

**North Carolina  
Division of Water Resources  
Ground Water Management Branch  
2018 Annual Report**

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**R 23X, Cove City Station, Craven County**

## TABLE OF CONTENTS

1.0	Introduction .....	2
2.0	Purpose and Scope .....	2
3.0	Background .....	2
4.0	DWR Statewide Monitoring Well Network Overview .....	3
4.1	Description .....	3
4.2	Monitoring .....	4
4.3	Chloride Sampling .....	6
5.0	Well Network Statistics.....	6
5.1	Ground Water Data Collection .....	6
5.2	Chloride Sampling .....	7
5.3	Well Installation and Development.....	9
5.4	Well Maintenance .....	10
5.5	Acquired Network Wells .....	11
5.6	Automatic Water Level Recorders.....	11
5.7	Site Surveys.....	12
6.0	Local Monitoring Well Network Information.....	13
6.1	Orange County Monitoring Well Network .....	13
6.2	Guilford County Monitoring Well Network .....	14
6.3	Western Carolina Hydrological Research Station Cooperative Network...	14
7.0	Planned Activities .....	15
7.1	New Well Installation .....	15
7.2	Well Abandonment .....	15
8.0	Water Quality .....	15
9.0	Central Coastal Plain Capacity Use Area.....	18
10.0	Summary and Conclusions.....	21

### FIGURES

Figure 1	North Carolina Division of Water Resources Monitoring Stations June 2018
Figure 2	Drought Indicator Wells
Figure 3	Water Level Data Collected From 1967-2018
Figure 4	Chloride Decreases in the Cretaceous Black Creek Aquifer
Figure 5	Chloride Decreases in the Cretaceous Upper Cape Fear Aquifer
Figure 6	Chloride Decreases in the Cretaceous Lower Cape Fear Aquifer
Figure 7	Orange Well Net Orange County 2018
Figure 8	Monitoring Well Network Guilford County 2018
Figure 9	Western Carolina Hydrological Research Station Jackson County

### TABLES

Table 1	Site Susceptibility Rating
Table 2	Site and Recorder Distribution by Region as of 6/30/18
Table 3	Solinst Telemetry System (STS) Distribution by Region as of 6/30/18

## **TABLES (continued)**

Table 4	Monitoring well Network Statistics (01-01-2005 through 06-30-2018)
Table 5	Well Construction Information for New Well Installation in the 2018 FY
Table 6	Well Development Information for 2018 FY
Table 7	Automatic Water Level Recorders as of 6/30/2018
Table 8	Orange Well Net Monitoring Well Information
Table 9	Orange Well Net Network Statistics
Table 10	Guilford County Monitoring Well Information
Table 11	Guilford County Monitoring Well Network Statistics
Table 12	Western Carolina Hydrological Research Station Well Information
Table 13	Western Carolina Hydrological Research Station Network Statistics
Table 14	Network Expansions 2018 FY
Table 15	Summary of Field Parameters 2018 FY

## **APPENDICES**

Appendix A	Well Construction Records
Appendix B	Ground Water Sampling Protocol

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## 1.0 Introduction

The State of North Carolina (the State) relies on ground water for approximately 50 percent of its drinking (potable) water use. In addition, the State has thousands of agricultural and industrial ground water users. The North Carolina Department of Environmental Quality (DEQ), Division of Water Resources (DWR), and preceding agencies have operated, installed, and monitored a statewide monitoring well network from the 1960s to the present. The operation of this monitoring well network is an essential part of DWR's mission to ensure that the State has an adequate water supply for its citizens. Information collected quarterly from this well network include the following:

- Evaluating climatic influences on the State's ground water supply, including effects of drought and recharge-discharge relationships;
- Monitoring human-induced impacts on the State's ground water supply, particularly in the regional aquifer systems of the Coastal Plain physiographic province. These effects include local and regional water level declines as well as migration of the fresh water-salt water interface within various aquifers;
- Providing supporting data for enforcement and creation of current and future ground water usage regulations, such as the Central Coastal Plain Capacity Use Area rules;
- Periodic sampling of the monitoring well network to establish background levels for constituents (e.g. nitrates, etc.); and
- Providing high quality ground water data to local governments, ground water professionals, and the public to use in making informed decisions in ground water related issues.

Data collected from the network are available to the public through DWR's internet website, [www.ncwater.org](http://www.ncwater.org). These data include ground water levels, chloride measurements, well construction information, borehole log construction (lithological and geophysical), ground water monitoring station locations, and geophysical/lithological data collection from non-DWR well sites.

## 2.0 Purpose and Scope

The 2018 Annual Report summarizes field activities and conclusions derived from activities performed or associated with the Ground Water Management Branch during the July 1, 2017 through June 30, 2018 fiscal year (2018 FY). These activities include the ground water monitoring well network water level and water quality data statistics, monitoring well installations including new installations and acquired wells, monitoring equipment usage and evaluations, site surveys, local monitoring well network information, and a summary of the Central Coastal Plain Capacity Use Area 2018 FY activities.

## 3.0 Background

DWR and its predecessor agencies have operated the statewide Ground Water Resource

Monitoring Program from the 1960s to the present. The active monitoring well network has expanded by approximately forty percent (269 monitoring wells) by either installation or acquisition of new monitoring wells since 1998.

The U.S. Geological Survey (USGS) has also contributed to the monitoring of the State's ground water resources under a cooperative agreement between the State of North Carolina and the Federal government. The cooperative well network consists of 13 monitoring wells, many of which are also part of the DWR statewide network.

#### 4.0 DWR Statewide Monitoring Well Network Overview

##### 4.1 Description

The monitoring well network currently consists of 668 wells at 229 monitoring stations (sites), divided into five regions, comprising 66 counties (Figure 1). There are 50 wells located in the Piedmont and Mountain physiographic provinces (Piedmont and Mountain) and 618 wells located in the Coastal Plain physiographic province (Coastal Plain). The Coastal Plain relies more heavily on ground water supplies than either the Piedmont or Mountains. Consequently, ground water monitoring and research have been more concentrated in the Coastal Plain.

In the past few years, more resources have been invested in monitoring the Piedmont and Mountain ground water conditions to better understand the impact of drought cycles on ground water supplies and their contribution to surface water flow. There are 41 DWR wells within the monitoring well network used to assess drought conditions in the 2018 FY (Figure 2).

