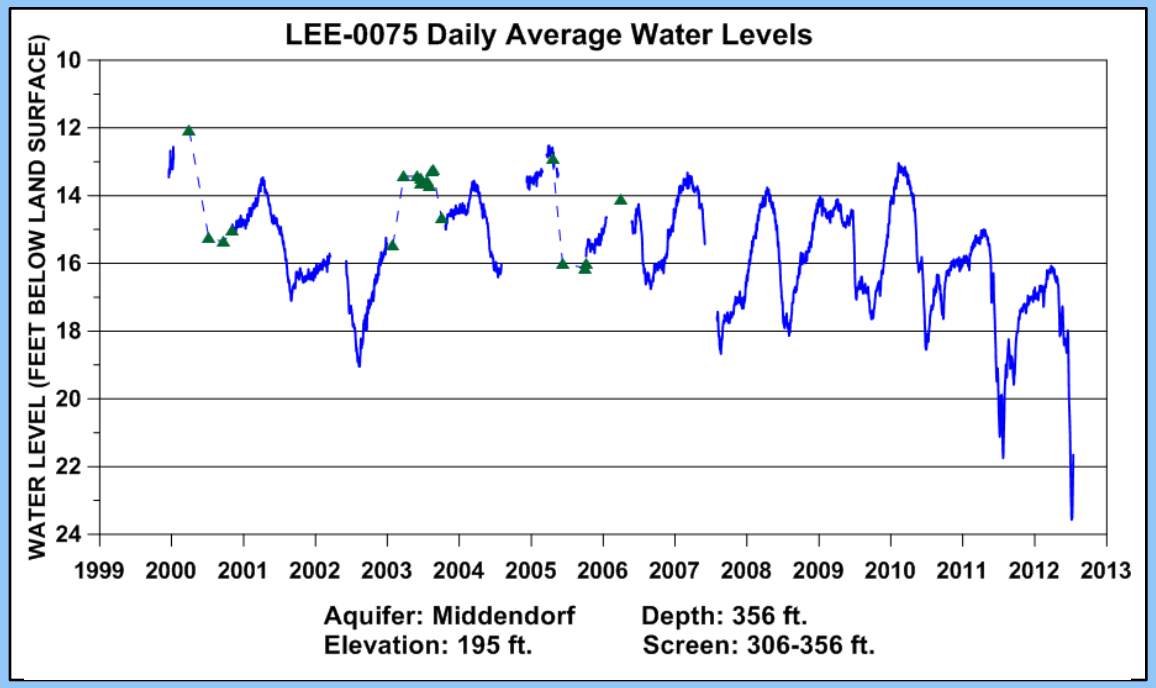
Some recovery after water users began supplementing ground water with surface water

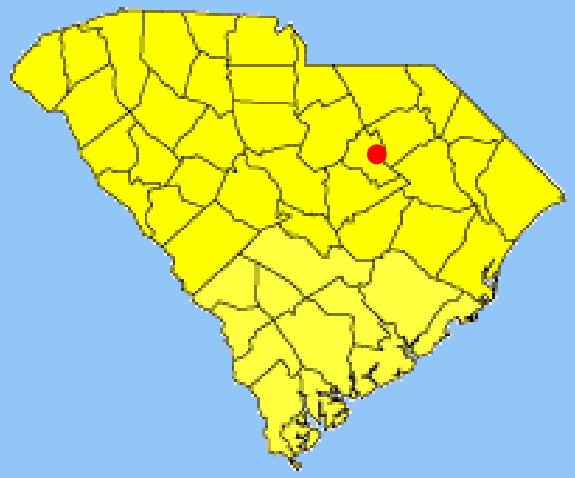




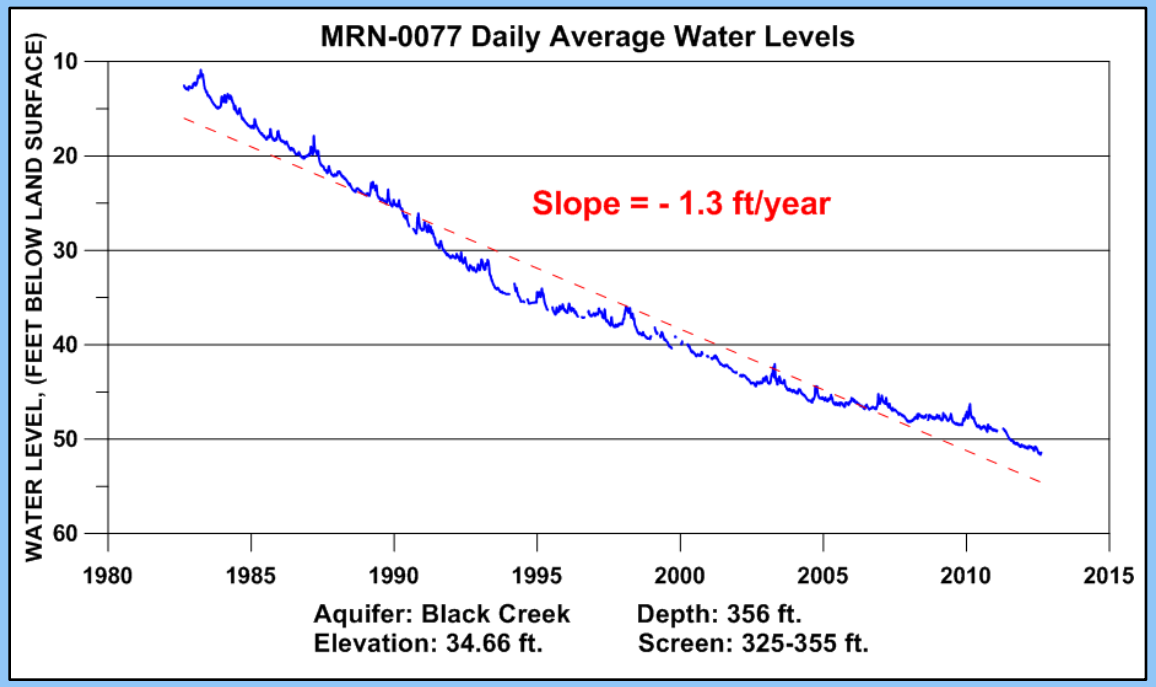


Smaller downward trends, stronger recovery from drought and evidence for recent increased pumping

