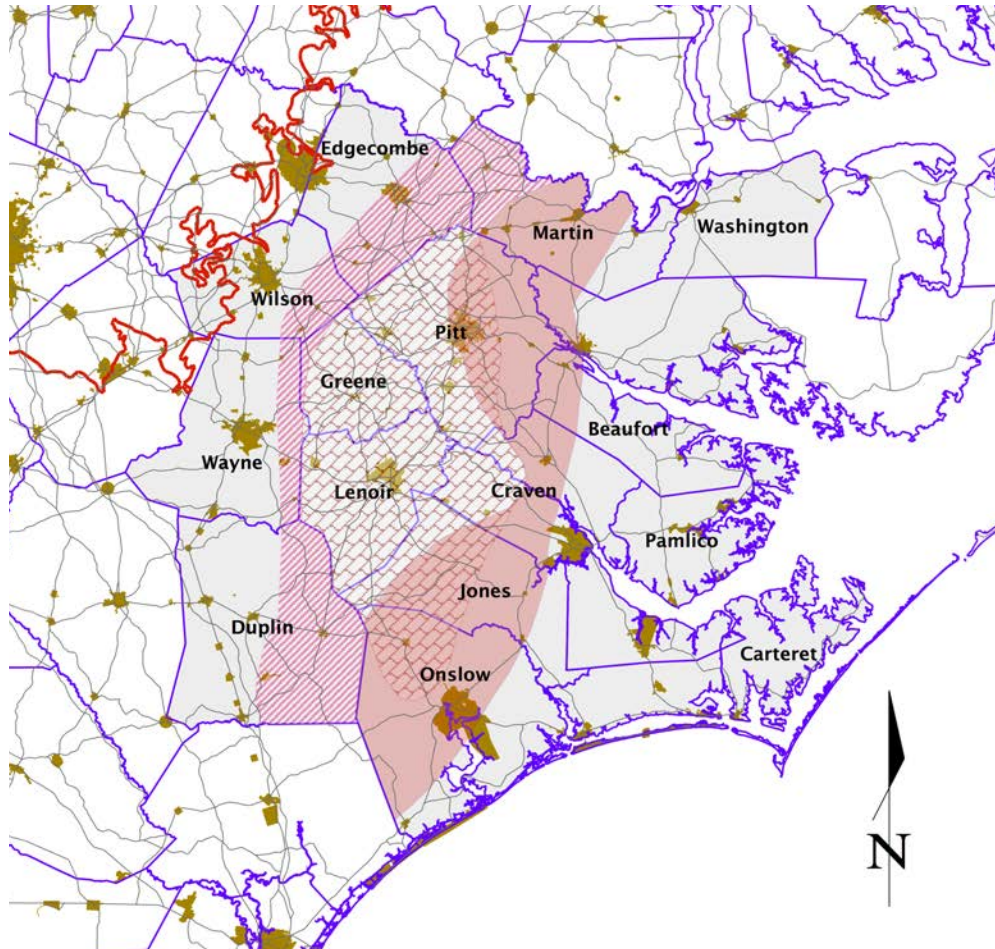


Central Coastal Plain Capacity Use Area Assessment Report



June 2018
Ground Water Management Branch
Division of Water Resources
North Carolina Department of Environmental Quality

Introduction

15A NCAC 2E .0503 (7) of the Central Coastal Plain Capacity Use Area (CCPCUA) rules requires that the Division of Water Resources (DWR) produce an analysis of central coastal plain aquifer conditions as set forth below:

"The CCPCUA Cretaceous Aquifer Zones map shall be updated, if necessary, in the sixth, eleventh, and sixteenth years following the effective date of this Rule to account for aquifer water level responses to phased withdrawal reductions. The map update shall be based on the following conditions:

- (a) Rate of decline in water levels in the aquifers;
- (b) Rate of increase in water levels in the aquifers;
- (c) Stabilization of water levels in the aquifers;
- (d) Chloride concentrations in the aquifers.

This aquifer information shall be analyzed on a regional scale and used to develop updated assessments of aquifer conditions in the CCPCUA. The Environmental Management Commission (EMC) may adjust the aquifer zones and the water use reduction percentages for each zone based on the assessment of conditions. The EMC shall adopt the updated map and reduction percentage changes after public hearing."

The CCPCUA rules require assessments to be produced in 2008, 2013 and 2018 which correspond with each of three phases of water withdrawal reduction (see attached rule at end of report). However, Division of Water Resources staff are committed to continuously tracking aquifer conditions in an effort to better serve permit holders and to be aware of potential ground water supply issues in the region.

As outlined in this report, after a thorough review of aquifer conditions, DWR has concluded that no action is needed by the Environmental Management Commission to alter either the reduction zone boundaries or rule language in 15A NCAC 2E .0503. Current total withdrawals by permit holders affected by reductions is already less than the 2018 final reduction rate. Permit holders have planned, made investments, and established alternative sources to reach this milestone. If necessary, DWR may issue temporary permits which give individual permit holders a different withdrawal amount if they meet a series of criteria for each production well and are able to prove that a certain water withdrawal amount is sustainable.

Ground Water Level & Chloride Concentration Analysis

DWR has invested over 2.5 million dollars and many staff hours since 1998 to improve the monitoring well network throughout the state, especially in the central coastal plain

area. That investment has enhanced our understanding of the regional aquifer system that underlies the state's coastal plain. It also has provided valuable information about how the aquifers are responding to the changing patterns of water withdrawals. Monitoring stations allow us to determine both the extent of the over-drafting situation and the recovery of water levels as investments in alternative water supplies come to fruition.

To those ends, 226 wells have been constructed at 70 monitoring stations since 1998. In combination with existing wells, they are positioned to provide a more detailed picture of the cone of depression beneath the coastal plain in each of the major aquifers. Automatic recording equipment is used on over 80 percent of the network. Chloride concentrations are now measured on a subset of network wells every two or three years to assess the fresh/salt water transition zone.

DWR provides access to water level and chloride data it collects through the division's Ground Water Management Branch website at www.ncwater.org/GWMB. Clicking the "Access the Databases" link then the "Ground Water Data Map Interface" link will provide access to the data spatially.

Reporting is required as part of every CCPCUA permit. Daily water withdrawals and monthly static and pumping water levels from every source well or sump are reported to DWR. This information is digitized and made available to the public. DWR also requires chloride concentrations to be submitted annually by select permit holders based on their location. Public access to all this data is available online at www.ncwater.org/CCPCUA.

DWR is firmly committed to providing easy access to all data collected by our agency, either through the monitoring well network or permitting system.

The 15 county CCPCUA, shown in figure 1, contains the Declining Water Level, Dewatering, and Salt Water Encroachment reduction zones. Figures 2 through 5 illustrate the distribution of water levels over time from the DWR monitoring well network, along with static water levels from the permit holders in the four primarily used coastal plain aquifers: Upper Cape Fear, Black Creek, Peedee and Castle Hayne. Each figure contains four maps that depict the water levels in each of these aquifers during certain time frames (2002, 2007, 2012 and 2017), which correlate with the start of the CCPCUA program and each subsequent reduction phase.

Each map displays ground water levels as color-filled contours referenced to mean sea level. Each map also has county boundaries, the fall line (the line that delineates the coastal plain from the piedmont), the transitional zone between fresh and salt water in the aquifer and points where water level data were collected. One must mentally reference the CCPCUA Cretaceous Aquifer Zones map (see figure 1) on these aquifer

maps.

While the maps are complex, they effectively demonstrate how the water level conditions in each of the aquifers has changed over 16 years. There are many areas showing improved conditions in the CCPCUA, especially during 2017 as compared to earlier years. As those aquifer conditions relate to the Cretaceous Zones, the potential for salt water encroachment still exists. Dewatering, although less likely, is still possible in many areas because available drawdown is limited due to the depth of the aquifers and so many production wells have pump intakes below the aquifer tops. Declining water levels are not occurring except during seasonal increases in demand.

Permit holders in the designated declining water level zone can be relieved of reductions under rule provision .0503 (9). That provision allows a permit holder to use three years of their most current water level data to remove reduction requirements, provided that data do not indicate a downward trend in ground water levels. To date, one permit holder (Guilford Mills Inc. in Duplin County) has already used this provision to be exempted from further reductions.

Any analysis of the water levels and chlorides in the Cretaceous aquifers would be incomplete without a discussion of the impact on the shallower aquifers, which make up many of the alternative sources used by permit holders and are increasingly used as a source for agricultural irrigation. It is extremely important that DWR monitor the switch from Cretaceous aquifer withdrawals to a combination of Cretaceous and shallower aquifer use. Craven County, Onslow Water and Sewer Authority, and the cities of Jacksonville and New Bern, among others, have all begun using shallower aquifers or are in the process of expanding their use of shallower aquifers. Although each new well field shows an associated cone of depression, none of the well fields show signs of aquifer overuse. However, DWR will continue to track impacts to these aquifers as well as Cretaceous aquifers using the monitoring well network and permit holder provided water levels and chloride data.

Estimating Ground Water Level Improvements

Individual hydrographs of wells in the DWR network delineate how ground water levels have changed over time. All of the network wells are available for visual analysis on the DWR website. Figure 6 shows eight examples of individual hydrographs in the Black Creek and Upper Cape Fear aquifers. All of these hydrographs show rising water levels associated with the reduction of water use from the Cretaceous aquifers. Water levels began to rise after 2008. You can see that some of the hydrographs show a delayed reaction in recovery even after regional withdrawals have been reduced.

One method that is employed to visualize the changes in water levels in map form is presented in figures 7 and 8. Two potentiometric surfaces from different dates are

developed and the change in water levels between those two dates is displayed in map view. Specifically, figures 7 and 8 illustrate the rebound in water levels in the Black Creek and Upper Cape Fear aquifers between November 2007 and November 2017. A highlight of these maps is the broad area of increase in ground water levels as much as 50-55 feet centered in Lenoir and Craven counties and 85 feet in Onslow County.

Figure 9 displays comparative withdrawals from the Cretaceous aquifers. Symbols are plotted for each permit holder which allows comparison of Approved Base Rates (ABRs), phased reduction amounts and current withdrawals. It is easy to see where the most reduction was required and the relative size of withdrawals through the reduction phases and current usage. As depicted in the map, the current usage for most permit holders is at or below the third phased reduction amount which is also depicted graphically in Figure 10. In this graphic, annual totals of all permit holder withdrawals of Cretaceous aquifers and alternative sources is compared to the annual permitted amounts. The current annual withdrawal is less than the 2018 permitted amount.

Taken together, these three types of graphics (hydrographs, mapped difference between potentiometric surfaces, and comparative usage maps) allow DWR to make the following insight about the water level improvements. Regardless of how we arrived at the current rates of use of the Cretaceous aquifers, the water levels near the center of the rebound area seem stable and a large portion of the water demand has switched to alternative sources. Therefore, we can draw the following conclusion: If we hold Cretaceous aquifer annual use to current rates, then that overall withdrawal appears to be a sustainable rate of use for many CCP water users outside of the salt water encroachment zone. In the salt water encroachment zone, available chloride data suggests that withdrawals may need further reductions to reach sustainable rates, but local data may allow temporary permits to be issued.

Temporary Permits

DWR offers individual systems a stable annual withdrawal limit at their current annual limit or some other amount as long as it meets the following criteria:

- Static water level trends must be level or upward trending after January 1, 2012 or over the previous year from present day and may involve construction and measurement of monitoring wells by permit holders [.0502 (c)],
- Pump intakes must be above the top of the shallowest Cretaceous aquifer screened by the well [.0502 (c) & (j)],
- Present day pumping water levels must be above the top of the shallowest Cretaceous aquifer screened by the well [.0502 (c) & (j)], and

- If applicable, chloride concentrations obtained from monitoring wells or unused production wells screened and gravel packed in one Cretaceous aquifer are fresh (< 250 mg/l) for 3 previous years from present day and do not trend toward higher concentrations or other site specific data which will allow determination of susceptibility to salt water encroachment [.0502 (c), (i) & (l)].

Permit holders may submit an application to modify their permit before the slated expiration date if all their reduction zone wells meet these requirements. If subsequent monitoring reports reveal problems, then DWR will re-open that permit and make appropriate adjustments and may allow additional time for permit holder compliance. The following permit holders have been issued temporary permits: Green County Regional Water, Town of La Grange, City of New Bern, Town of Snow Hill, Belfast-Patetown, Fork Township, Southeastern Wayne and Northwestern Wayne Sanitary Districts, and Chinquapin Water Association.

It is paramount that permit holders continue to report water levels, water withdrawals, and chloride data. Our overall picture of the aquifer will improve as permit holders understand the importance of their data and that they may be able to make use of more Cretaceous aquifer water than the reduction zones and schedule allow through the temporary permit procedure. DWR is determined to be only as restrictive as necessary to ensure the sustainable use of these aquifers.