Of the 229 monitoring stations, 81 are on State or Federal property, 57 are located on property owned by local governments, 87 are located on private property through agreements with



**Boiling Spring RS 2 Station  
FF 32Y1, Brunswick County**



**Hwy 102 Station  
O 21Q, Pitt County**



**Dublin Monitoring Station, Y 40G, Bladen County**

landowners, and 4 stations are located on properties where the landowner indicates that the land property ownership may change. In the past, some wells have been abandoned at the landowner's request due to changes in land use or ownership. Due to the high cost of well construction, combined with the fact that the wells are most valuable when they are monitored continuously over a period of decades, every attempt is made to put new stations in secure, stable locations. A scale has been developed to rank new and existing well sites for potential well abandonment due to land-use issues in the future ([Table 1](#)). It is preferred that new wells be installed at sites with a susceptibility rating of 1 or 2.

#### 4.2 Monitoring

The statewide monitoring network is divided into five regions ([Figure 1](#)). One staff member is responsible for each region. Staff member responsibilities include visiting the wells quarterly to collect water level data, collecting data from drought wells monthly if needed, performing routine site maintenance, keeping automatic data recorders in working order, and keeping sites accessible and aesthetically pleasing. Additional site activities (i.e. recorder removal/replacement, site maintenance, video-logging, etc.) are conducted on an as needed basis.

Depth to ground water level measurements are collected from the network in two different ways. Manual water levels are measured using electronic water level indicators. Hourly water level

measurements are collected using unvented pressure transducers. Hourly water level data are extremely valuable in assessing aquifer recharge, impacts of large storms on ground water conditions, and delineation of aquifer boundaries. Manual water level readings and daily automatic recorder water level data are typically published on the DWR website. However, hourly data is available upon request for specific wells. [Table 2](#) summarizes site and recorder distribution by region.

In addition to the recorders mentioned above, Solinst Telemetry System (STS) recording units have been installed in sixteen wells that are included in the Drought Indicator Well network. They consist of one pressure transducer, one barometer, and are powered by a twelve-volt battery. Data is collected by a controller unit that stores hourly readings. The readings are sent to the home station (DWR web page server) every reporting interval (currently 3



**Video Camera, Deep Creek Station  
O 97L, Swain County**



**Video-logging, Deep Creek Station, O 97L, Swain County**



hours) via a cell phone modem apart from the Laurel Springs (C 31U1) and Como (B 20U) stations. The Laurel Springs and Como monitoring stations transmit data two to three times daily due to inconsistency in cell phone service in this area. DWR uses the STS system on the Drought Indicator Well network to take the place of monthly visits. They are serviced every quarter or semi-annually depending on battery life. The STS data is especially helpful in keeping the Drought Indicator well water levels up to date

([www.ncwater.org/?page=345](http://www.ncwater.org/?page=345)). [Table 3](#) summarizes STS system information.

#### 4.3 Chloride Sampling

Chloride samples are collected from select wells in the Coastal Plain. The samples are analyzed using the Quantab® field method. Field results are used to monitor the migration of the fresh water-salt water interfaces in the Coastal Plain aquifers. Additional chloride samples are collected for field analyses when new monitoring wells are installed and as needed for special projects. The next chloride sampling event will occur in September-October 2019 to track salt water encroachment conditions. Section 5.2 summarizes the 2017 chloride sampling event.

### 5.0 **Well Network Statistics**

#### 5.1 Ground Water Data Collection

Depth to ground water was measured in 661 wells in the 2018 FY. [Table 4](#) contains DWR monitoring well network statistics from January 1, 2005 through June 30, 2018. Statistics may vary in comparison to previous



**STS Equipment**  
**Lewiston Station, H 22I, Bertie County**



**Solinst Telemetry System**  
**Clarendon Station, DD 42N, Columbus County**

years due to additional data entry in the DWR database as older field books are scanned and unrecorded data entered. [Figure 3](#) compares the number of wells monitored to the water level data collected from the network from 1967 to present. Hourly water level data is not included in this graph. Calendar year 2016 represents the most water level data collected in any single year since starting the monitoring well network operation. The 2018 FY data was collected from January 1 through June 30, 2018.

Archived water level recorder charts obtained from DWR and its predecessor agencies, with records dating from the 1960s through 1980s, continue to be digitized and data recorded into the DWR online database. Additional continued digitized information recorded in the database includes, but is not limited to, well construction records, well development information, chloride sampling events, memorandums of agreement, and field notes.

## 5.2 Chloride Sampling

A chloride sampling event was performed in 2017. Ground water from 322 wells within the network was sampled for chlorides using Quantab® chloride titrators from July 12, 2017 through October 5, 2017. Field data were collected for pH, conductivity, and salinity using YSI® portable probes.

The purpose of chloride sampling is to evaluate trends in water quality of the fresh water-salt water interface within each of the major coastal plain aquifers. Current results are compared to results of previous sampling events to evaluate potential landward migration of the fresh water-salt water interface due to aquifer overuse. Chloride levels were used to determine if ground water was fresh (0 ppm chloride), transitional (1-250 ppm chloride), or salty (>250 ppm chloride). Chloride analytical results for the Cretaceous Black Creek (Kbc), Upper Cape Fear (Kucf), and Lower Cape Fear (Klcf) aquifers are shown in Figures 4, 5, and 6, respectively.



**Data Collection  
Cremo Station, F 19V, Bertie County**



**Hobo Datalogger  
Bear Grass Station, K 21R  
Martin County**

Figure 4 shows chloride levels in the Black Creek aquifer have remained below detection limits or relatively uniform for all except 4 of 27 wells since 2010. A continuous increasing trend was recognized at Lee Creek, (P 17I), where chlorides rose from 6,766 ppm in 2010 to 9,056 ppm in 2017. The increase at Lee Creek is potentially related to open-pit mining activities near that location.

Figure 5 shows non-detectable or low-level chloride fluctuations within the Upper Cape Fear aquifer for the majority of the 37 wells sampled. Recent chloride decreasing trends were observed at the Chicod (O 23L), Cove City (R 23X), Jones Middle School (T 24J), and Clarendon (DD 42N) wells, with a decrease at Clarendon from 202 to 100 ppm between 2012 and 2017. Recent chloride increasing trends were observed at select Gold Point (J 22P), D H Conley (N 23P), Clarks (S 22J), Comfort (U 26J), and Nakina (EE 39O) wells with an increase at Clarks from 1,735 to 2,297 ppm between 2012 and 2017. The cause for fluctuations may be attributable to local or regional pumping effects.