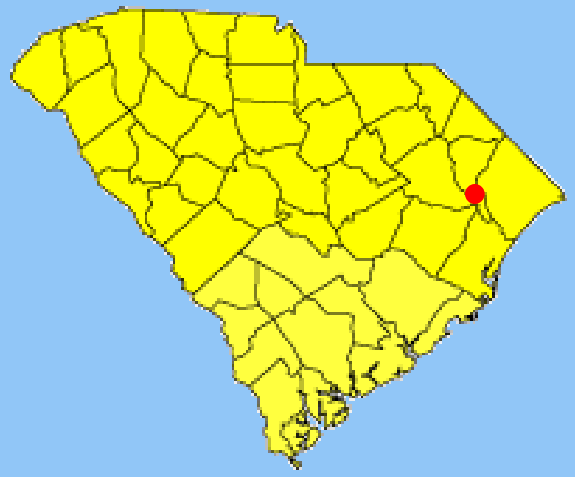


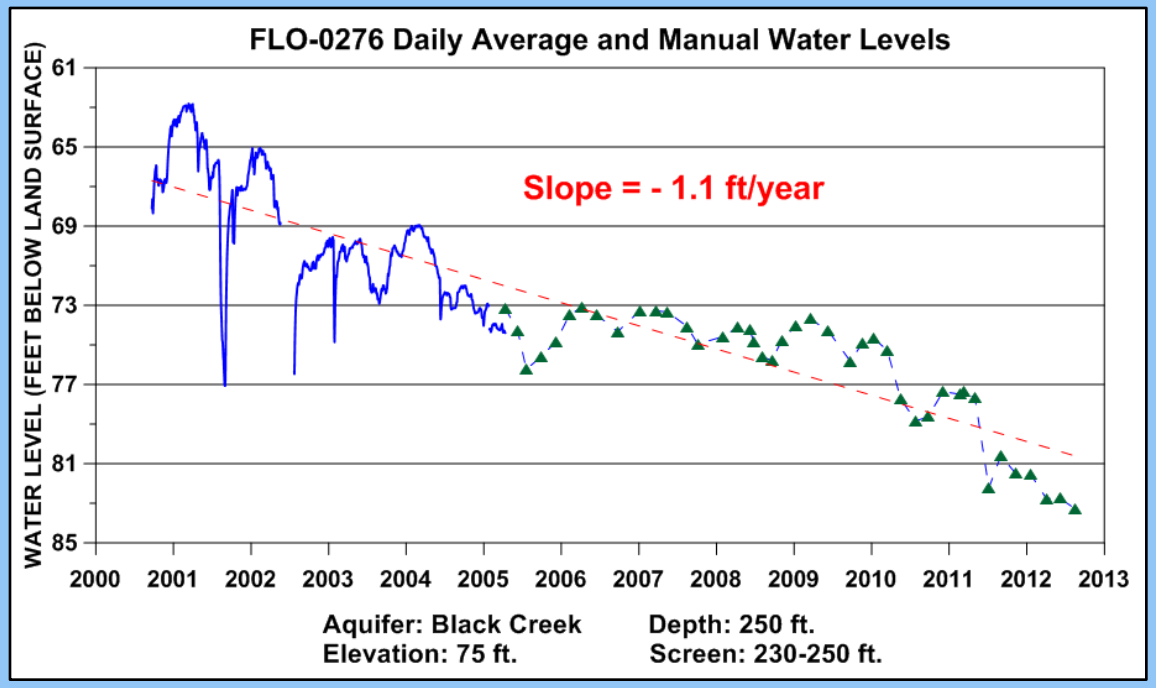


Water-Level Trends in the Black Creek Aquifer

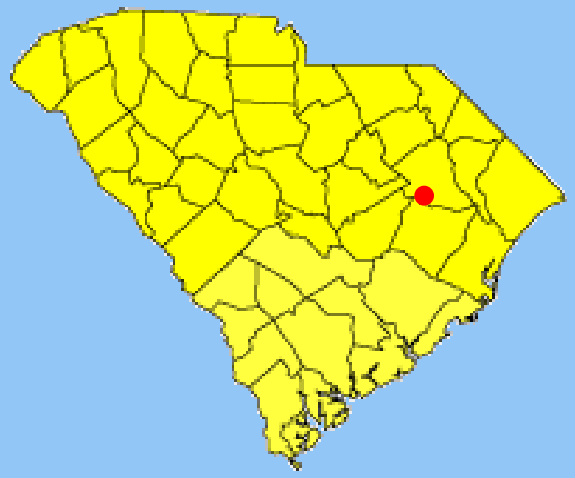


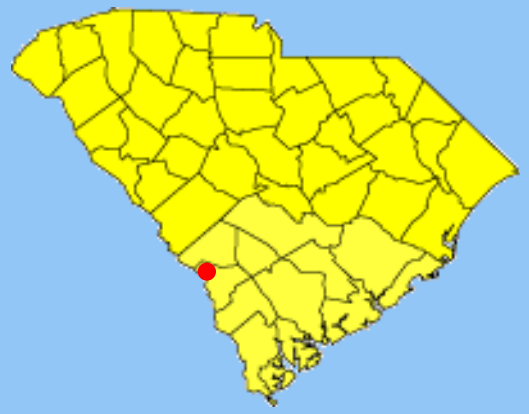
Industrial and Municipal Pumping in southeastern Florence County