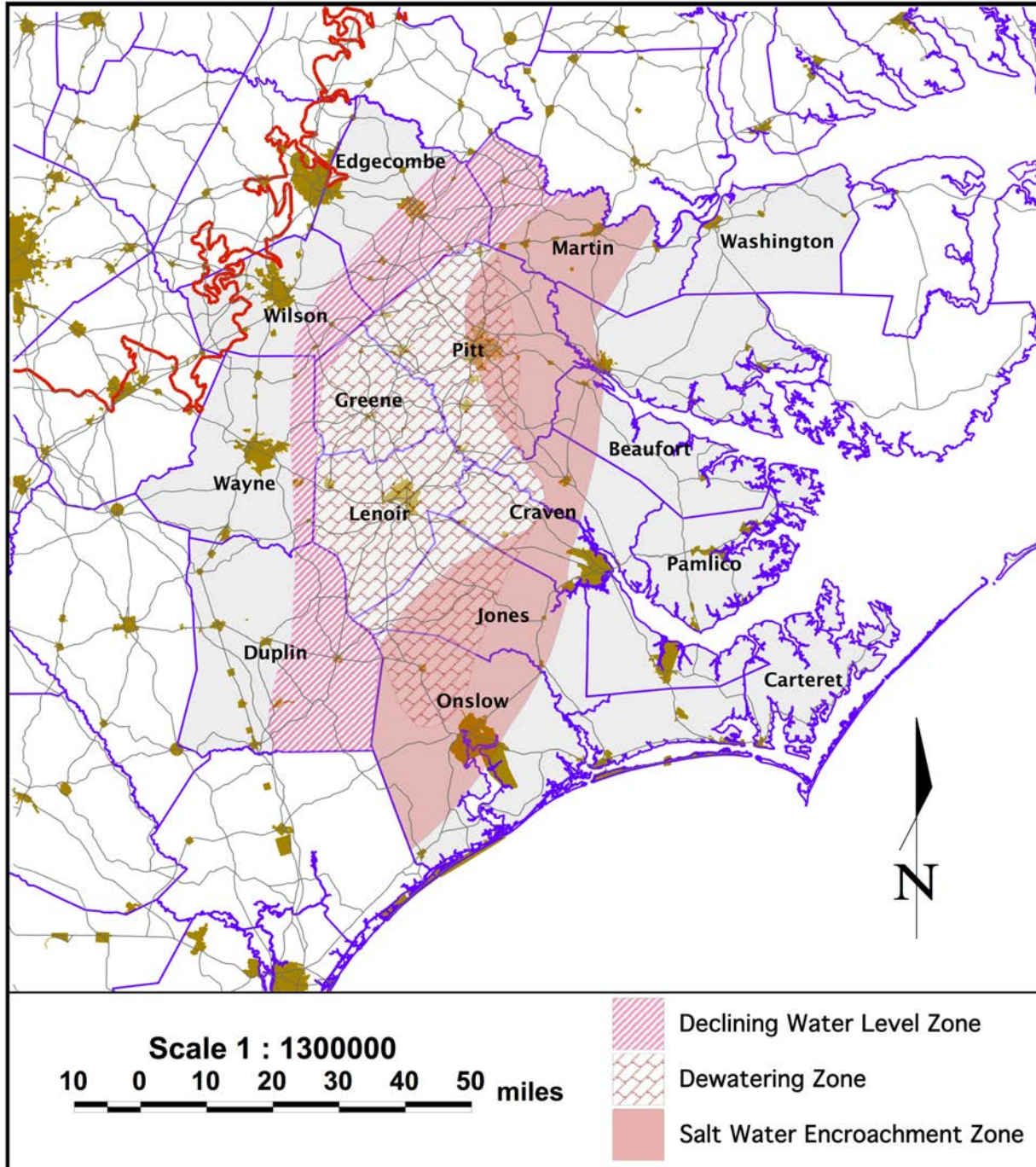
Conclusions

Based on analysis of water level and chloride concentration conditions in the CCPCUA that were gathered through November 2017, we recommend that the EMC not adjust either the CCPCUA reduction zone boundaries or reduction percentages. Although water levels in many areas have risen and aquifer dewatering is less of a concern, salt water encroachment is still problematic.

The Division of Water Resources staff remains committed to continuously tracking aquifer conditions to better serve permit holders and to stay apprised of any potential ground water supply issues in the region.

Figure 1.

CCPCUA Cretaceous Aquifer Zones



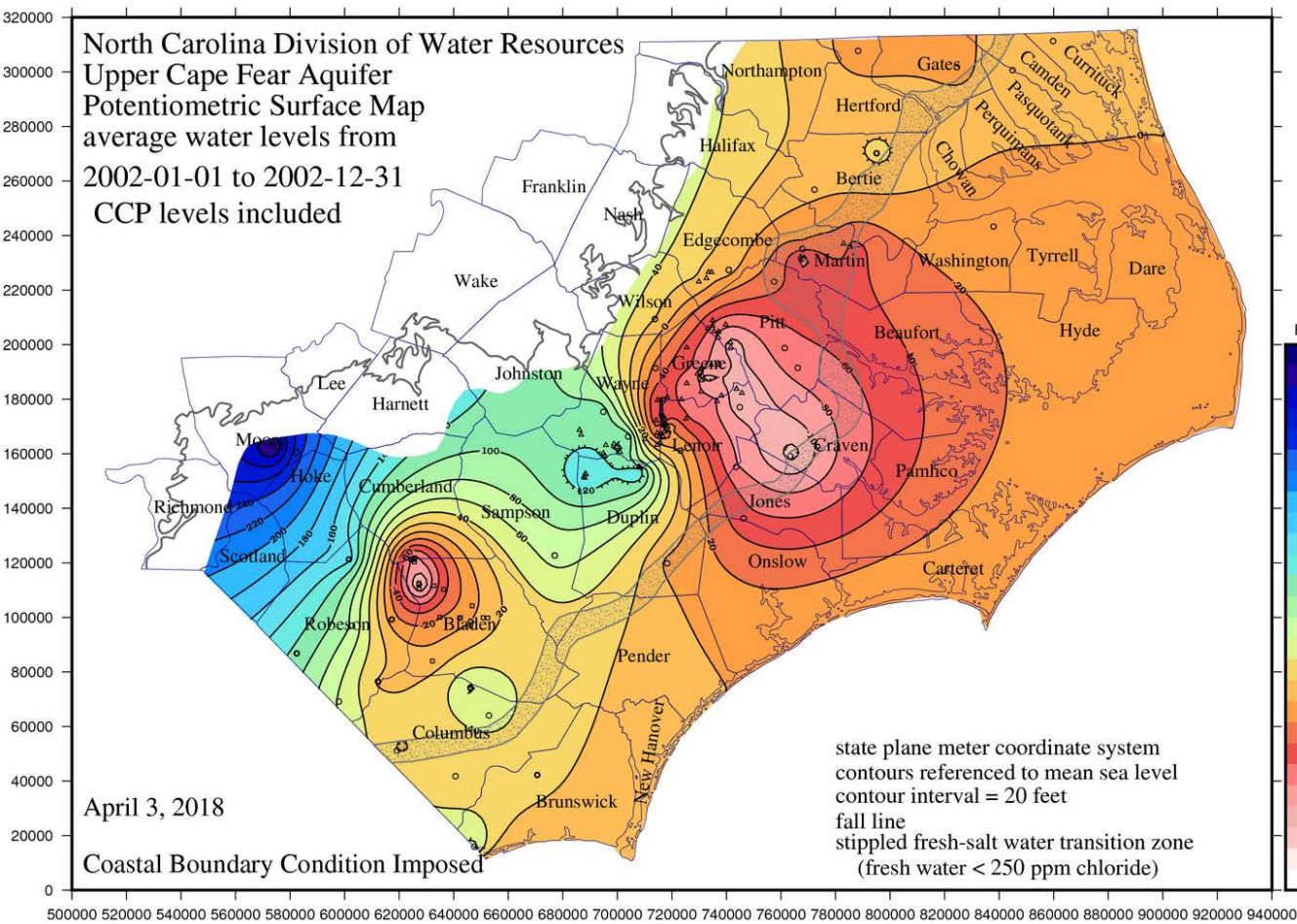
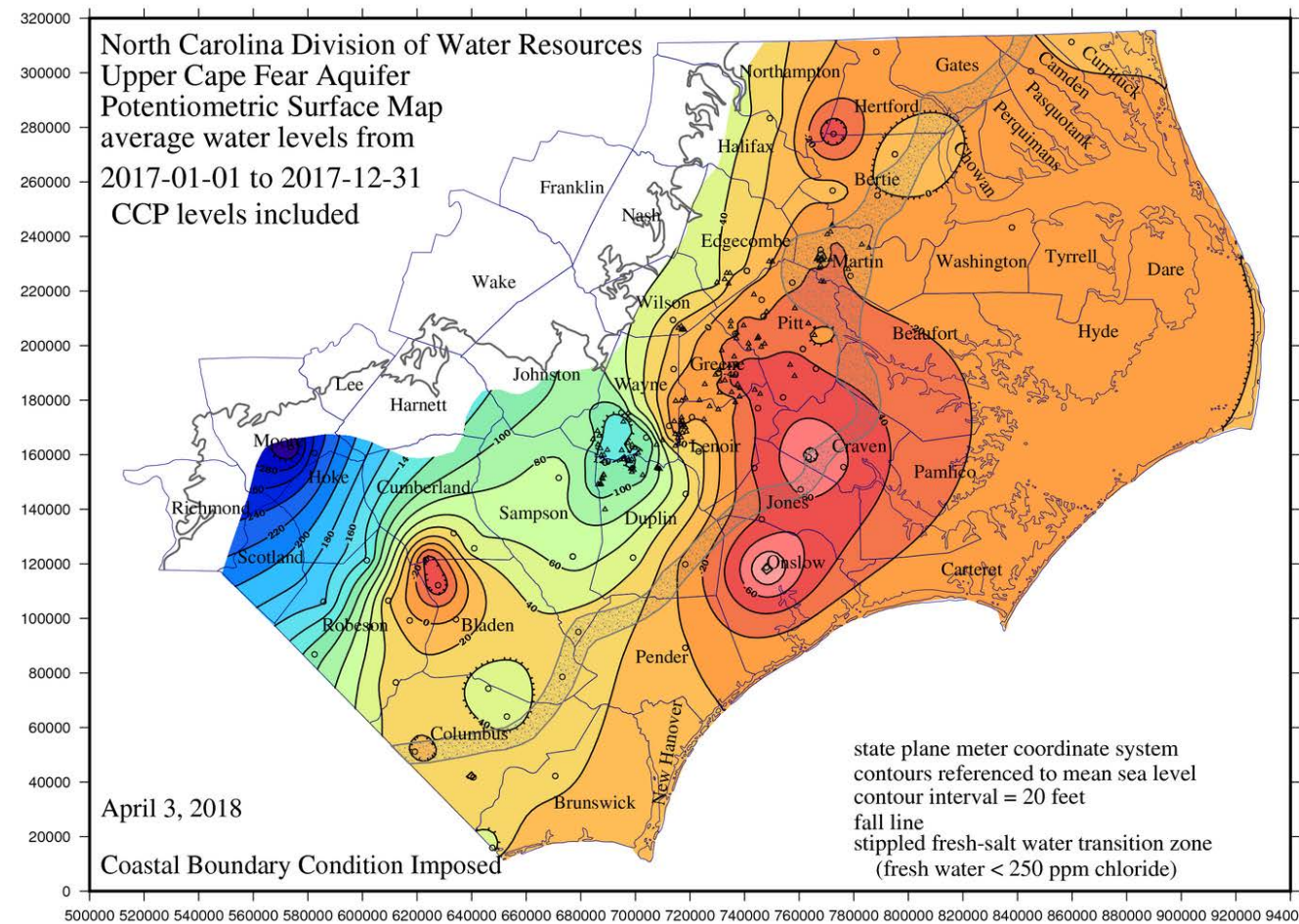
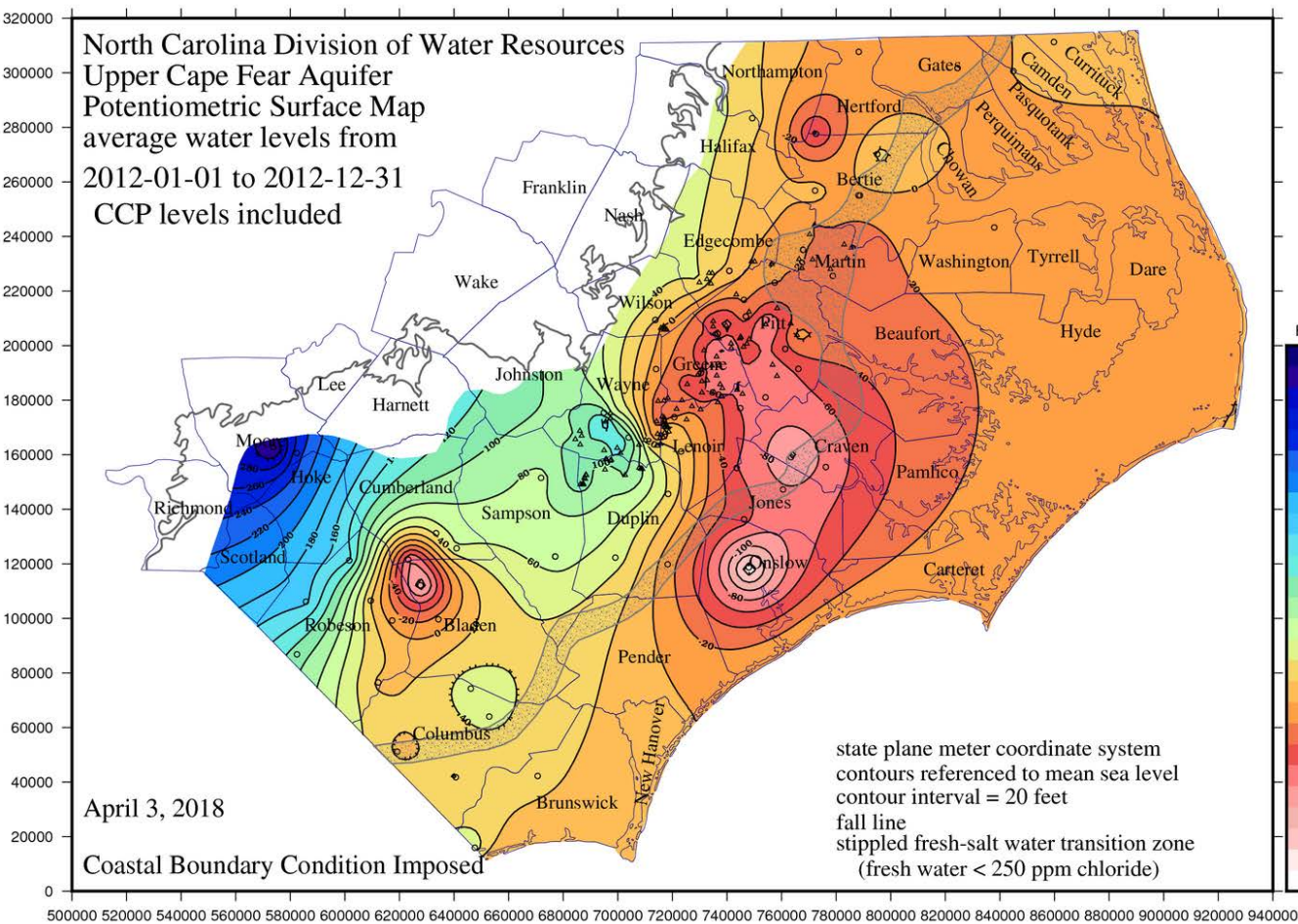
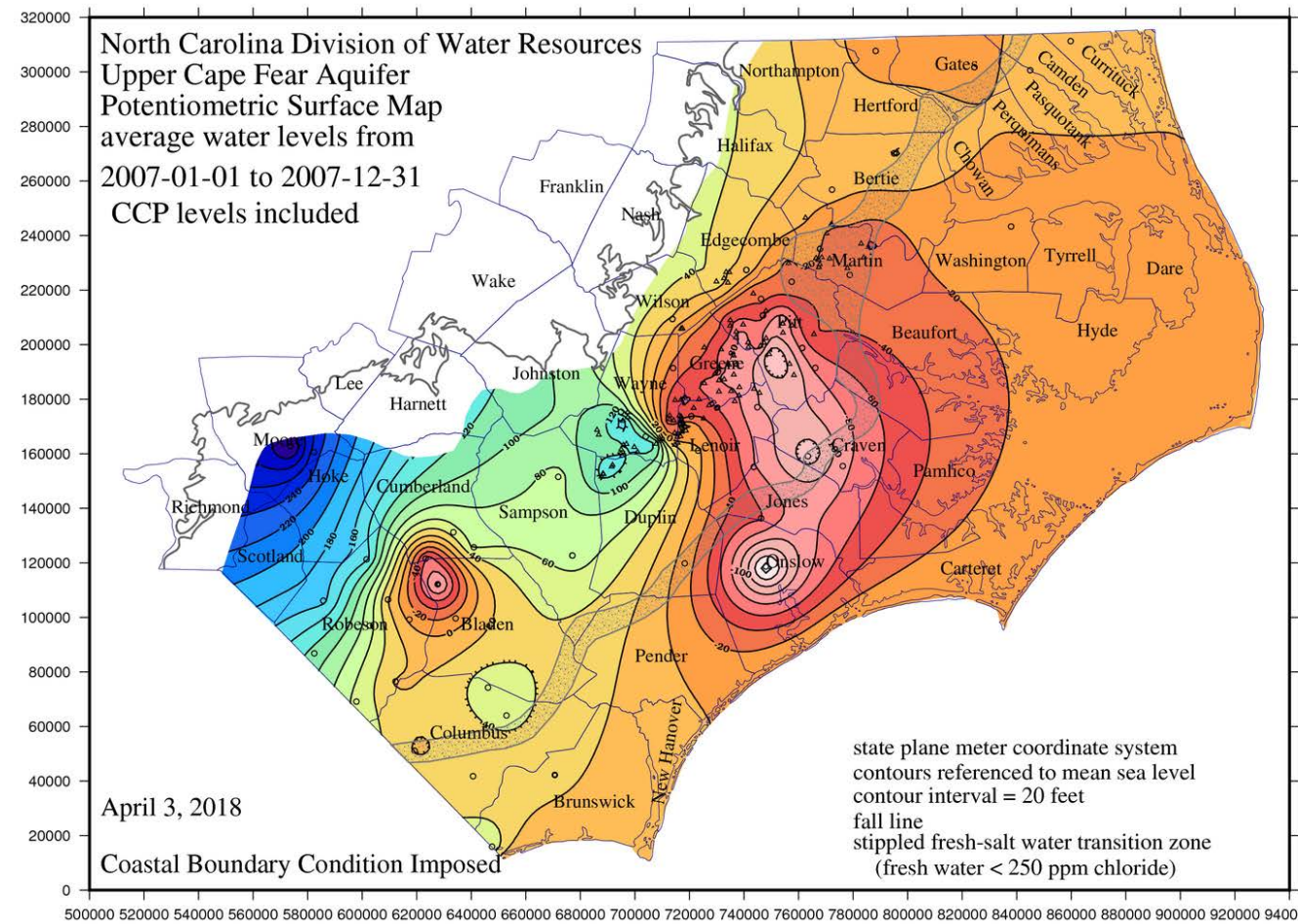