Figure 6 shows low to moderate chloride fluctuations within the Lower Cape Fear aquifer for the majority of the 20 wells sampled. Notable chloride level decreases were observed at the Morgans Corner (C 12W), Gold Point (J 22P), North Pitt High School (L 24B), Falkland (L 25P), and Kelly (AA 35N) wells with decreases of over 1,000 ppm per well at Morgans Corner and Kelly between 2010 and 2017. Chloride decreases in these wells are potentially attributable to CCPCUA pumping reductions.



**Measuring Depth to Water Level  
Bonnerton Station, P18V  
Beaufort County**



**Chloride Sampling  
WCWC Station, X 190  
Carteret County**

### 5.3 Well Installation and Development

From April 2018 through May 2018, the following monitoring wells were installed using the mud rotary drilling method:

- WCWC Station, Carteret County, six wells (X 1901, X 1902, X 1903, X 1904, X 1905 and X 1906);

A pilot hole was previously advanced at the newly installed station by Magette Well and Pump Company from Ahoskie, NC using the mud rotary drilling method. The borehole was used to construct monitoring well X 1901. DWR staff collected samples of the drill cuttings at ten-foot intervals in order to assess the borehole lithology. In addition, a borehole geophysical log was obtained by lowering a probe into the borehole once the borehole was completed. The geophysical log makes a detailed record of the geologic formations in the borehole. Geophysical and lithologic log interpretation enabled the DWR staff to assess well screen intervals and the number of wells to be installed at the WCWC monitoring station. The wells were installed using 4-inch PVC riser and 10 to 20 feet of 4 to 4.5-inch stainless steel continuous wire wrap V-slot screen. The wells were constructed of a gravel pack extending from the bottom of the screen to a minimum of five feet, but no more than ten feet, above the screen. A minimum of ten feet of bentonite overlays the top of the gravel pack to provide a sufficient bentonite seal in the well. [Table 5](#) summarizes the monitoring well construction information. These wells are included in [Figure 1](#). Well construction records for the 2018 FY installed wells are included in [Appendix A](#). Wells 2-6 at the WCWC Station were installed by A.C. Schultes of Carolina, Inc.



**Well Casing Installation  
Rose Hill Station, V 32V  
Duplin County**



**Mud Rotary Drill Bits  
Farmville Station, M 27U, Pitt County**

Development removes fine-grained sediments from the vicinity of the well screen and ensures proper hydraulic connection with the aquifer. During development, field data were collected for pH, conductivity, salinity, and temperature in thirty minute or hourly intervals. Field data exhibiting overall consistency was used to assist in the decision to stop well development. DWR staff plans to redevelop several existing monitoring well stations in the 2019 FY. Monitoring wells developed in the 2018 FY are listed in [Table 6](#).

#### 5.4 Well Maintenance

The well network requires continual maintenance to keep active monitoring stations usable. Many of the wells exceed 30 years in age and are constructed of materials that are susceptible to corrosion, especially in acidic or saline ground water conditions. Some older wells were constructed with outdated, less than desirable construction practices including backfilling boreholes with cuttings instead of neat cement or bentonite grout. Boreholes backfilled with cuttings form an inadequate seal and allow other aquifers to influence the water level and water quality in that well. Another outdated practice included well construction using telescoped casing. Telescoped casing uses a reducer to trim the well to a smaller diameter casing at depth apparently to save money during well construction. Telescoped wells are very susceptible to blockage at the depth of the reducer. Approximately 152 wells in the network were constructed with reducers. DWR has implemented a long-term program for replacing damaged or unsuitably constructed wells with new, properly constructed wells.



**Well Development  
Holly Shelter, Z 29N, Pender County**



**Well Development  
Myrtle Grove Station, EE 30M, New Hanover County**

5.5 Acquired Network Wells

DWR acquired one existing monitoring station, Burton Park Boulevard in Onslow County, during the 2018 FY. The three wells comprising this station were constructed by Magette Well and Pump Company/Groundwater Management Associates and funded by the City of Jacksonville during the Summer of 2016. The City of Jacksonville is one of three partners in the Onslow Regional Water Resources Group which also includes Onslow Water and Sewer Authority and the Marine Corps Base, Camp Lejeune. DWR supported this effort to help increase the understanding of the freshwater-saltwater distribution in the Black Creek and Upper Cape Fear aquifers. DWR is awaiting a report from the Onslow Group which will summarize the results of monitoring these three wells since their construction. Details of the monitoring station are included in [Table 5](#).

### 5.6 Automatic Water Level Recorders

Automatic water level recorders play an integral role in the DWR monitoring program. Hourly water level measurements are collected using unvented submersible pressure transducers. They allow for economical collection of near-continuous data at remote well stations. Two primary recorders (Onset Computer's Hobo U20 series and Solinst Telemetry System or STS) were utilized in the 2018 FY and are included in [Table 2](#). [Table 7](#) lists the recorders present on network wells as of June 30, 2018.

### 5.7 Site Surveys

Concrete survey monuments have been installed at each of the 229 active monitoring well stations within the network. Five of those stations have more than one monument.

Each of the installed monuments have been surveyed using Survey Grade Global Positioning System (GPS) to calculate the most accurate horizontal and vertical location data possible. The monuments were surveyed during March, April, and December 2015 and a select number of sites were surveyed a second time in January 2016. Monitoring stations installed in the 2016 FY, in addition to select wells, were surveyed in October 2016. Monitoring stations installed in the 2017 FY, in addition to select wells, were surveyed in March 2018. DWR was unable to get elevations at two monitoring stations, Beach Grove School Field (M93L and Woody Creek M93R), due to the inability to acquire a cell phone signal at the station's location. GPS surveying will be conducted again in the winter/spring of the 2019 FY to provide horizontal and vertical



**Monument Installation  
Beach Grove School Field Well  
Cataloochee Valley, Haywood County  
Great Smoky Mountain National Park**



**R10 Survey Equipment  
Long Creek Station, AA 32R, Pender County**



**Leveling, Beach Grove School Field Well, M 93L  
Cataloochee Valley, Haywood County  
Great Smoky Mountains National Park**

data on the newly installed, acquired, and re-activated monitoring well stations, as well as a select number of sites to obtain additional measurements.