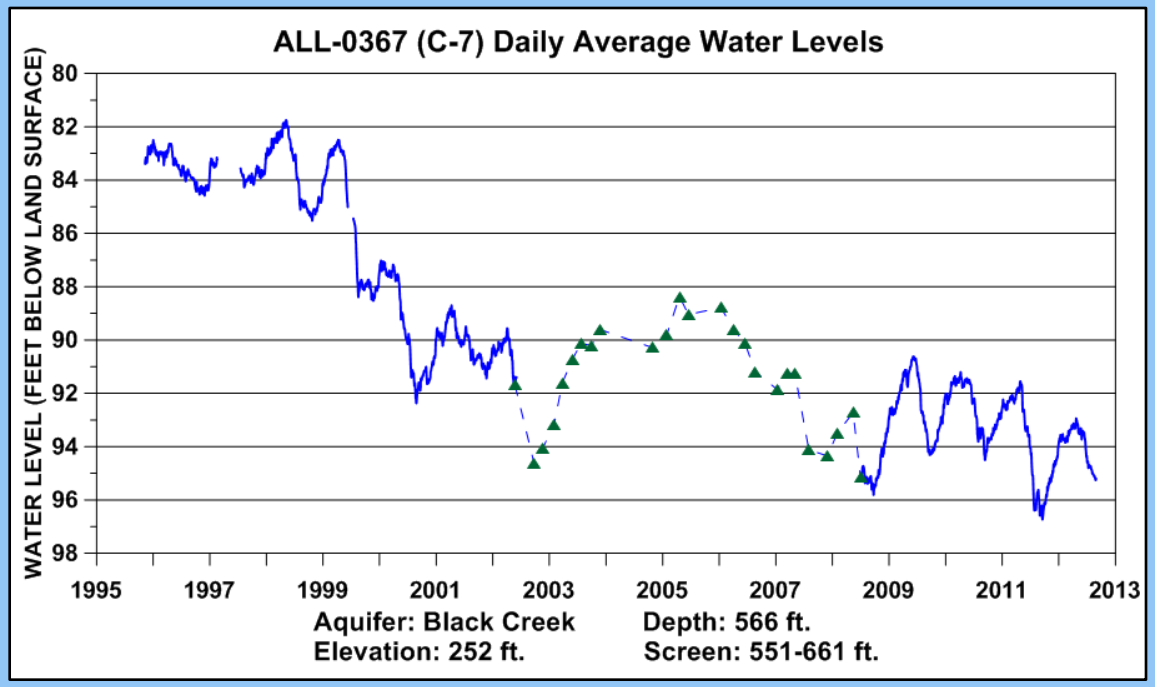




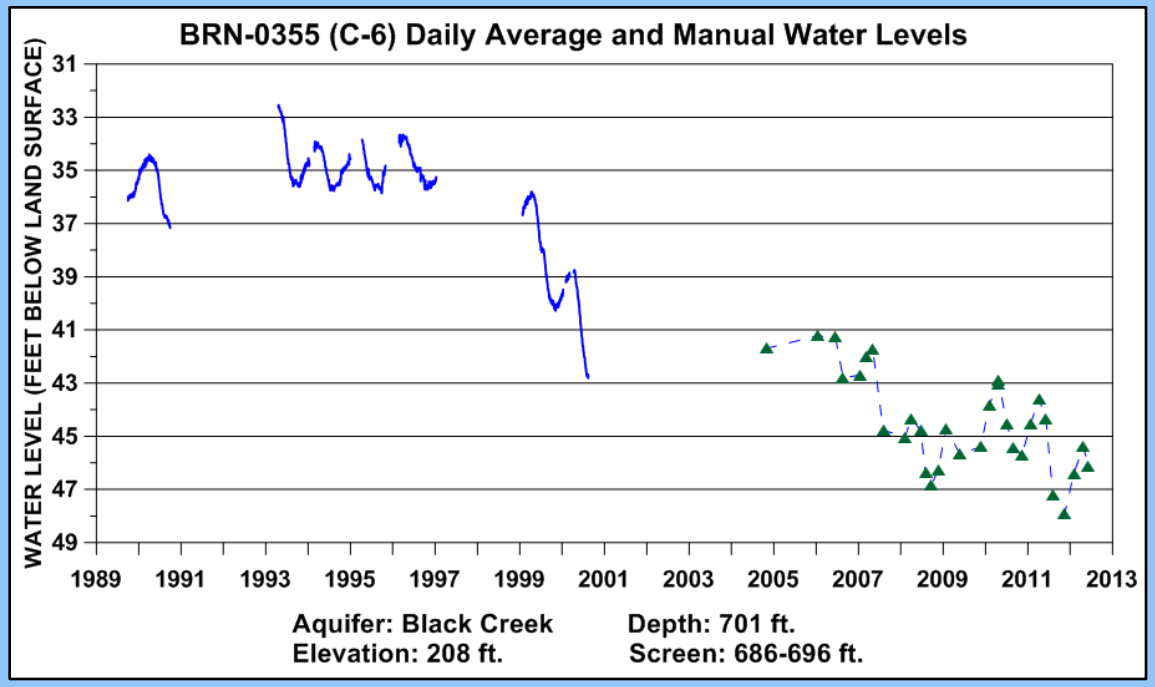
Declines due to regional pumping?