Figure 2.



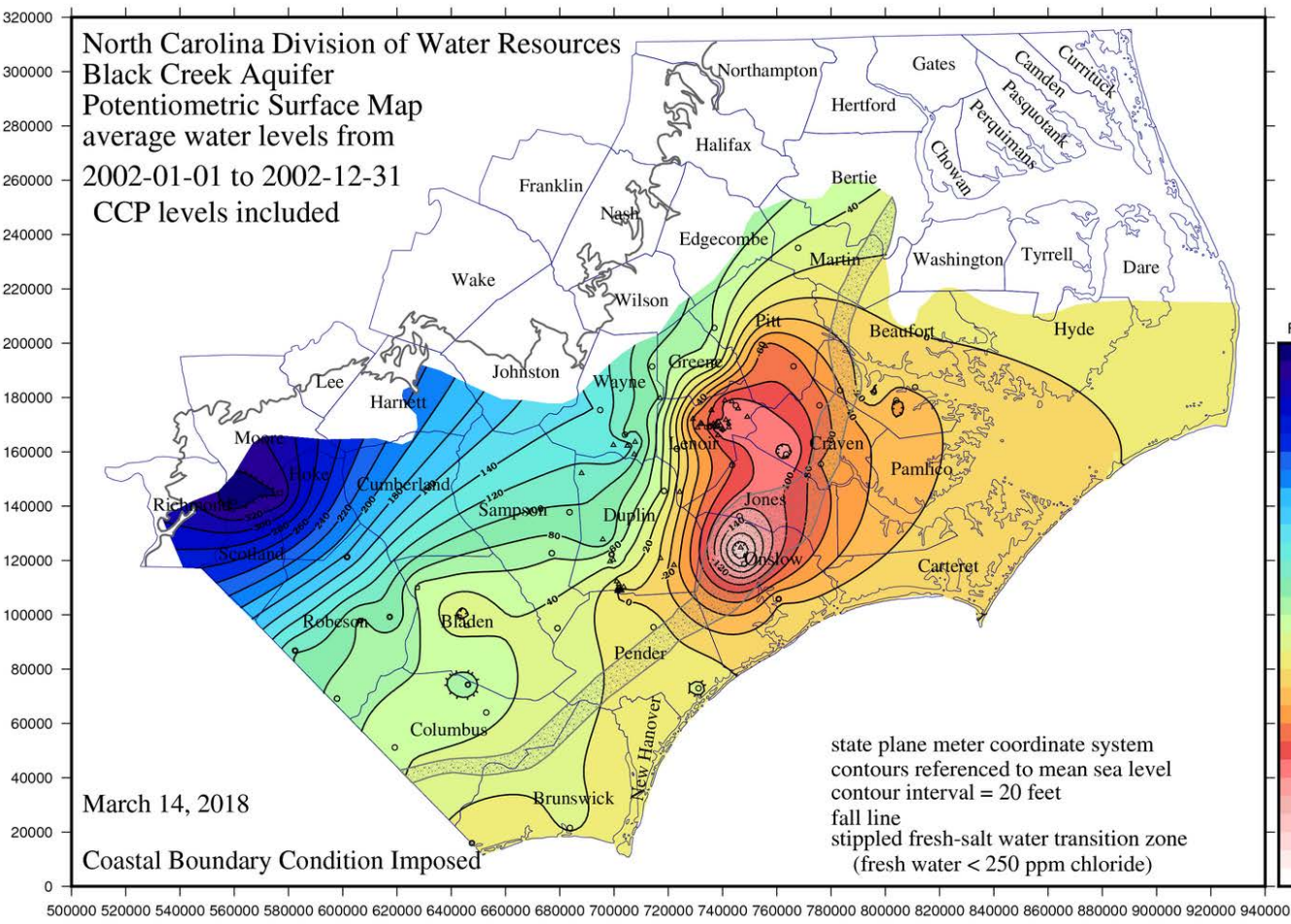


Figure 3.