## **6.0 Local Monitoring Well Network Information**

### **6.1 Orange County Monitoring Well Cooperative Network**

The creation of the Orange County Ground Water Observation Well Network, Orange Well Net (OWN), was proposed in May 2005. It was decided to utilize existing bedrock wells in lieu of installing new wells for monetary reasons. In March 2010, the OWN included six inactive bedrock wells for ground water data collection. In 2011, three regolith wells were added to the OWN as a result of a cooperative arrangement. In 2012, two bedrock wells, the Ray Road and Rocky Ridge wells were removed from the network and replaced with two bedrock wells, well 4D in Duke Forest and a well at the former Orange County 911 Center. The wells that were most recently added to the network are the Brumley East well, as the result of an agreement with the Triangle Land Conservancy, and the Duke Forest 4S and 4I wells, with the agreement (informal) of DWR and Duke Forest. [Table 8](#) summarizes the OWN well information. [Figure 7](#) is a map of the OWN well locations.



Ground water data is collected periodically from the OWN. This data is collected to assess ground water availability and concerns locally in Orange County. The data is formatted and uploaded to the DWR ground water database and is available to the public. [Table 9](#) is a summary of the OWN statistics from March 2010 through June 30, 2018. The 2011, 2012, and 2013 OWN Annual Reports are available on the DWR website. Tom Davis (Water Resources Coordinator for the Orange County Department of Environment, Agriculture, Parks and Recreation), the OWN Annual Reports, and information provided by the DWR database, are the sources for the Orange County Monitoring Well Network information provided herein.

## 6.2 Guilford County Monitoring Well Cooperative Network

The Guilford County ground water monitoring network was established in 2002 and includes eight monitoring well stations located on public properties owned by Guilford County or the City of Greensboro. Each well site was selected to represent an area of the county and to minimize the influence of any existing water supply wells nearby. [Table 10](#) summarizes the Guilford County monitoring well information. In addition, NC A&T State University uses the Knox Road Station for their hydrology class and the students use the data from this station for their course project.

Water levels are collected manually on the same day of each month. Hourly data is collected using Global Water WL16 submersible transducers and are downloaded at the time of manual collection of depth to ground water levels. The data is formatted and uploaded to the DWR ground water database and is available to the public.

[Table 11](#) summarizes the Guilford County monitoring well statistics from 2008 through June 30, 2018. [Figure 8](#) is a site map of the Guilford County monitoring well locations. Gene Mao (Guilford County Department of Health and Human Services, Division of Environmental Health, Health, Environment, & Risk Assessment Unit), and information obtained from the DWR database, are the sources for the Guilford County Monitoring Well Network information provided herein.

## 6.3 Western Carolina Hydrological Research Station Cooperative Network

The Western Carolina Hydrological Research Station, (WCHRS), was established in 2010 in a partnership between Western Carolina University (WCU) and DEQ. The WCHRS is comprised of approximately 40 monitoring wells and is located within the Cullowhee Creek watershed. It was decided in 2017 that the WCHRS cooperative well network would be comprised of seventeen of these wells, including two wells acquired by DWR, Stillwell Building Station (Q 94J1) and the CC Old Well Station (Q 94I1), both active well in the statewide monitoring well network. According to the WCU description of the WCHRS located in the DWR database, “the well network was designed to study ground water interaction with streams in a headwaters region typical of the southern Appalachians. Most ground water levels are measured weekly by student researchers at WCU. A few wells have computer sensors so water level data are collected continuously at 15-minute intervals.”

Table 12 summarizes the WCHRS cooperative network well information. Figure 9 is a map of the WCHRS cooperative network well locations.

Ground water data is collected periodically from the WCHRS. Data from select wells are formatted and uploaded to the DWR ground water database and is available to the public. Table 13 is a summary of the WCHRS statistics from 2011 through June 30, 2018. Mark Lord and David Kinner, Professors of Geology with the Department of Geosciences and Natural Resources, WCU in Cullowhee, NC, the wcu.edu website, and information provided by the DWR database are the sources for the WCHRS information provided herein.

## **7.0 Planned Activities**

### **7.1 New Well Installation**

Monitoring well network expansion efforts for the 2019 FY will be focused mainly on Pender, Sampson and Duplin counties. Table 14 summarizes the potential upcoming expansion of the network in 2019 FY.

### **7.2 Well Abandonment**

Some wells throughout the network that cannot be used due to bad construction, screening in multiple aquifers, etc., may be abandoned during the 2019 FY.

## **8.0 Water Quality**

The Ground Water Management Branch added some ground water quality staff members in December 2015. Among the responsibilities of these employees is to support Tasks 5 & 6 of the North Carolina 2016 FY Workplan for the Clean Water Act Section 106 Groundwater Grant (EPA).

### **Task 5 - Characterize the State's Ground Water Resources, and Task 6 - Groundwater Monitoring Program**

The Division of Water Resources conducts an active program of ground water monitoring that advances the DWR mission by improving DWR's knowledge in the following areas:



**Measuring Field Parameters  
Bonnerton, P18V, Beaufort County**

- 1 Impacts of land-applied wastes, artificial infiltration practices, or other human activities, including:
  - Potential impacts of these activities on the surficial aquifer and the secondary impacts to the deeper aquifers or surface waters;
  - The occurrence of "emerging contaminants" related to these activities; and
  - Effectiveness of regulations and permits for these activities.
- 2 Threats to ground water quality, including:
  - The existence, nature, and scope of emerging or existing threats;
  - Assessment of the causes and factors affecting naturally-occurring contamination, agricultural contamination, or contamination resulting from activities permitted by DWR; and
  - Tracking the status of ground water quality across the state.



**Ground Water Sample Collection  
Bonnerton, P 18V, Beaufort County**

The goal of all characterization, monitoring, and investigation efforts is to improve DWR's understanding of the causes and extent of problems, to minimize human exposure to contaminants, and identify areas where regulations or best management practices can be improved to prevent contamination from occurring.

The state has an extensive network of ground water monitoring stations which can be utilized as an ambient ground water monitoring network. Prior to December 2015, the Piedmont-Mountain Resource Evaluation Program sampled wells annually from a well network installed and constructed for characterizing the relationship of water quality to underlying geology in the Piedmont and Mountain physiographic provinces. Less water quality monitoring occurred in the Coastal Plain in the last two decades.