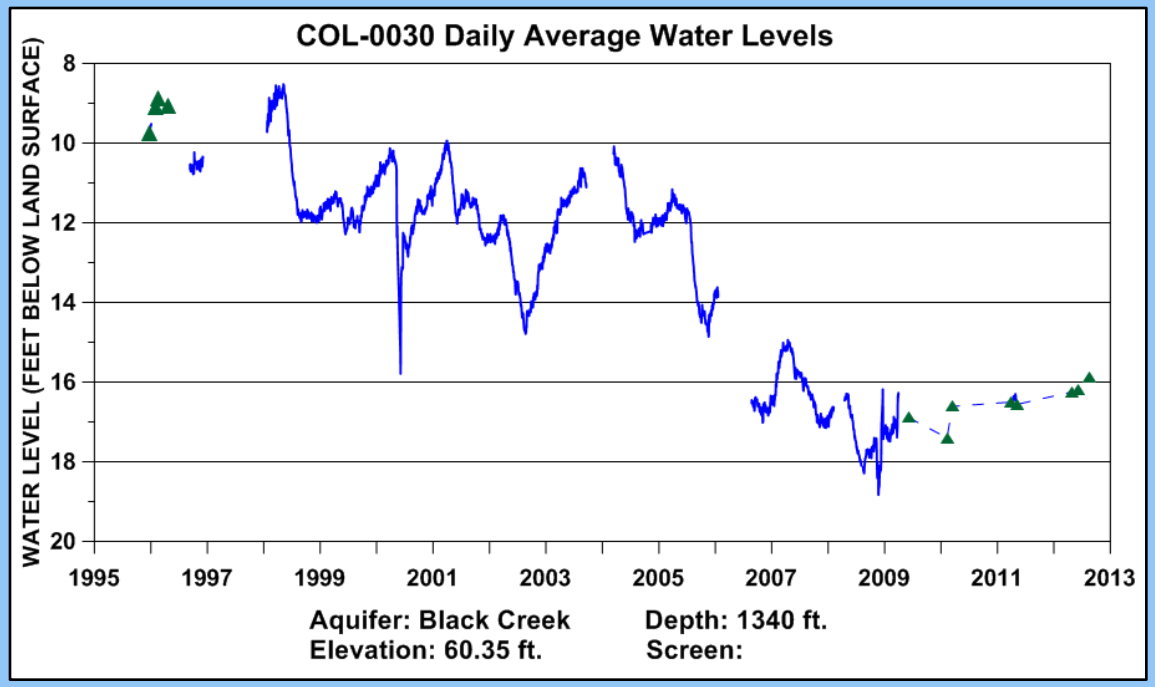




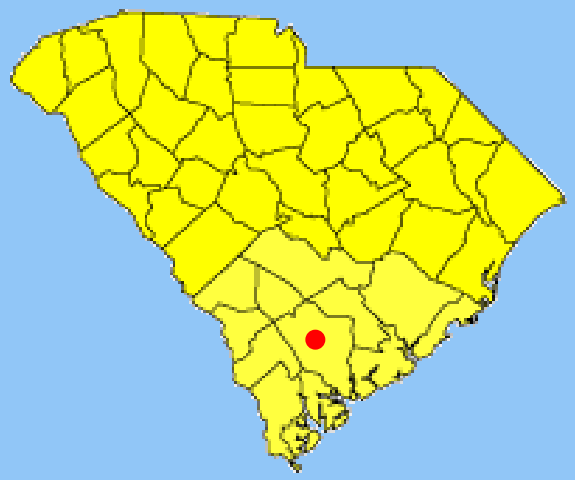


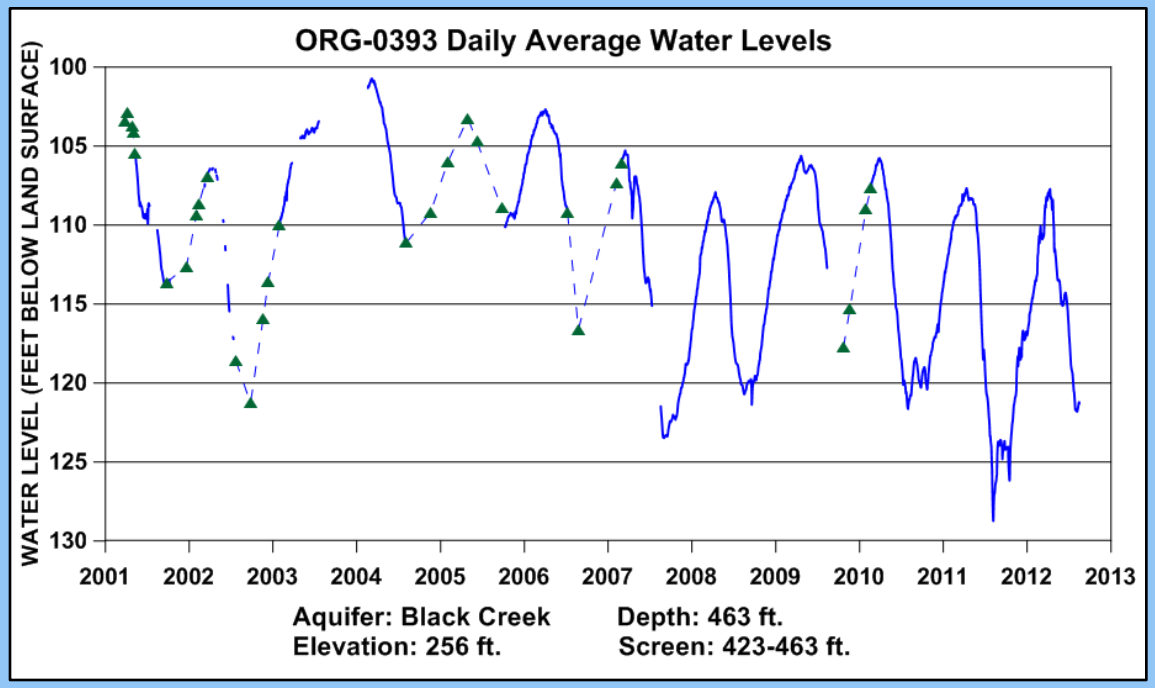
Similar to observations in the Middendorf aquifer for these counties, little to no recovery after 1998-2002 drought