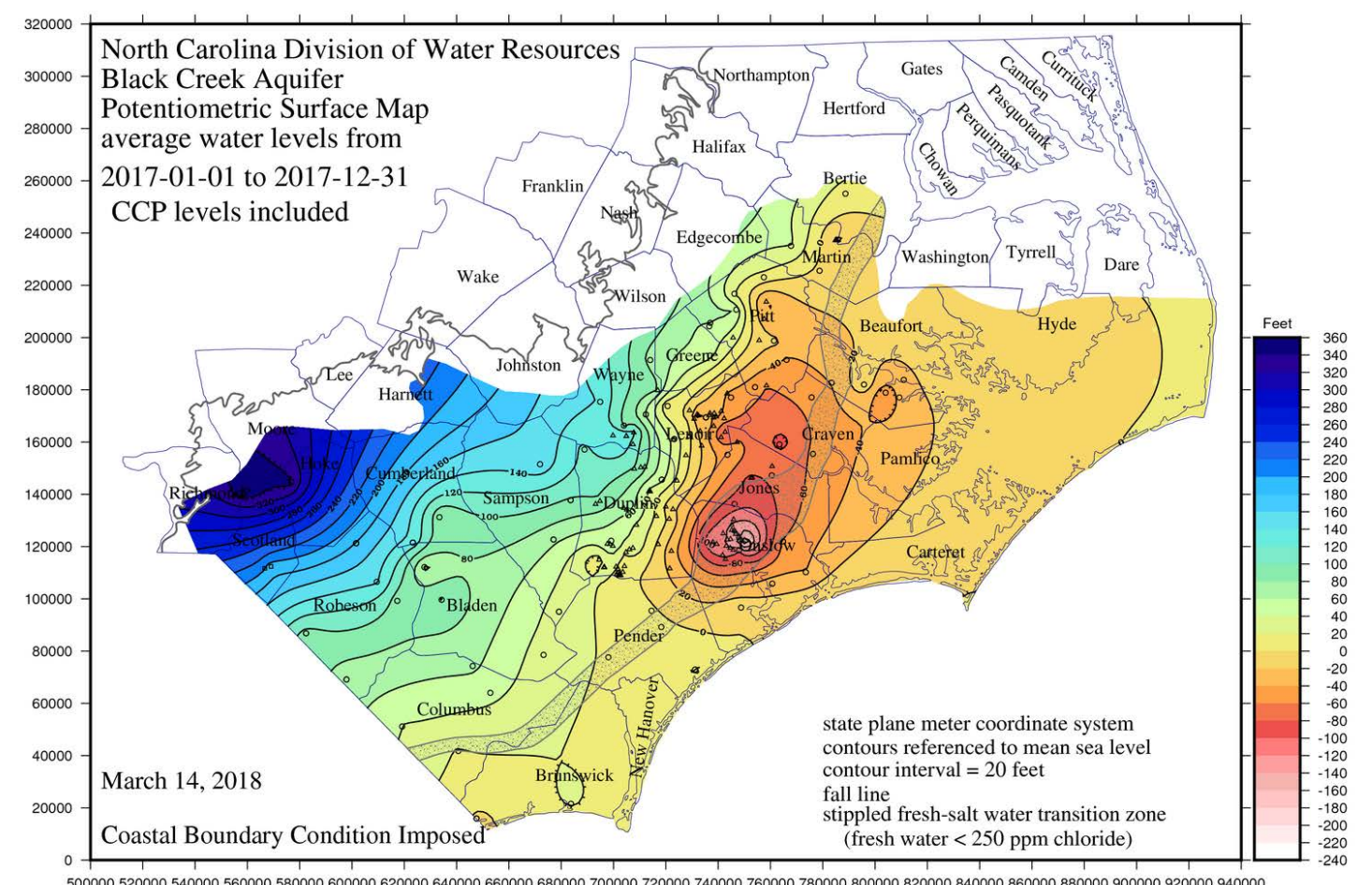
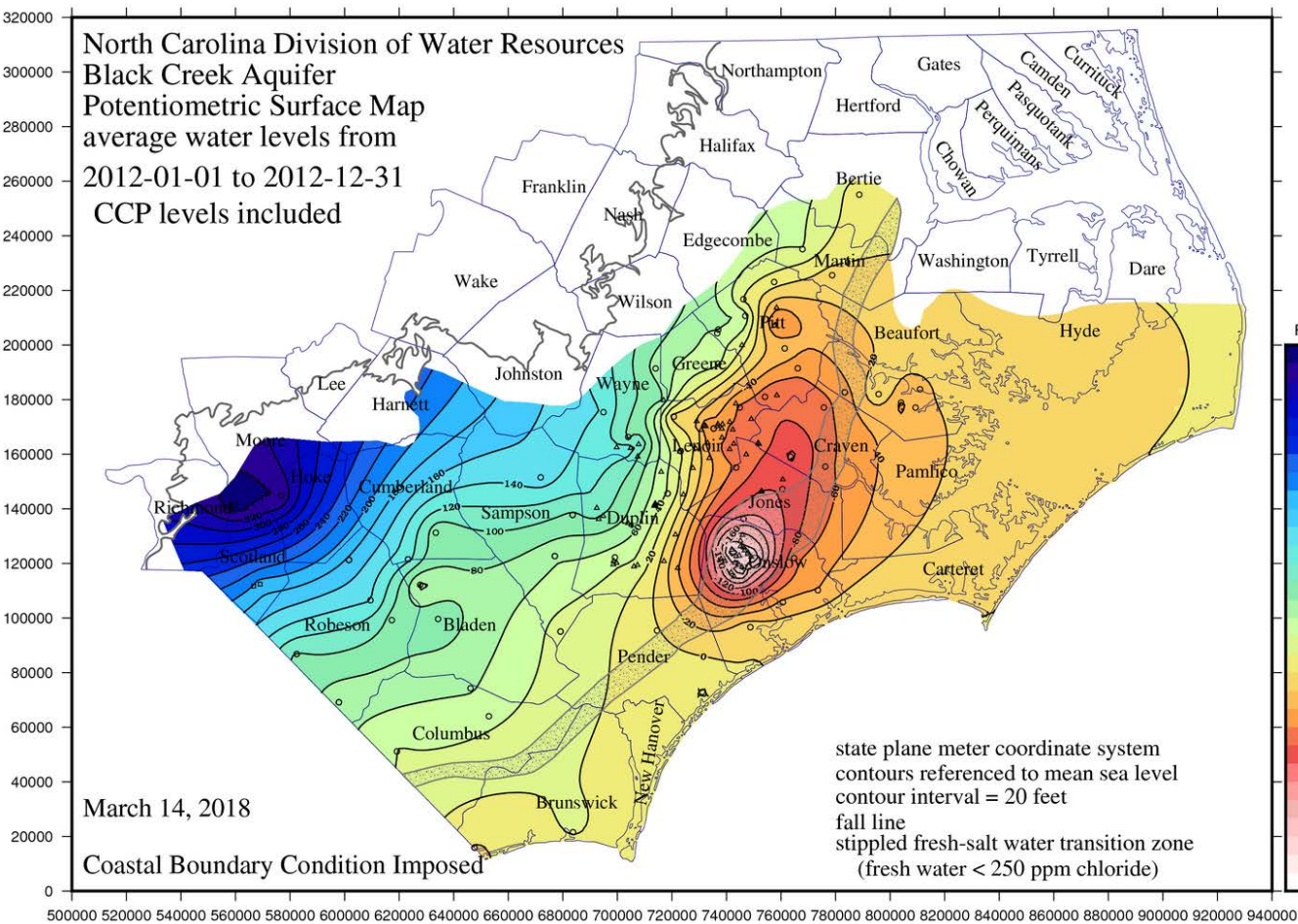
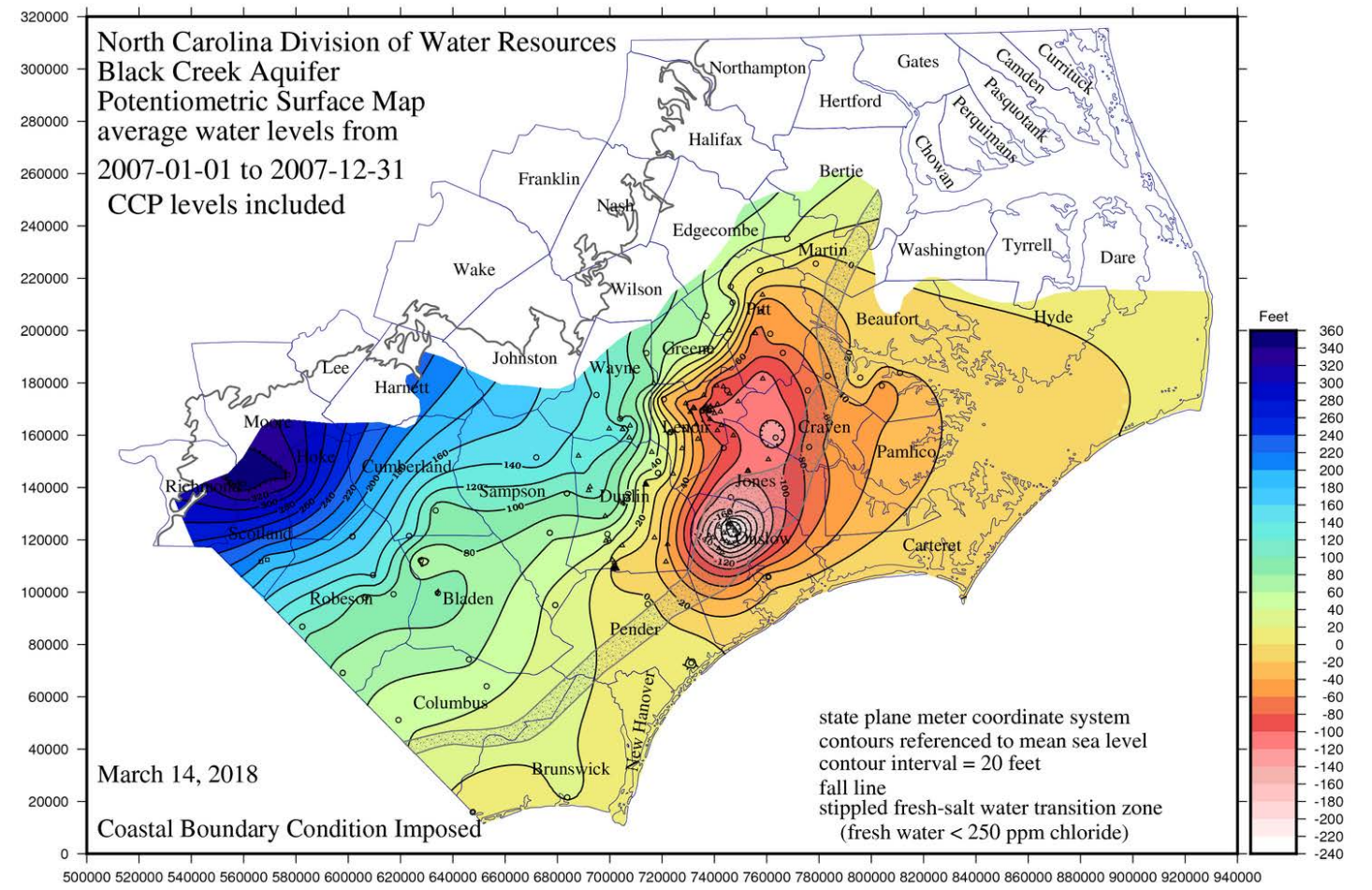


Figure 4.