The Ground Water Management Branch intends to collect samples from each active well in the statewide monitoring well network. In the 2018 FY, samples were collected from ten monitoring stations and two surface water bodies. The samples were analyzed for the following parameters:

- Standard private well parameters – arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), fluoride (Fl), lead, (Pb) iron (Fe), magnesium (Mg), mercury (Hg),

- nitrates (NO<sub>3</sub>), selenium (Se), silver (Ag), sodium (Na), zinc (Zn), pH, and bacterial indicators;
- Ammonium (NH<sub>4</sub>), Total Kjeldahl Nitrogen (TKN), organic Nitrogen, and Phosphate (PO<sub>4</sub>);
  - Volatile Organic Compounds (VOCs), and Pesticides (also consult with area agricultural experts on local practices);
  - Major ions (Na, calcium (Ca), potassium (K), manganese (Mn), sulfate (SO<sub>4</sub>), (carbon trioxide (CO<sub>3</sub>), bicarbonate (HCO<sub>3</sub>) and chlorides (Cl);
  - Metals
    - Dissolved (filtered in field) (geochemistry applications require dissolved metals)
    - Total (drinking water standards are based on total metals)
    - Cu and Zn, (in both swine permits and the standard private well suite)
    - Coal Ash Metals – this would incur only minor additional costs yet would increase our knowledge of naturally occurring contaminants of interest to the coal ash program.
      - Note, at this time chromium analysis performed by the DWR lab is not sufficiently precise enough to satisfy coal ash program needs. Analysis for hexavalent chromium would need to be sent to a private lab at some cost.
      - Note, at this time the DWR lab analyzes for total vanadium. The 2L standard for vanadium (V) is under review and will probably be based on particular species of V, not total V.
  - Field parameters
    - Specific Conductivity, pH, Dissolved Oxygen (DO), Temperature (°C), Oxidation-Reduction Potential (ORP)

Analytical results will be presented in the forthcoming report "An Analysis of Water Quality in Division of Water Resources Network Wells in Sampson and Duplin Counties." A preliminary review of the data indicates no results of concern.

Ground water sampling protocol is included in [Appendix B](#). Field data information for the 2018 FY are included in [Table 15](#). Laboratory analytical results received for the 2018 FY are available upon request. In the 2019 FY, ground water samples will continue to be collected from wells in the monitoring well network and analyzed for the parameters referenced above. Analytical data will be available to the public through the DWR website in the 2019 FY.

## 9.0 Central Coastal Plain Capacity Use Area

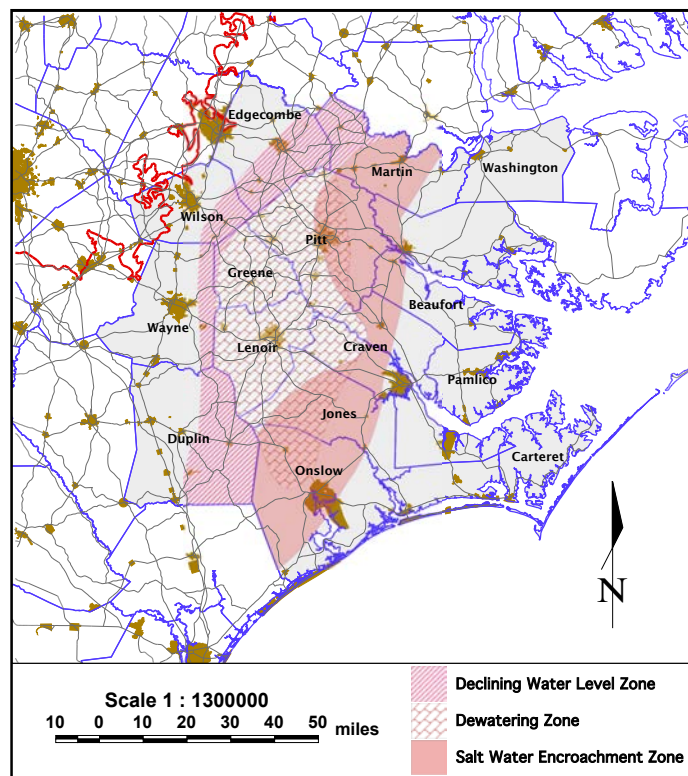
The [Central Coastal Plain Capacity Use Area](#) (CCPCUA) is a 15-county region in the coastal plain that is an example of a water overuse situation. On August 1, 2002, the CCPCUA rules came into effect because of significant ground water depletion problems. As stated in 15A NCAC 2E .0501, “the intent of this Section [the CCPCUA rules] is to protect the long term productivity of aquifers within the designated area and to allow the use of ground water for beneficial uses at rates which do not exceed the recharge rate of the aquifers...” For many years, water was withdrawn from the deep confined aquifers, which are a primary source of water in the CCPCUA, at a rate that was greater than they were naturally recharged. If this situation had been allowed to continue indefinitely, the aquifers could have been permanently damaged, impairing their ability to function as a water supply.

The goal of the DWR is to regulate water withdrawals in the Central Coastal Plain (CCP) under the authority of the Environmental Management Commission (EMC). The following summarizes how these withdrawals are regulated:

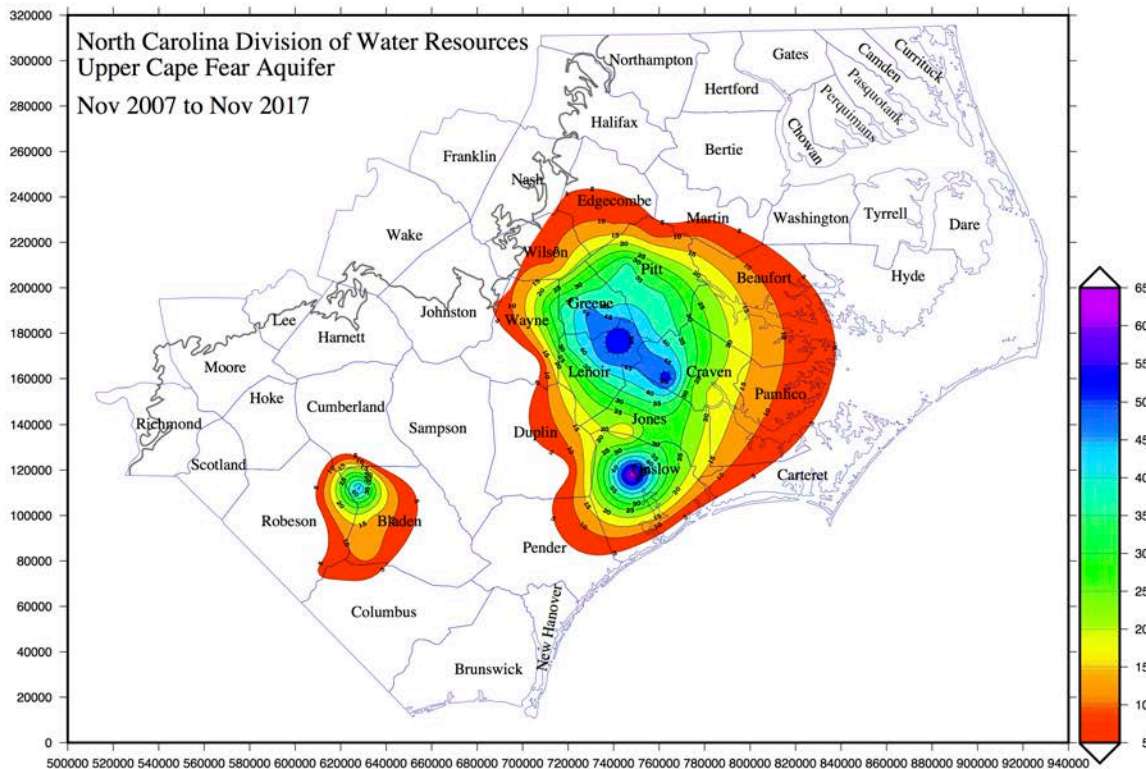
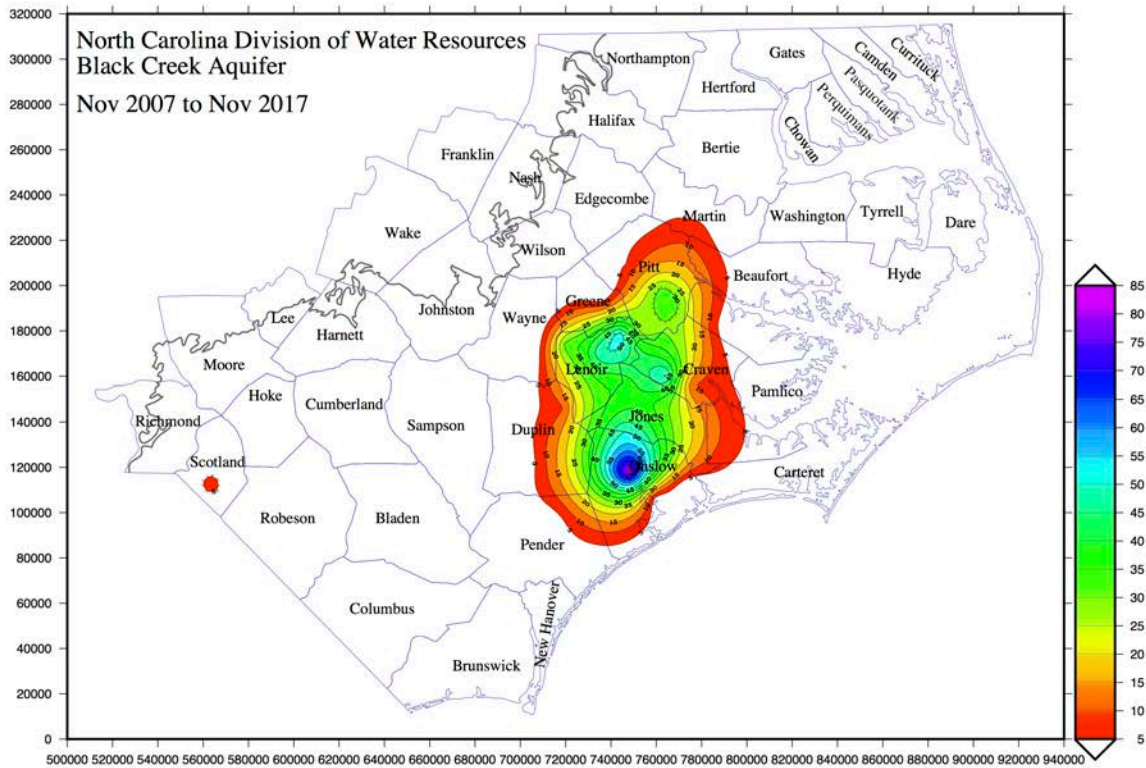
- Water withdrawal permits are required for ground water users who withdraw greater than 100,000 gallons of water per day;
- Annual registration and reporting of withdrawals is required for surface and ground water withdrawals greater than 10,000 gallons per day;
- Counties included in the CCPCUA are Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne, and Wilson.

DWR collects depth to water level measurements and chloride sampling event data from monitor wells within the state’s well network and CCPCUA permitted wells to assess aquifer conditions. 15A NCAC 2E .0503 requires that DWR assess aquifer conditions in 2008, 2013 and 2018 to determine if CCPCUA rule changes are necessary. Through the CCPCUA permitting system, large ground water users (>100,000 gpd) in some parts of the capacity use area are required to progressively reduce withdrawals in 2008, 2013, and 2018 to allow the aquifers to recover. The managed withdrawals from these aquifers have allowed the aquifers to recover as depicted in the following recovery maps of the Upper Cape Fear Aquifer and the Black Creek Aquifer.

CCPCUA Cretaceous Aquifer Zones



The map of the Black Creek Aquifer shows the areas where ground water levels have risen between 5 feet (red) to more than 75 feet (purple) from November 2007 through November 2017.



The map of the Upper Cape Fear Aquifer shows the areas where ground water levels have risen between 5 feet (red) to more than 55 feet (blue) from November 2007 through November 2017.

Based on analysis of water level and chloride concentration data gathered through January 2013 in the CCPCUA, and a thorough review of aquifer conditions, DWR concluded that no action needed to be taken by the EMC to alter either the reduction zone boundaries or rule language in 15A NCAC 2E .0503, but recommended the use of temporary permits under rule .0502. This may give certain permit holders a stable withdrawal rate which is higher than indicated by their reduction schedule and reduction zone, provided that all well construction and reporting criteria are met as specified in the 2013 CCPCUA Assessment Report.