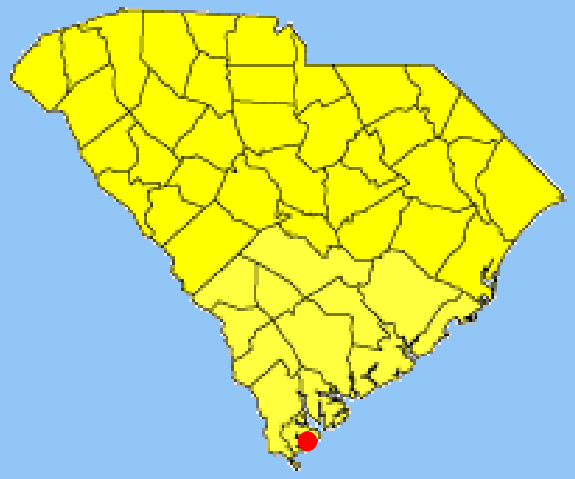
Cause of decline uncertain

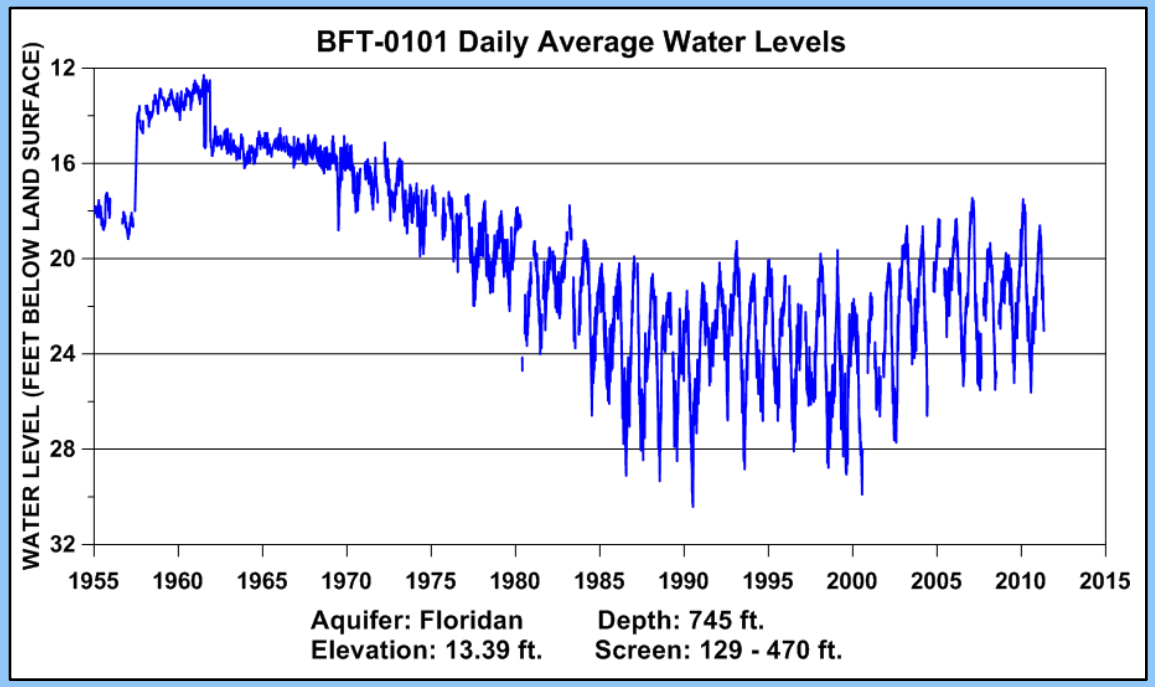




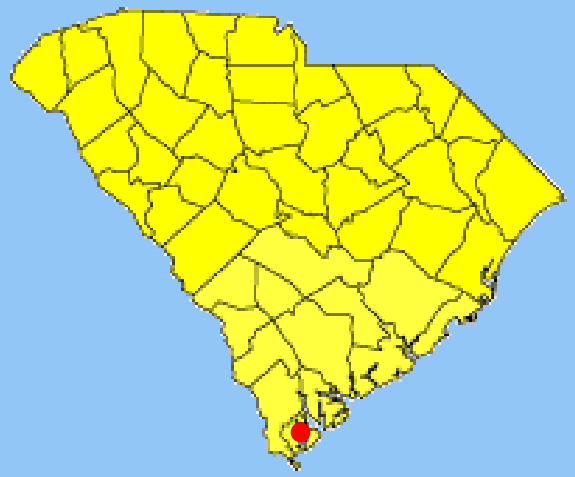
Strong seasonal signature – likely due to irrigation