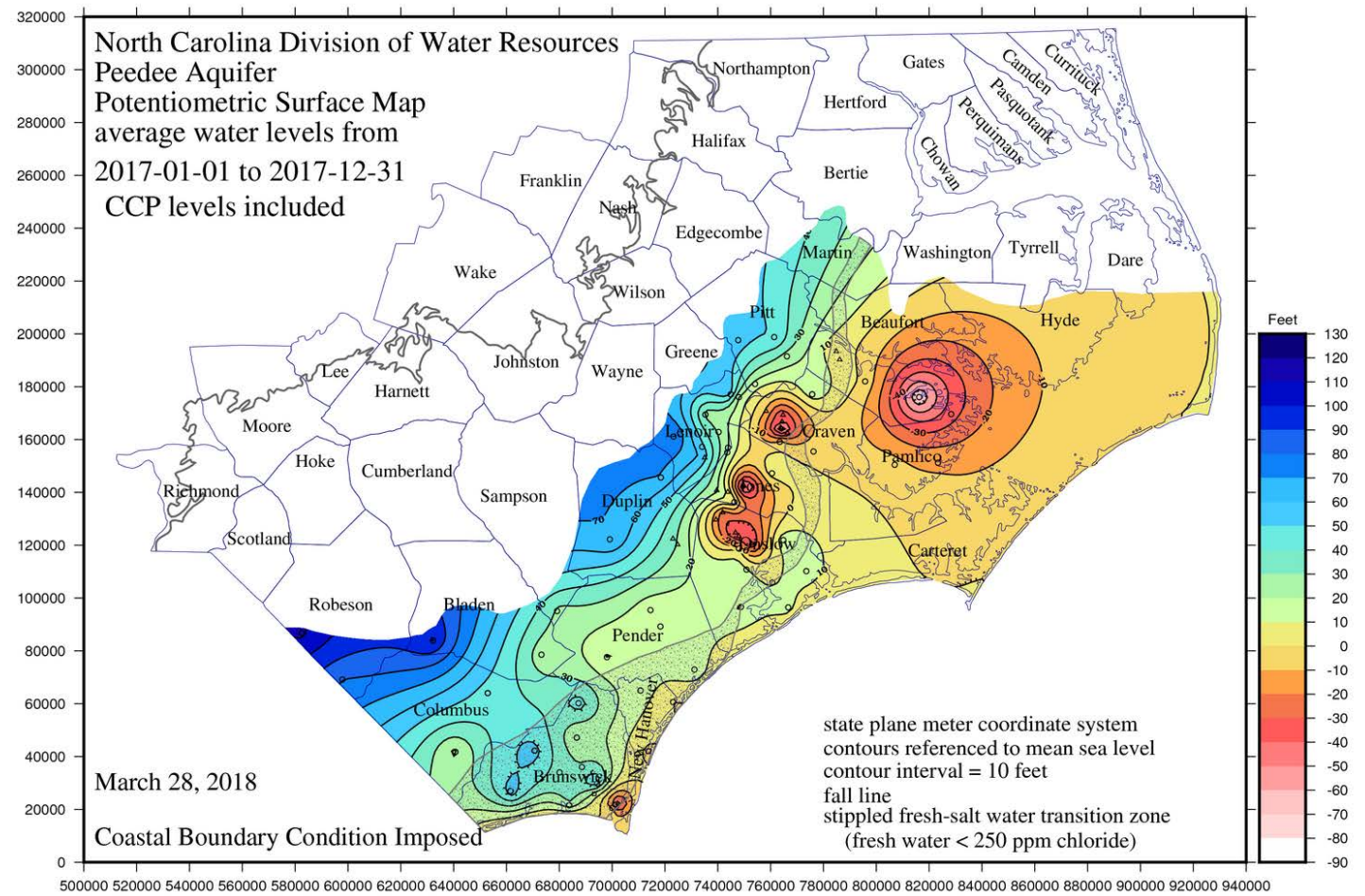
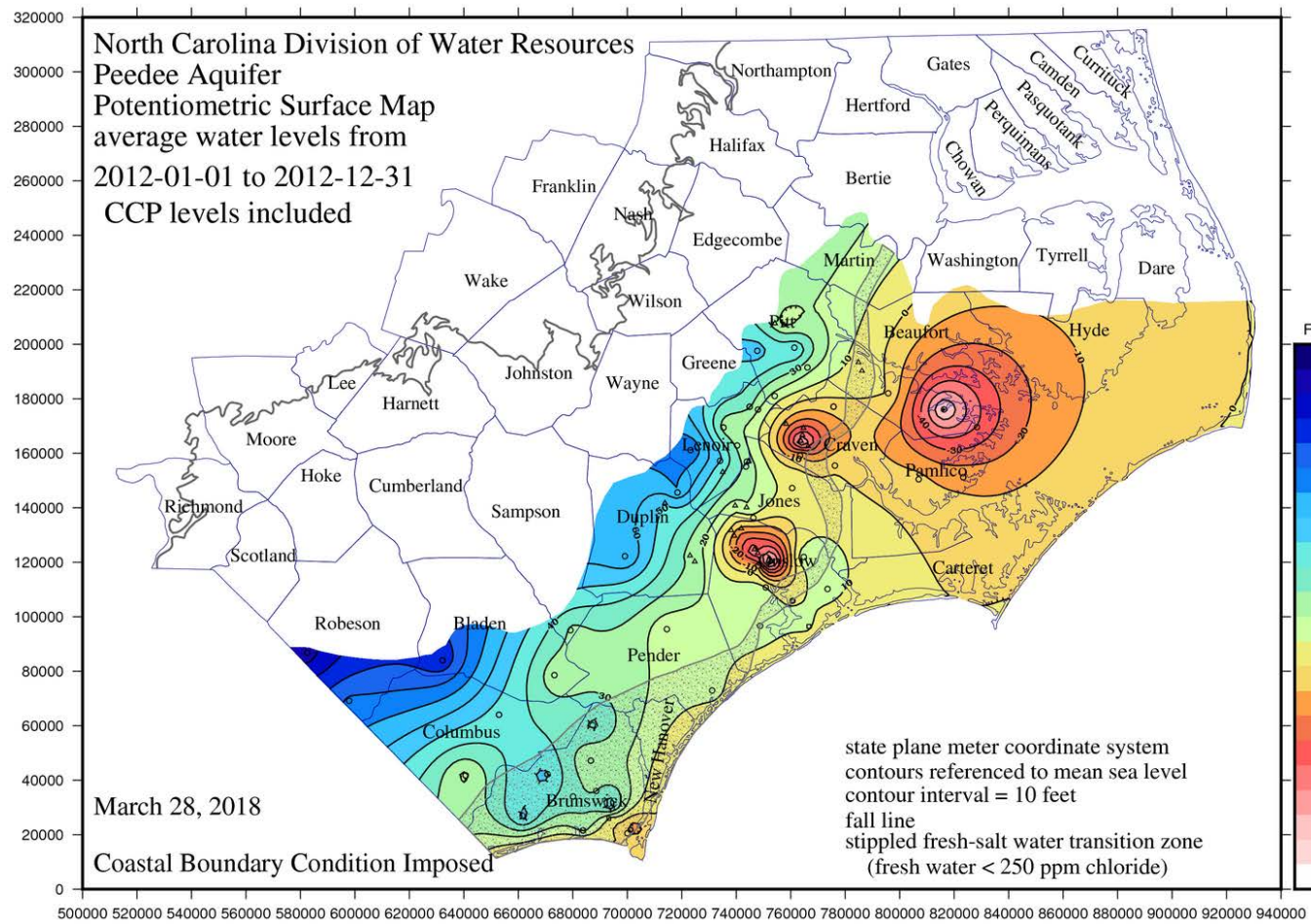
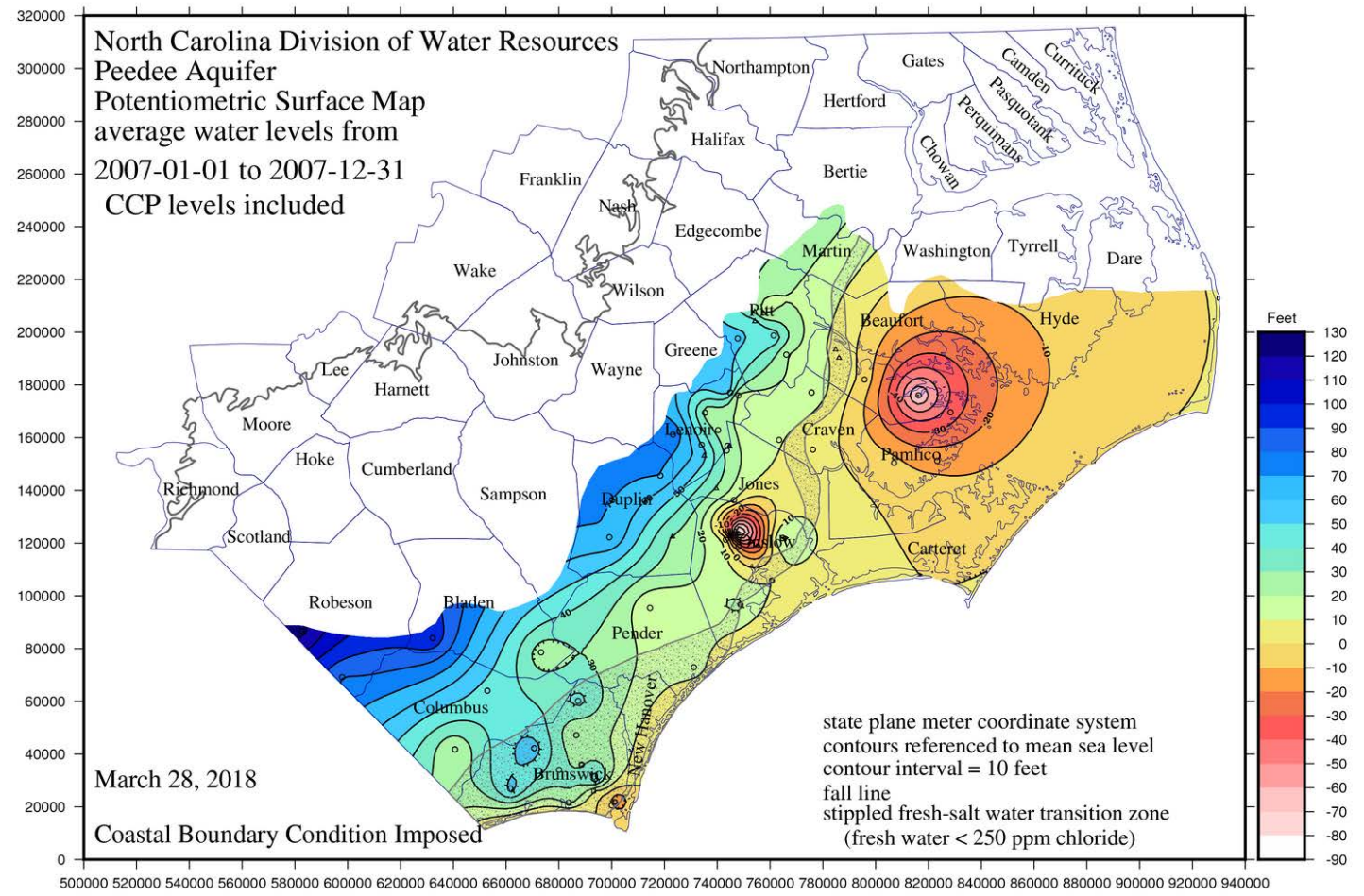
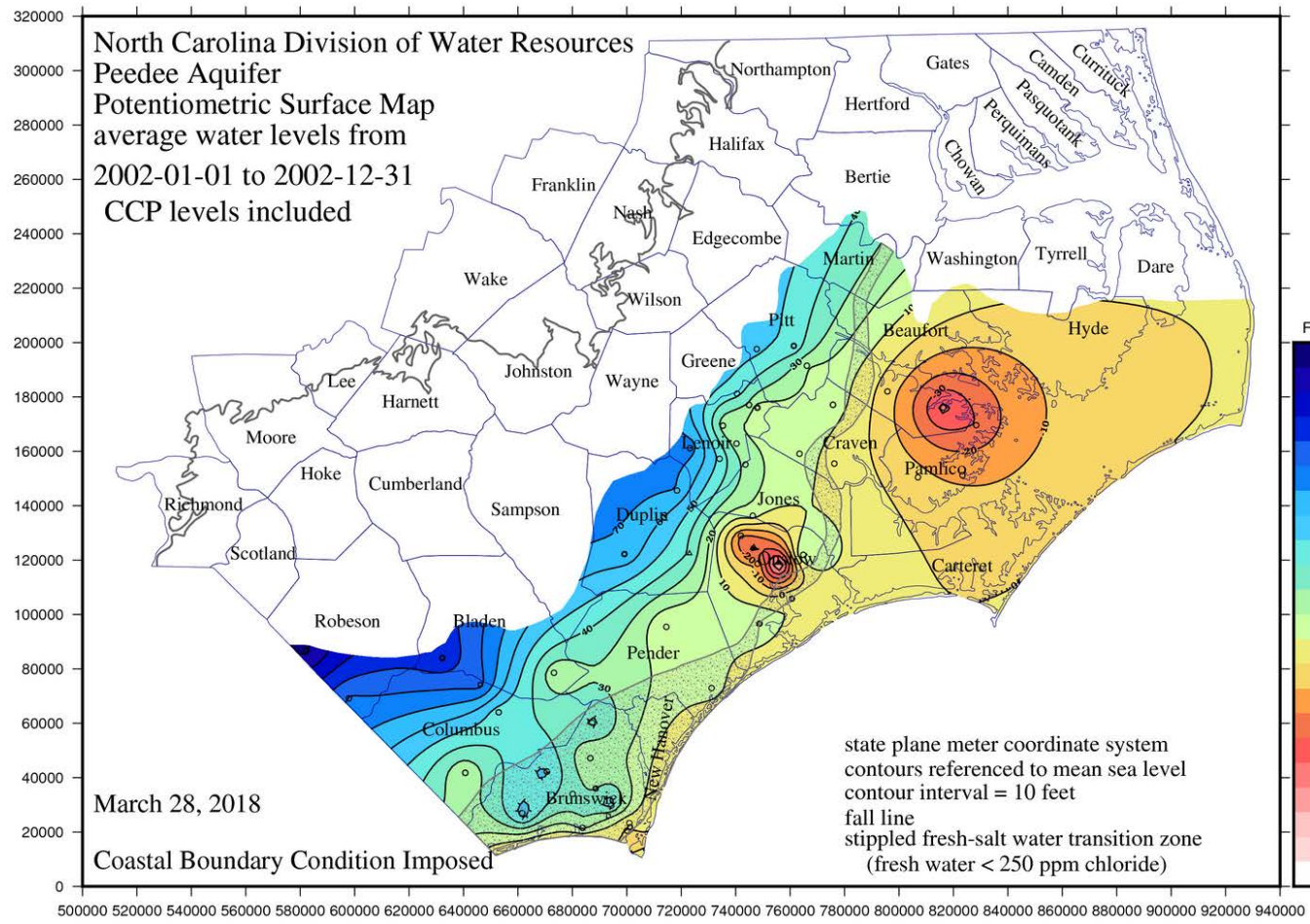


Figure 5.