DWR uses a series of criteria to judge each production well and aquifer conditions by individual permit in the permitting process. This enhanced permit application review allows the division to alter an individual permit holder's reduction requirements if the permit holder can demonstrate they are using the ground water at a sustainable rate. As of June 2018, the following nine permit holders have acquired temporary permits: Greene County Regional Water System, Town of La Grange, Belfast-Patetown Sanitary District, Northwestern Wayne Sanitary District, Southeastern Wayne Sanitary District, Fork Township Sanitary District, Chinquapin Water Association, Inc., City of New Bern, and the Town of Snow Hill.

Although the CCPCUA rules require assessments to be produced in 2008, 2013, and 2018, the DWR staff will continue to constantly track aquifer conditions so as to best serve the permit holders in the region and to provide awareness of potential ground water supply issues. The 2018 assessment concluded recently with the EMC's approval of the report on October 10, 2018. The assessment report reviewed aquifer data in a similar fashion to previous efforts in 2008 and 2013. Water levels in the Black Creek and Upper Cape Fear aquifers were found to be equilibrating to the lower rate of aquifer use as water systems continue to shift demand to other sources which include surface water and shallower aquifers. While water level data are consistent with sustainable use of the aquifer system, chloride concentrations are somewhat inconsistent. Smaller and static cones of depression have developed in the Peedee and Castle Hayne aquifers in response to new well fields and are only visible using the combined DWR and permit holder water level data. Reports referencing the CCPCUA rules can be viewed by visiting the DWR website, [www.ncwater.org/CCPCUA](http://www.ncwater.org/CCPCUA).

## **10.0 Summary and Conclusions**

DWR and its predecessor agencies have maintained and monitored a statewide network of ground water monitoring wells used to assess North Carolina's ground water supply since the 1960s.

Data collected from the monitoring well network are available to the public through DWR's Internet website, [www.ncwater.org](http://www.ncwater.org). These data include, but are not limited to, ground water levels, chloride measurements, well construction information, borehole log construction (lithological and geophysical), ground water monitoring station locations, and geophysical/lithological data collected from other (non-DWR) well sites.

The monitoring well network consists of 668 monitoring wells at 229 individual stations. From July 2017 through June 2018, ground water level data were collected from 661 wells within the network. These data include manual measurements taken quarterly from wells, plus hourly water levels collected using automatic data recorders from 558 wells.

Sixteen STS units have been installed as of 2018 FY on drought monitoring network wells. The addition of the STS units replace monthly site visits, allow access to current water level data, and provide positive economic impacts.

Chloride sampling was performed on 322 wells from August through October 2017. Sampling results indicated that there continues to be concern for saltwater encroachment especially near larger pumping centers located near the fresh-salt water interface. Chloride levels in the Black Creek aquifer have remained below detection limits or relatively uniform for all except 4 of 27 wells since 2010. Chloride levels in the Upper Cape Fear aquifer are non-detectable or low level chloride fluctuations for the majority of the 37 wells sampled. The Lower Cape Fear aquifer had low to moderate chloride fluctuations for the majority of the 20 wells sampled.

Six monitoring wells were installed at WCWC monitoring station during the 2018 FY. This station is scheduled for complete development and chloride sampling in the 2019 FY.

One monitoring well station, Burton Park Boulevard, Onslow County, was acquired and added to the monitoring well network in the 2018 FY.

No wells were abandoned or received major repair during the 2018 FY.

There are three local networks whose water level data are currently being uploaded to the DWR database. The OWN in Orange County, the Guilford County network, and the WCHRS in Jackson County water level data can be viewed by the public on the DWR website.

Survey monuments have been installed at each of the well stations. Survey Grade GPS was performed on all newly installed well stations and select existing stations with installed monuments during the 2018 FY. Plans are to survey the newly installed WCWC well station and resurvey selected stations in the winter/spring of the 2019 FY.

DWR has tentative plans to expand the monitoring well network by installing up to 30 wells at five sites in the 2019 FY.

Ground Water Management added ground water quality staff in December 2015. A main focus of these employees is to comply with Tasks 5 & 6 of the North Carolina 2016 FY workplan for the Clean Water Act Section 106 Ground Water Grant (EPA). Staff intends to collect samples from each active well in the statewide monitoring well network. In the 2018 FY, samples were collected seventeen monitoring stations and two surface water bodies. A preliminary review of the data indicates no results of concern.

Fifteen counties in the Central Coastal Plain are governed by the Central Coastal Plain Capacity Use Area rules. Data collected from the monitoring well network is being used to assess aquifer