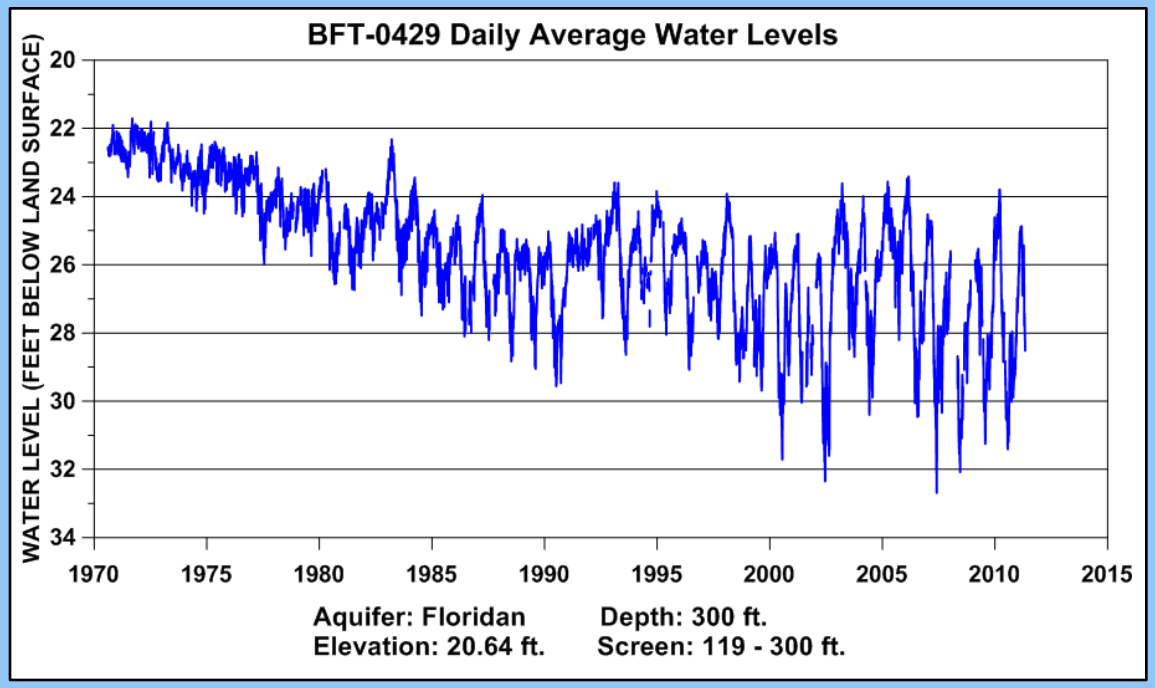
Water-Level Trends in the Floridan Aquifer

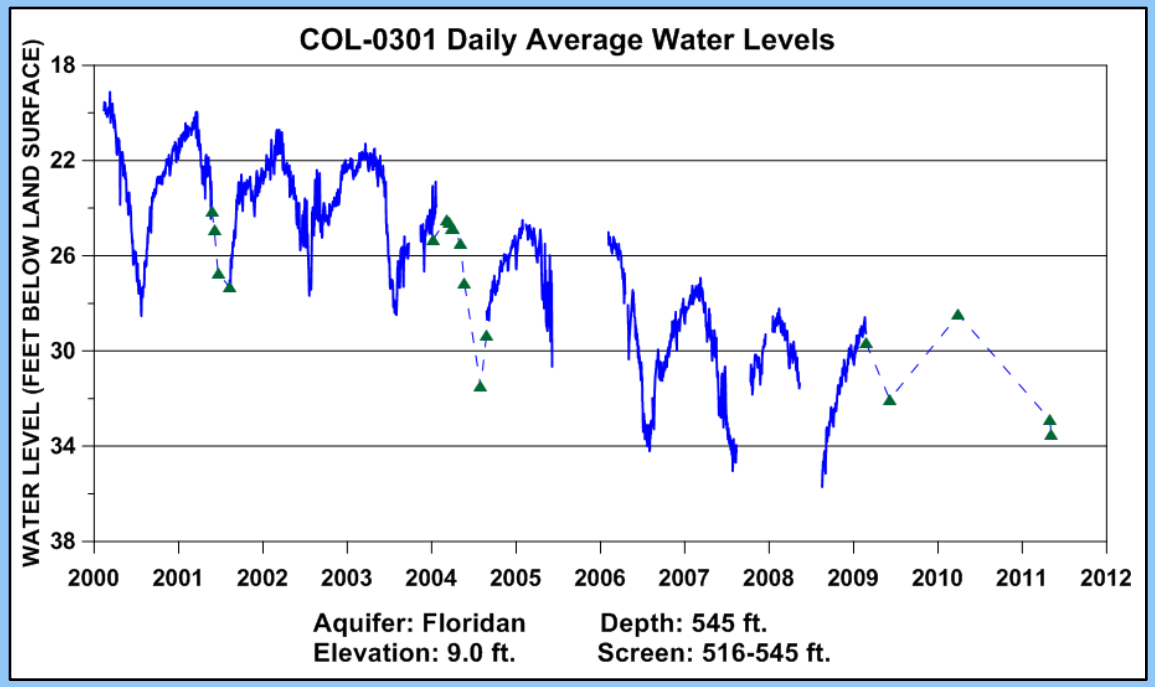




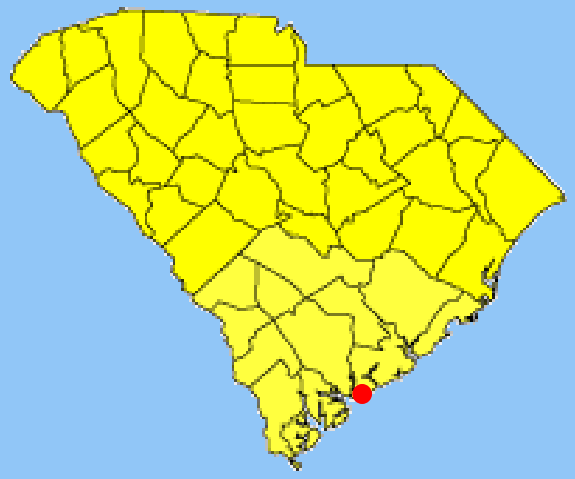
Water levels have leveled off after declines during the 1960s, 1970s and 1980s, but have greater seasonal variations