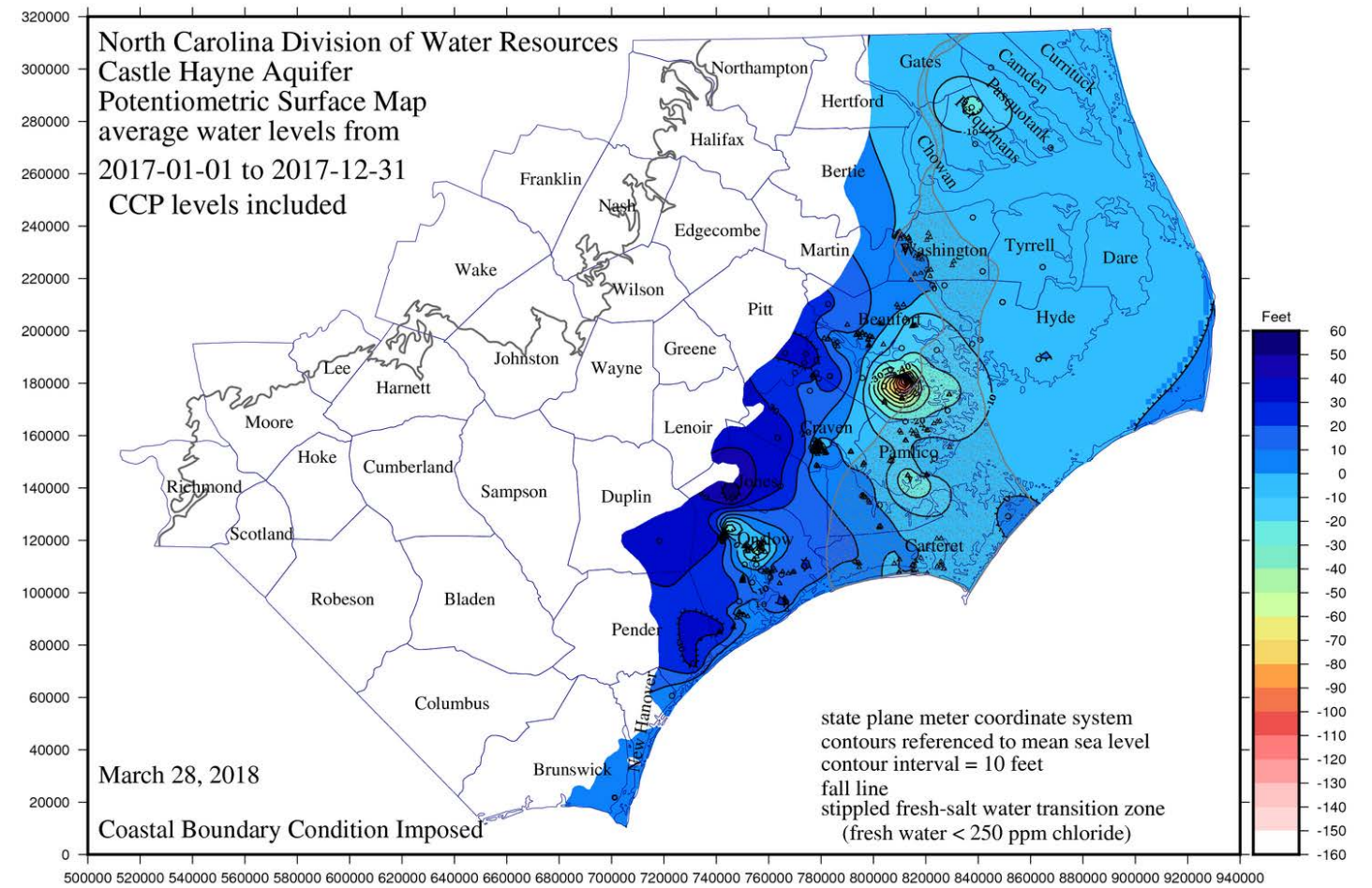
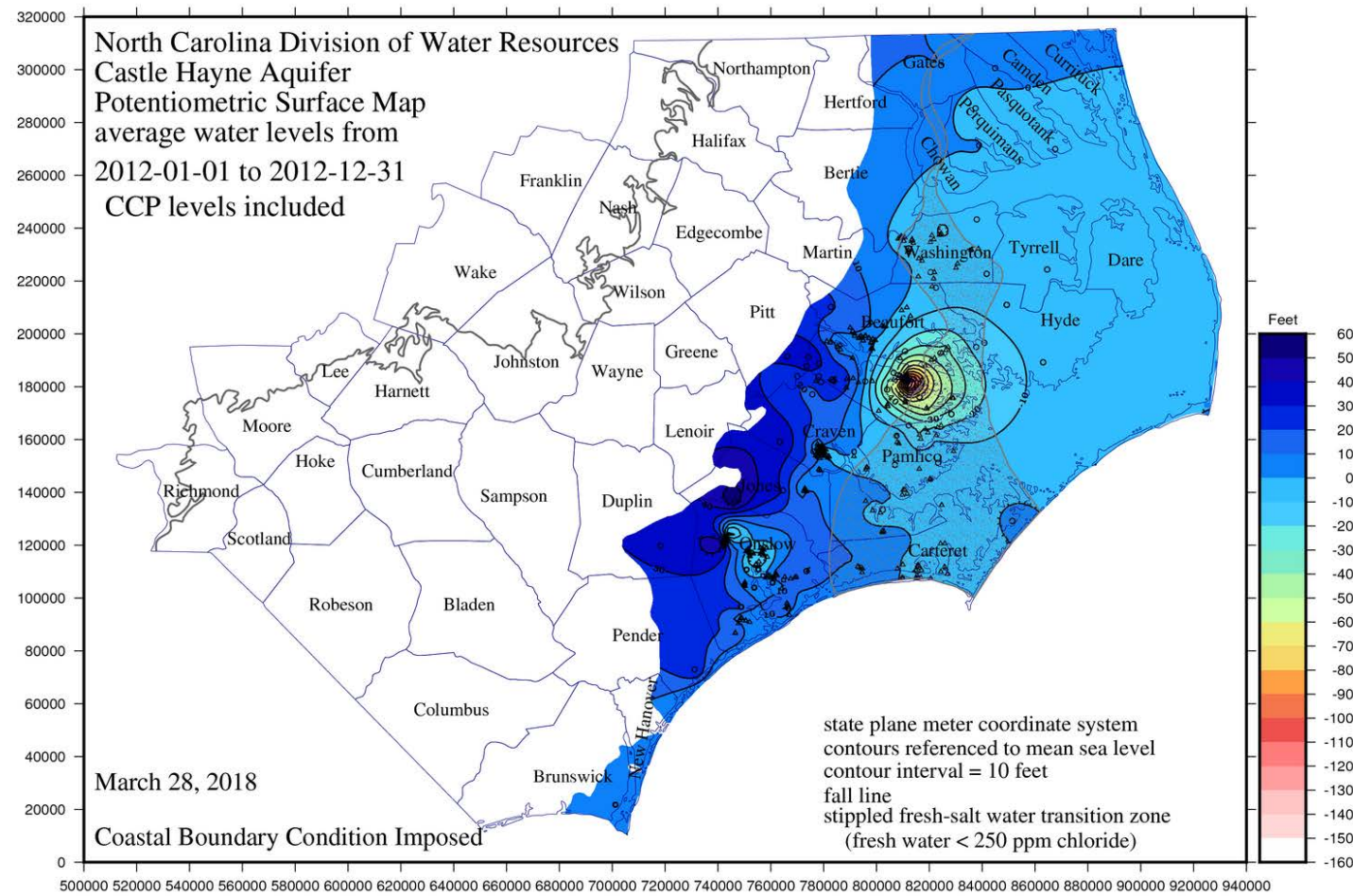
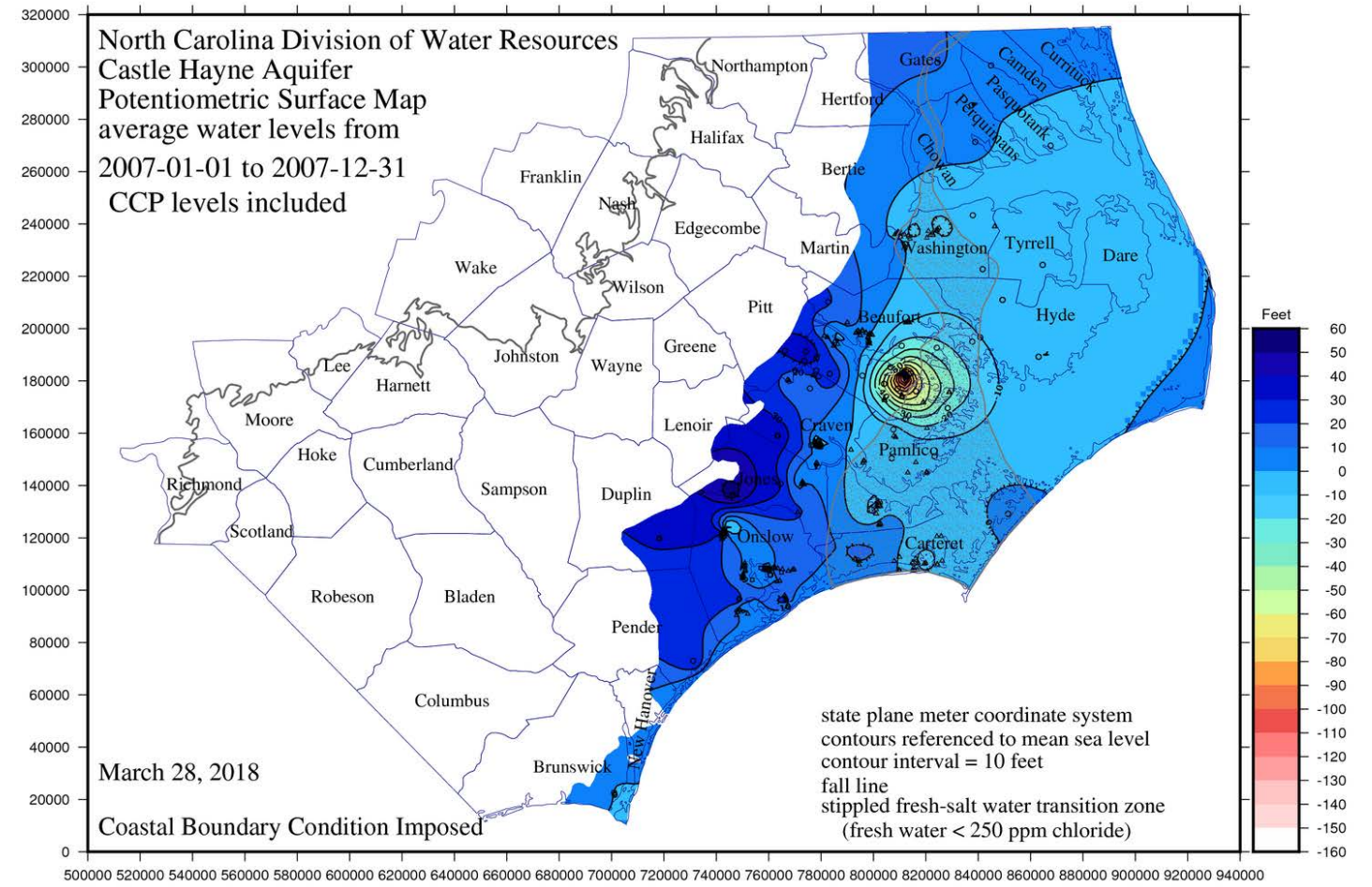
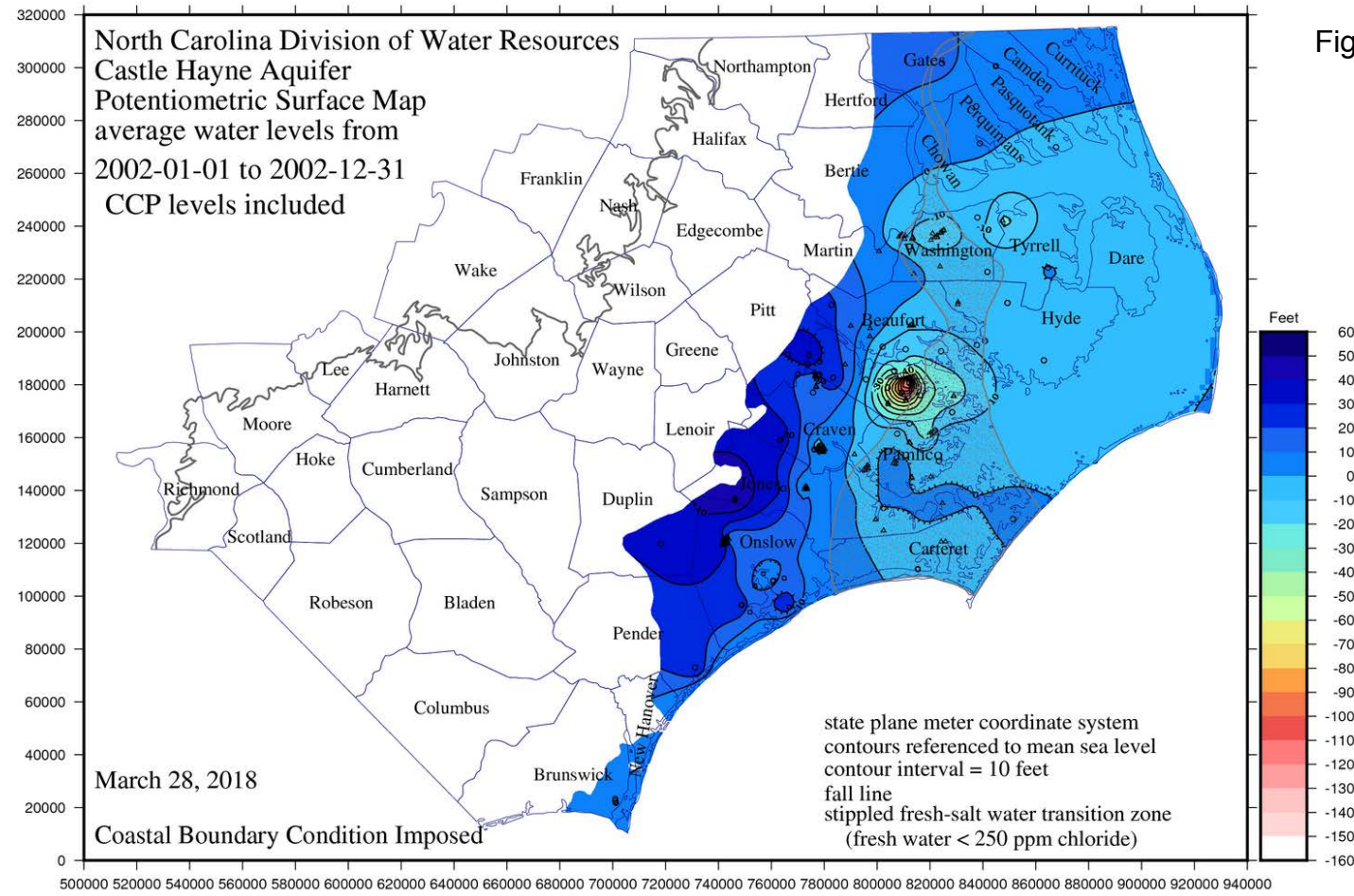


Figure 6 (a-d) Upper Cape Fear Aquifer.

Figure 6a. Chicod Station, Pitt County

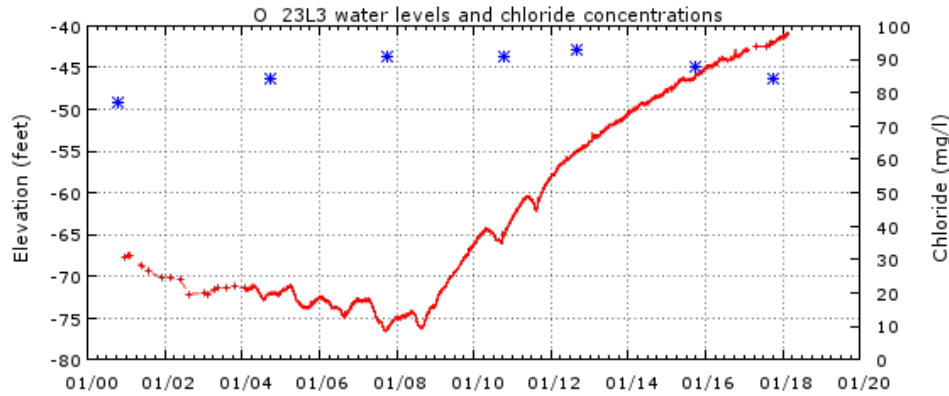


Figure 6b. North Pitt High School Station, Pitt Count

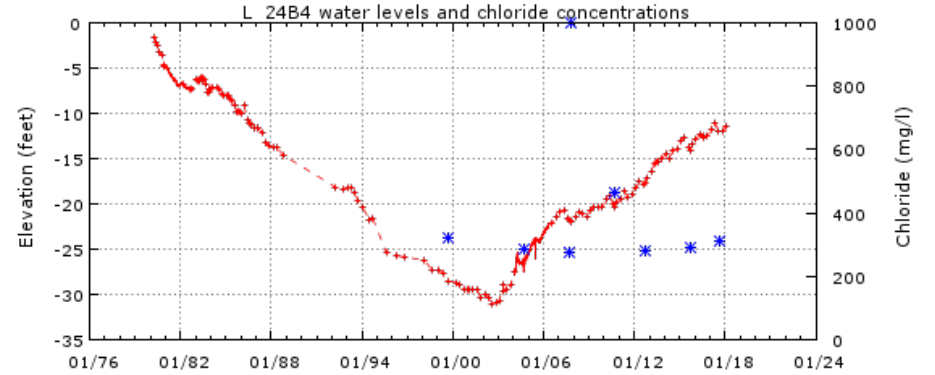


Figure 6c. Chinquapin Station, Duplin County

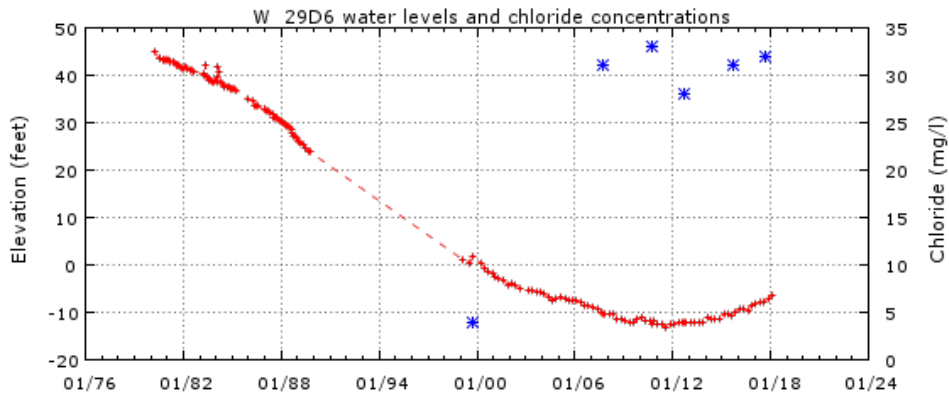


Figure 6d. Savannah School Station, Lenoir County

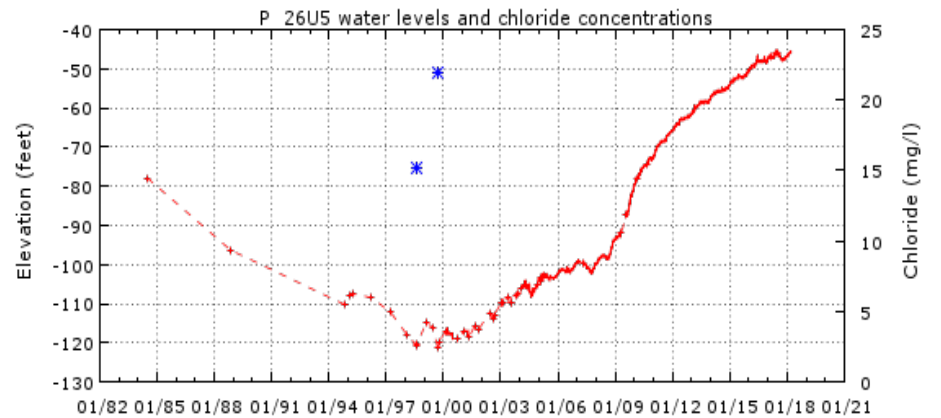


Figure 6 (e-h) **Black Creek Aquifer.**

Figure 6e. Clarks Station, Craven County

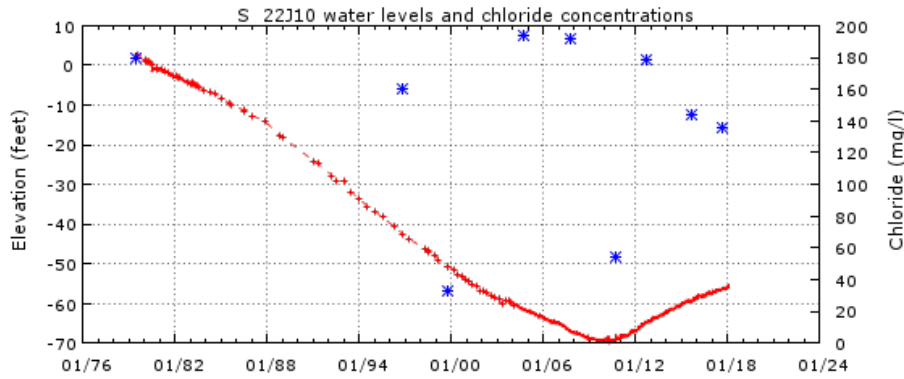


Figure 6f. Pink Hill Station, Duplin County

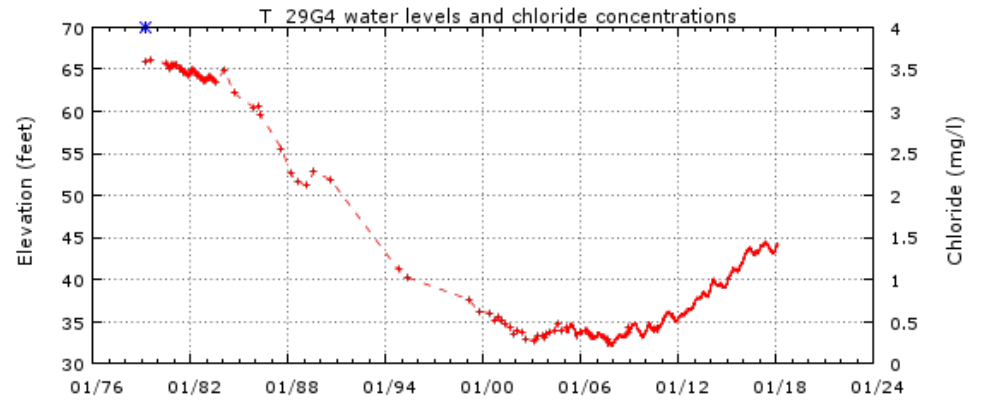


Figure 6g. Kinston Yard Station, Lenoir County

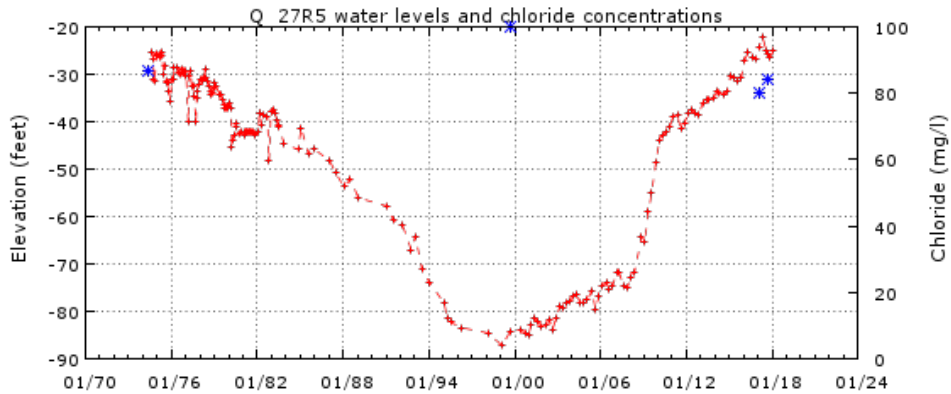


Figure 6h. Comfort Station, Jones County

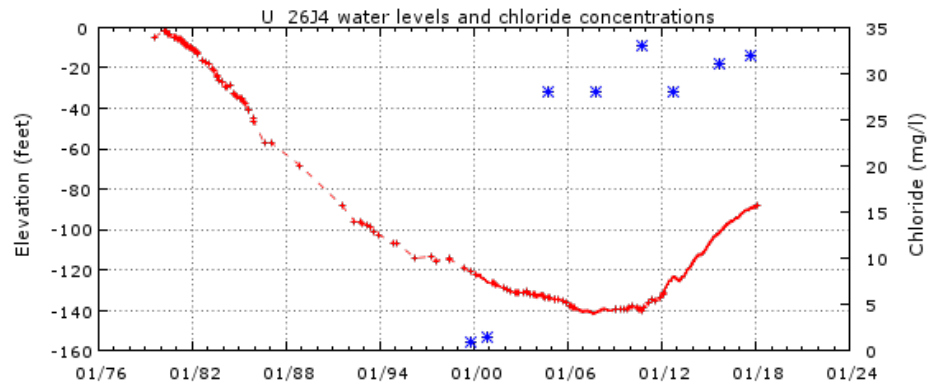


Figure 7. Black Creek Aquifer Rebound (feet)
Nov 2007 through Nov 2017

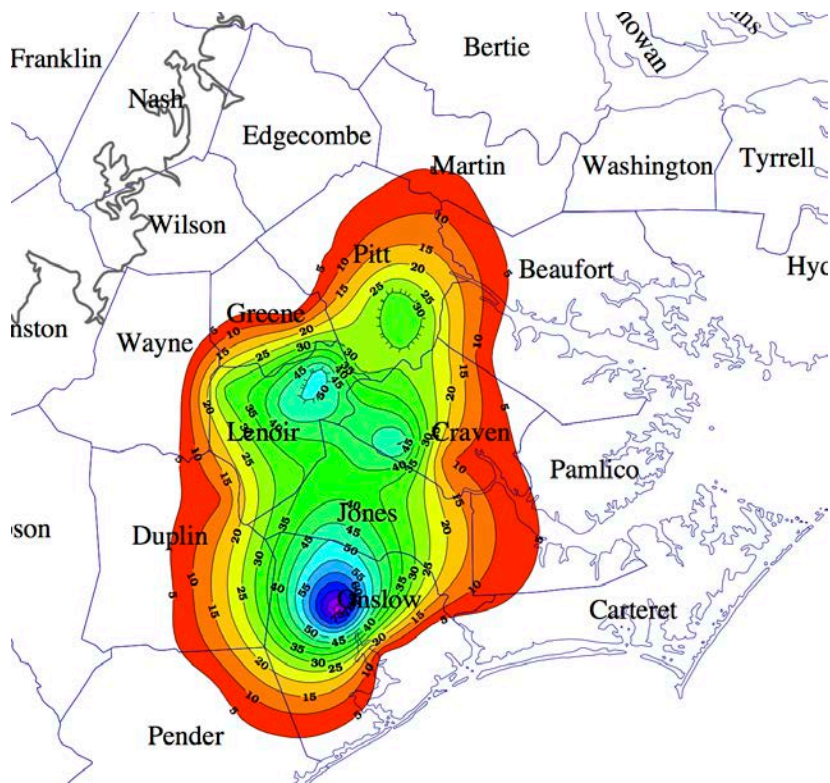
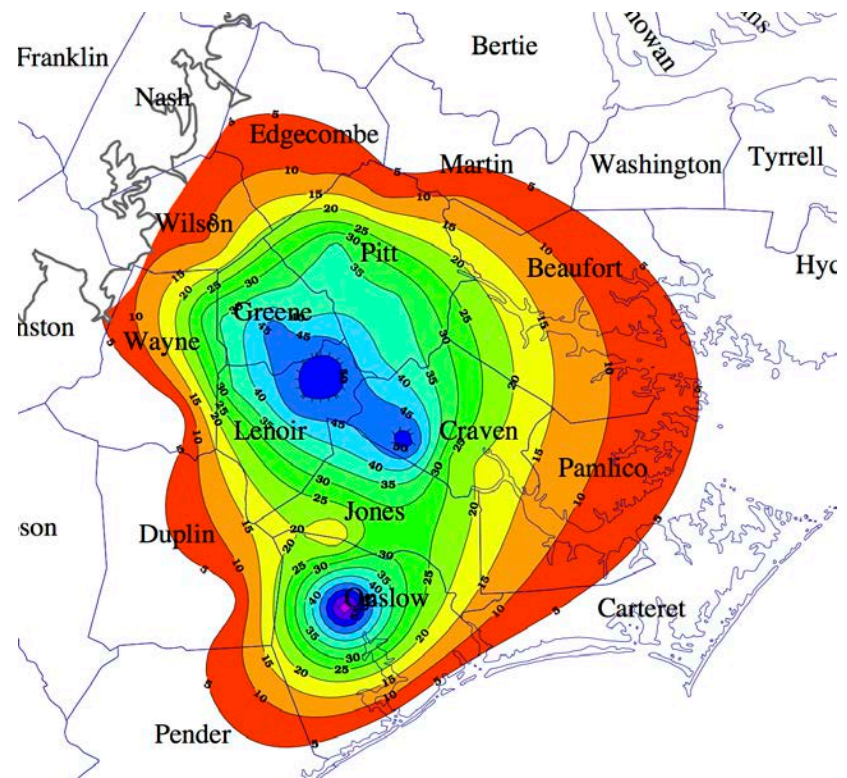