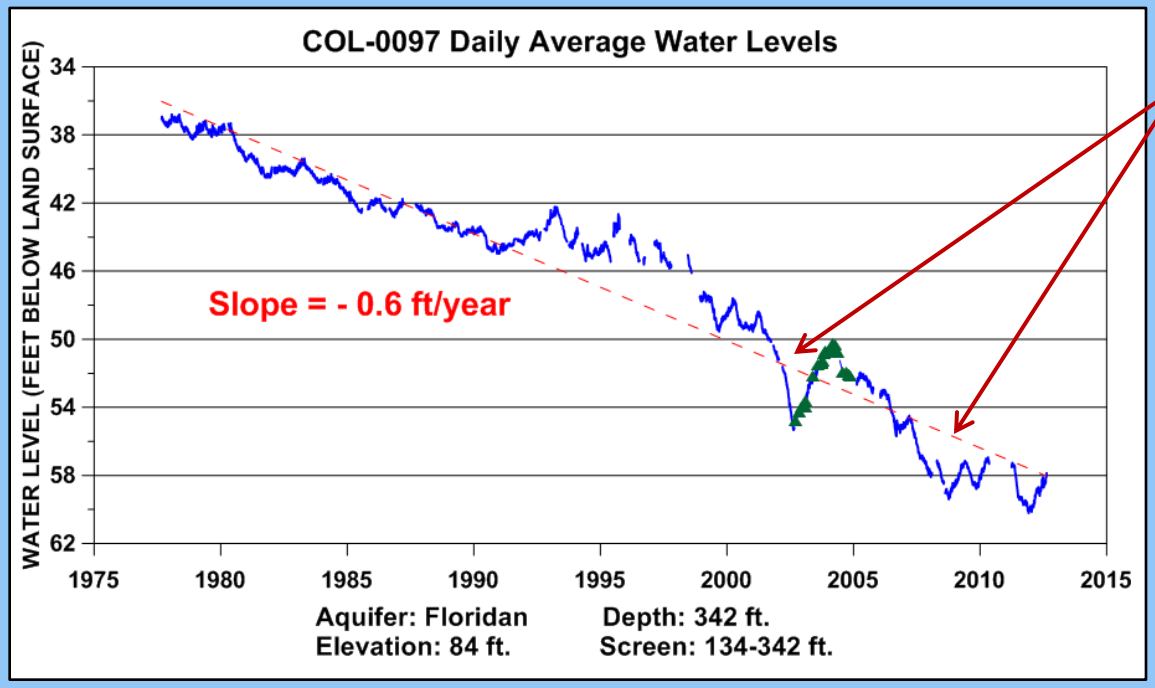




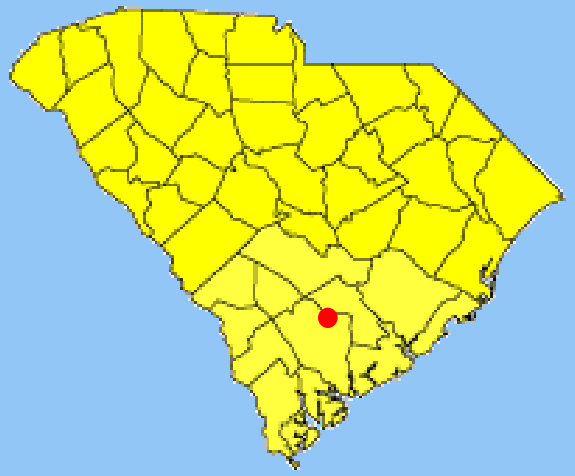


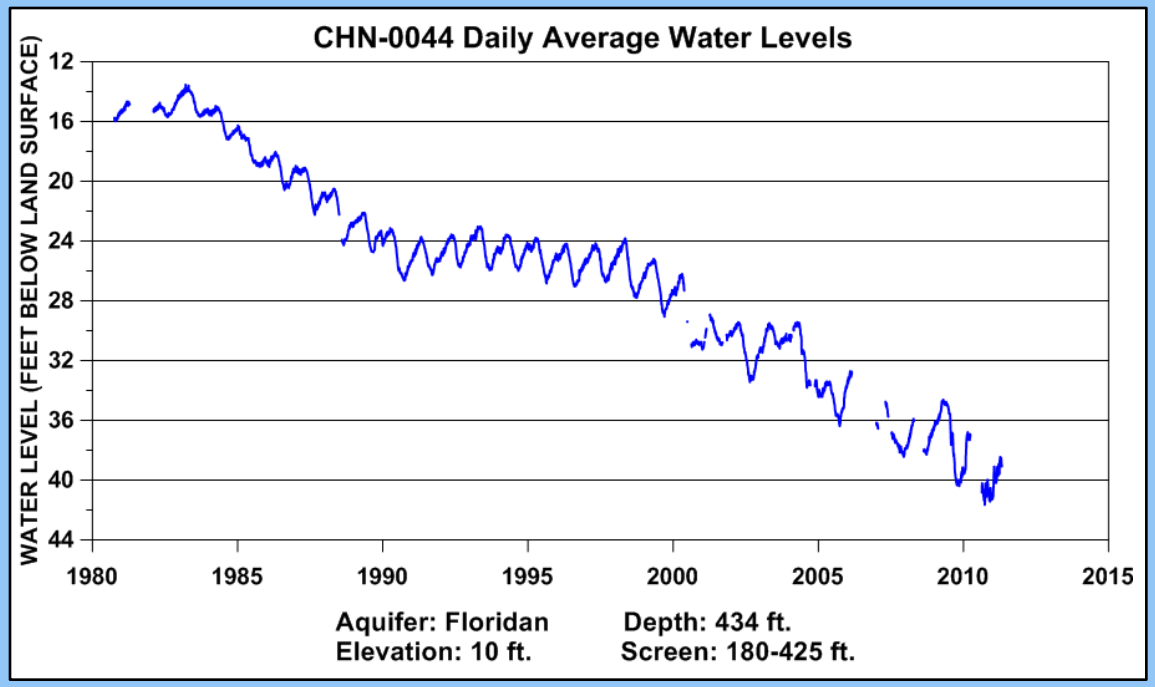
Strong seasonal signal and overall downward trend