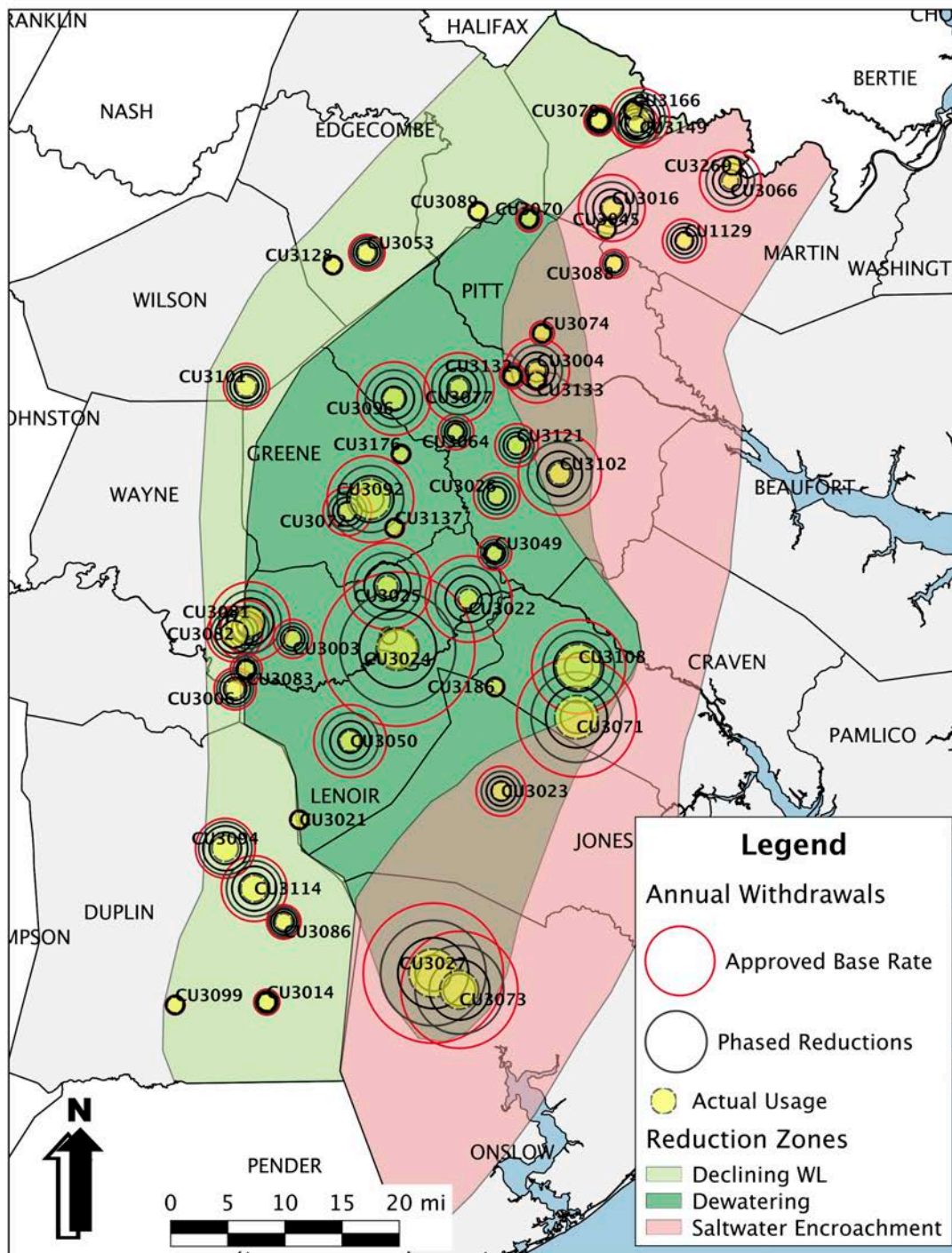
Figure 8. Upper Cape Fear Aquifer Rebound (feet)
Nov 2007 through Nov 2017



5 foot contour interval starting at 5 feet and ending with 80 feet

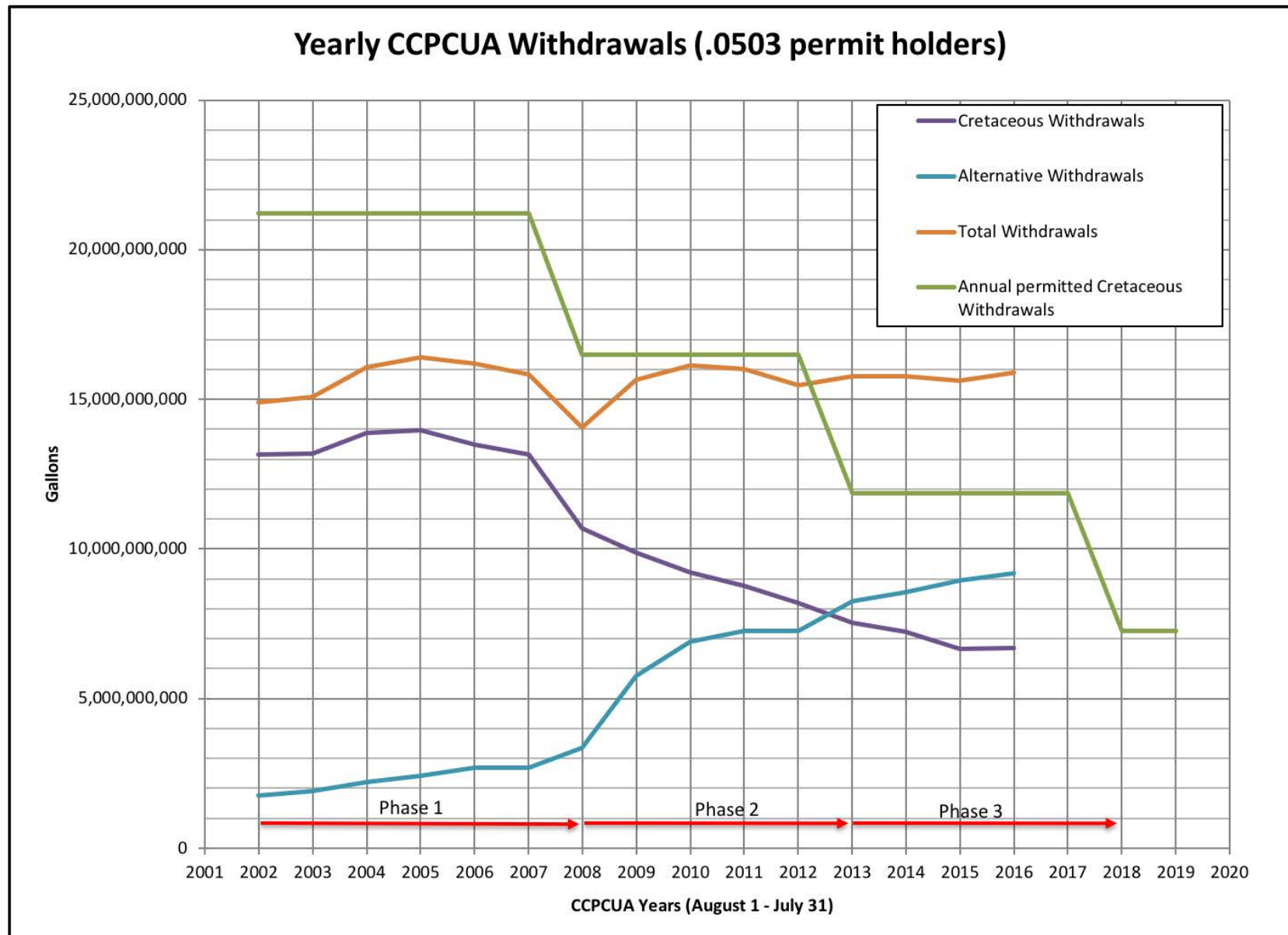
Figure 9.

**CCPCUA Comparative Cretaceous Aquifer Withdrawals
Year 2016 (2016-08-01 thru 2017-07-31)**



DWR 2018-01-10

Figure 10.



15A NCAC 02E .0503 PRESCRIBED WATER USE REDUCTIONS IN CRETACEOUS AQUIFER ZONES

Cretaceous aquifer water use shall be reduced in prescribed areas over a 16 year period, starting from approved base rates on the effective date of this Rule. The Cretaceous aquifer system zones and the three phases of water use reductions are listed as follows:

(1) Cretaceous aquifer system zones are regions established in the fresh water portion of the Cretaceous aquifer system that delimit zones of salt water encroachment, dewatering and declining water levels. These zones are designated on the paper and digital map entitled "Central Coastal Plain Capacity Use Area Cretaceous Aquifer Zones" (CCPCUA) on file in the Office of the Secretary of State one week prior to the effective date of these Rules.

(2) The reductions specified in Rule .0503 of this Section do not apply to intermittent users.

(3) If a permittee implements an aquifer storage and recovery program (ASR), reduction requirements will be based on the total net withdrawals. The reductions specified in Rule .0503 of this Section do not apply if the volume of water injected into the aquifer is greater than the withdrawal volume. If the withdrawal volume is greater than the injected volume, reductions specified in Rule .0503 of this Section apply to the difference between the withdrawal volume and the injected volume.

(4) The reductions specified in Rule .0503 of this Section shall not reduce permitted water use rates below 100,001 gallons per day.

(5) Phase definitions:

- (a) Phase I: The six year period extending into the future from the effective date of this Rule.
- (b) Phase II: The five year period extending into the future from six years after the effective date of this Rule to 11 years after the effective date of this Rule.
- (c) Phase III: The five year period extending into the future from 11 years after the effective date of this Rule to 16 years after the effective date of this Rule.

(6) Phase reductions:

(a) Phase I:

- (i) At the end of the Phase I, permittees who are located in the dewatering zone will be required to reduce annual water use from Cretaceous aquifers by 25% from their approved base rate.
- (ii) At the end of the Phase I, permittees who are located in the salt water encroachment zone will be required to reduce annual water use from Cretaceous aquifers by 25% from their approved base rate.
- (iii) At the end of the Phase I, permittees who are located in the declining water level zone will be required to reduce annual water use from Cretaceous aquifers by 10% from their approved base rate.
- (iv) At the end of the Phase I, permittees who are located in the Cretaceous zone, but outside of the salt water encroachment, dewatering, or declining water level zones will be required not to exceed annual water use from Cretaceous aquifers as established by their approved base rate.

(b) Phase II:

- (i) At the end of the Phase II, permittees who are located in the dewatering zone will be required to reduce annual water use from Cretaceous aquifers by 50% from their approved base rate.
- (ii) At the end of the Phase II, permittees who are located in the salt water encroachment zone will be required to reduce annual water use from Cretaceous aquifers by 50% from their approved base rate.
- (iii) At the end of the Phase II, permittees who are located in the declining water level zone will be required to reduce annual water use from Cretaceous aquifers by 20% from their approved base rate.
- (iv) At the end of the Phase II, permittees who are located in the Cretaceous zone, but outside of the salt water encroachment, dewatering, or declining water level zones will be required not to exceed annual water use from Cretaceous aquifers as established by their approved base rate.

(c) Phase III:

- (i) At the end of the Phase III, permittees who are located in the dewatering zone will be required to reduce annual water use from Cretaceous aquifers by 75% from their approved base rate.
- (ii) At the end of the Phase III, permittees who are located in the salt water encroachment zone will be required to reduce annual water use from Cretaceous aquifers by 75% from their approved base rate.
- (iii) At the end of the Phase III, permittees who are located in the declining water level zone will be required to reduce annual water use from Cretaceous aquifers by 30% from their approved base rate.
- (iv) At the end of the Phase III, permittees who are located in the Cretaceous zone, but outside of the salt water encroachment, dewatering, or declining water level zones will be required not to exceed annual water use from Cretaceous aquifers as established by their approved base rate.

(7) The CCPCUA Cretaceous Aquifer Zones map will be updated, if necessary, in the sixth, eleventh, and sixteenth years following the effective date of this Rule to account for aquifer water level responses to phased withdrawal reductions. The map update will be based on the following conditions:

- (a) Rate of decline in water levels in the aquifers;
- (b) Rate of increase in water levels in the aquifers;
- (c) Stabilization of water levels in the aquifers;
- (d) Chloride concentrations in the aquifers.

This aquifer information will be analyzed on a regional scale and used to develop updated assessments of aquifer conditions in the Central Coastal Plain Capacity Use Area. The Environmental Management Commission (EMC) may adjust the aquifer zones and the water use reduction percentages for each zone based on the assessment of conditions. The EMC will adopt the updated map and reduction percentage changes after public hearing.

History Note: Authority G.S. 143-215.15;
Eff. April 1, 2001.