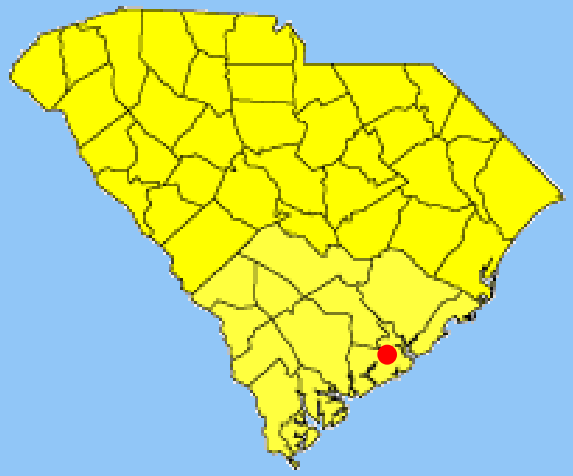




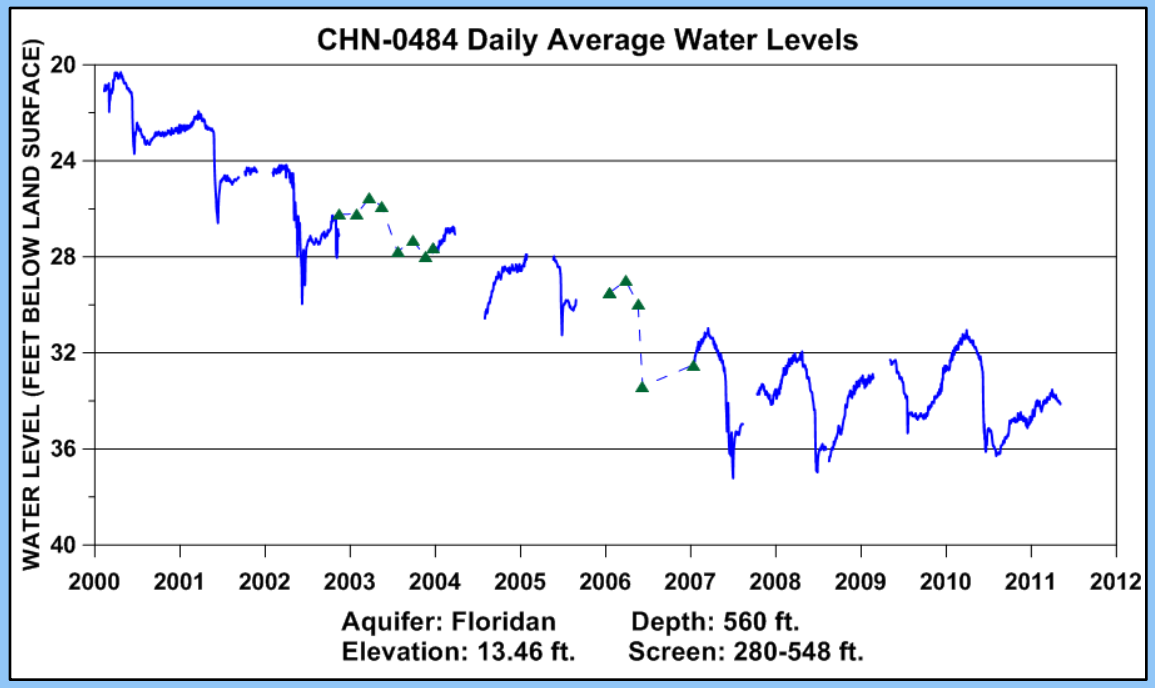
Evidence of drought impacts superimposed over long-term downward trend

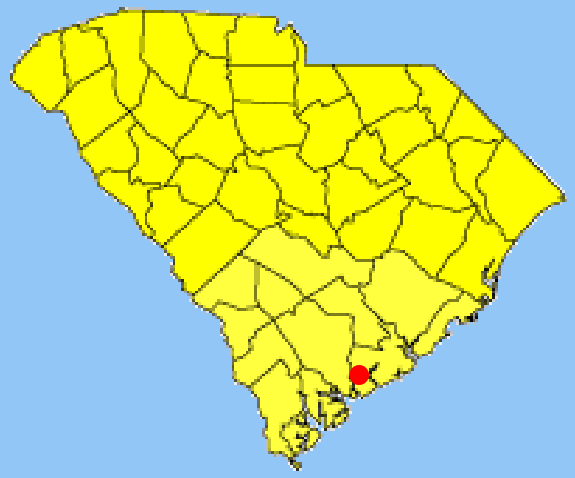






Seasonal fluctuations coupled with overall downward trends





Summary

- Many of our well sites are experiencing downward trends.
  - Declines are generally more severe along the Coastal counties.
  - Substantial number of sites had little to no recovery after 1998-2002 drought.
  - Water level behavior likely a function of increased drought frequency and local/regional pumping.
- Upward trends associated with areas where water users have supplemented water supply with surface water or transitioned from ground water to surface water.

Future Work

- Detailed study of water withdrawals from each aquifer is needed to better understand ground water trends
  - How much of the declines are due to the severe droughts over the last 15 years and how much is due to pumping?

- Hydrographs and other information about the network can be found in:
  - *Ground-Water Levels in South Carolina, 2006-2010*
    South Carolina Department of Natural Resources
    Water Resources Report 50

- Report is available at:
  http://dnr.sc.gov/water/hydro/PubsDNRrep.htm

- Data are available at:
  http://dnr.sc.gov/water/hydro/groundwater/groundwater.html

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