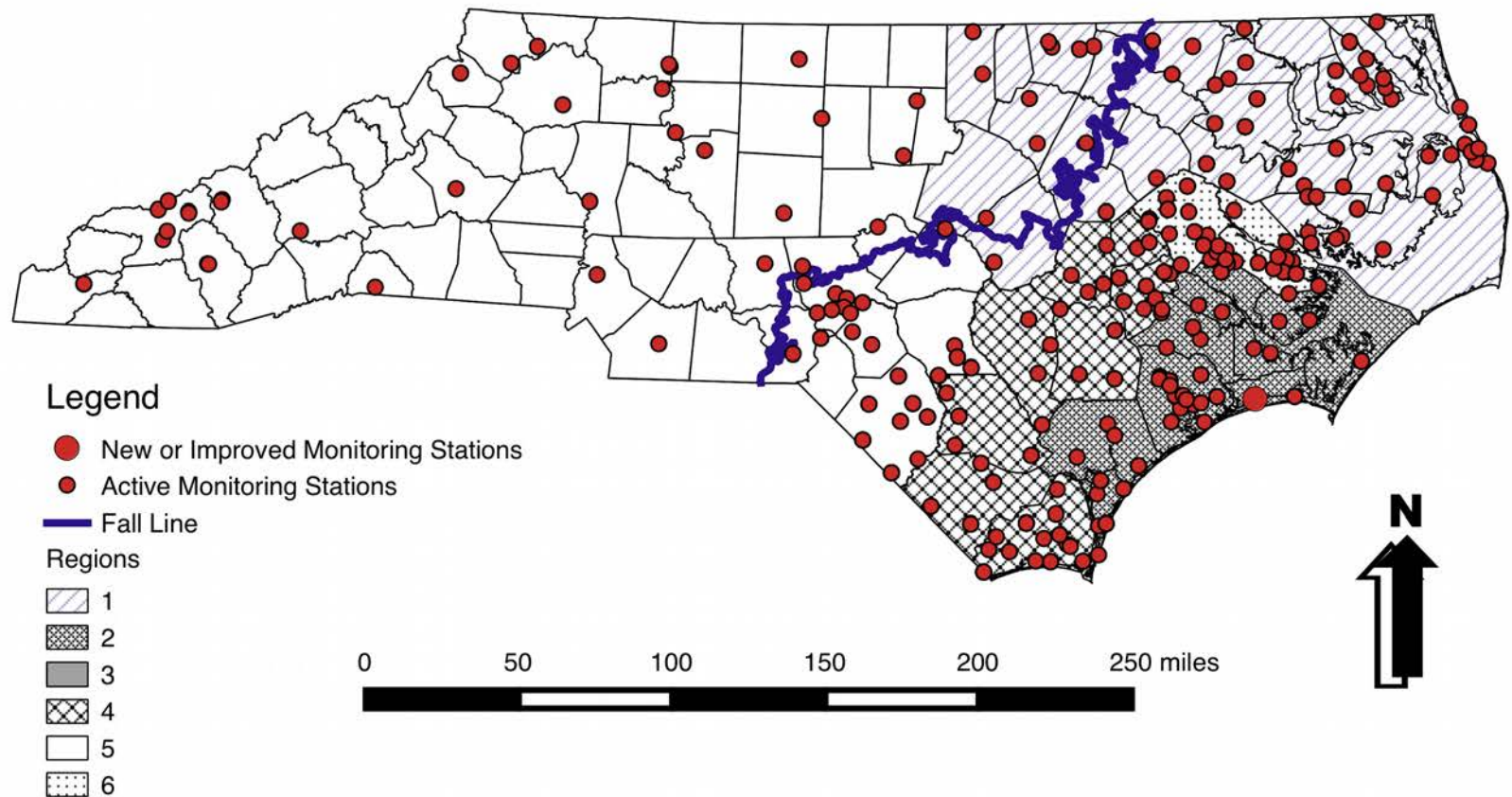


conditions and determine whether or not changes to the rules are warranted. Based on the results of the 2018 assessment, concluding with the EMC's approval of the report on October 10, 2018, DWR will not pursue rule changes. Instead, DWR will continue issuing temporary permits under rule 15A NCAC 2E .0502 which can ease withdrawal reduction requirements for certain permit holders, but adds other permit conditions.

## **FIGURES**

**Figure 1**  
**NCDWR - Ground Water Management Branch**  
**Monitoring Well Station Locations**  
**2018 Annual Report**

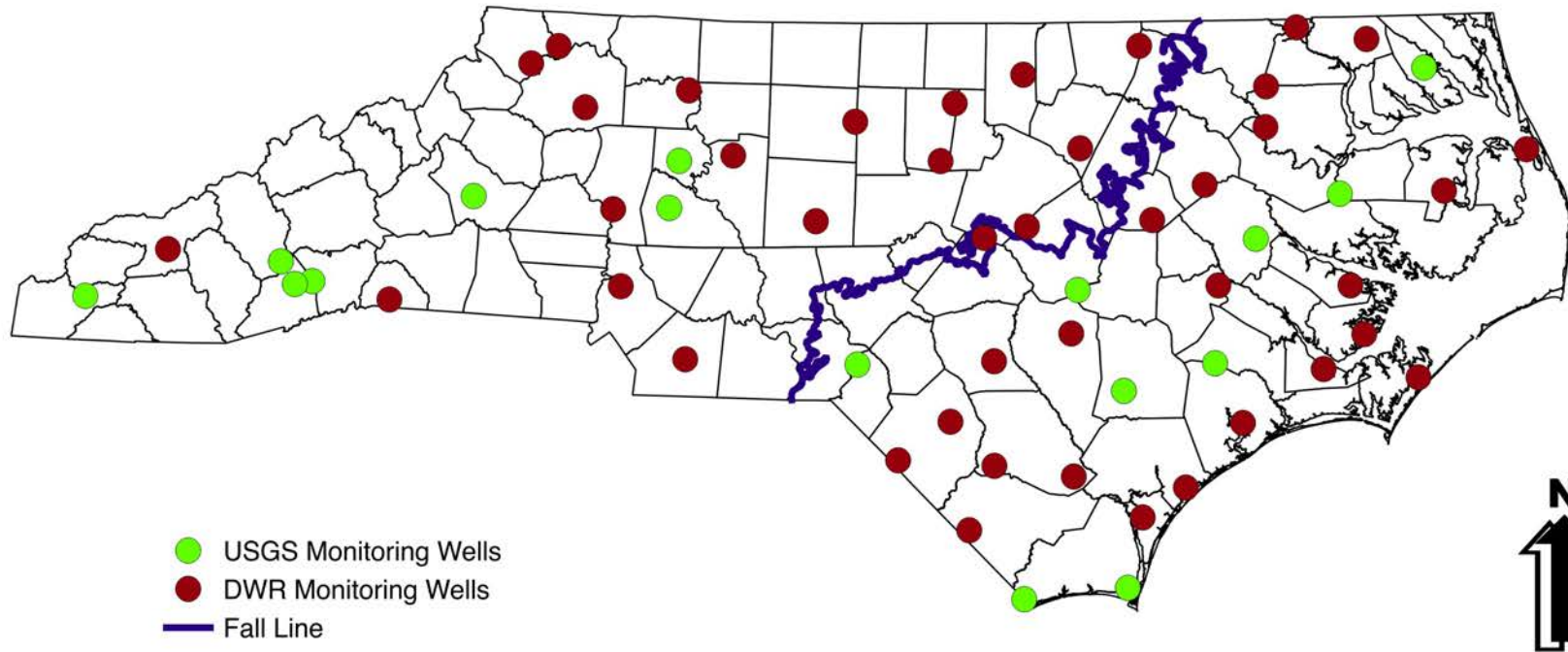
**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.



## **Figure 2**

### **NCDWR - Ground Water Management Branch Drought Indicator Well Network 2018 Annual Report**

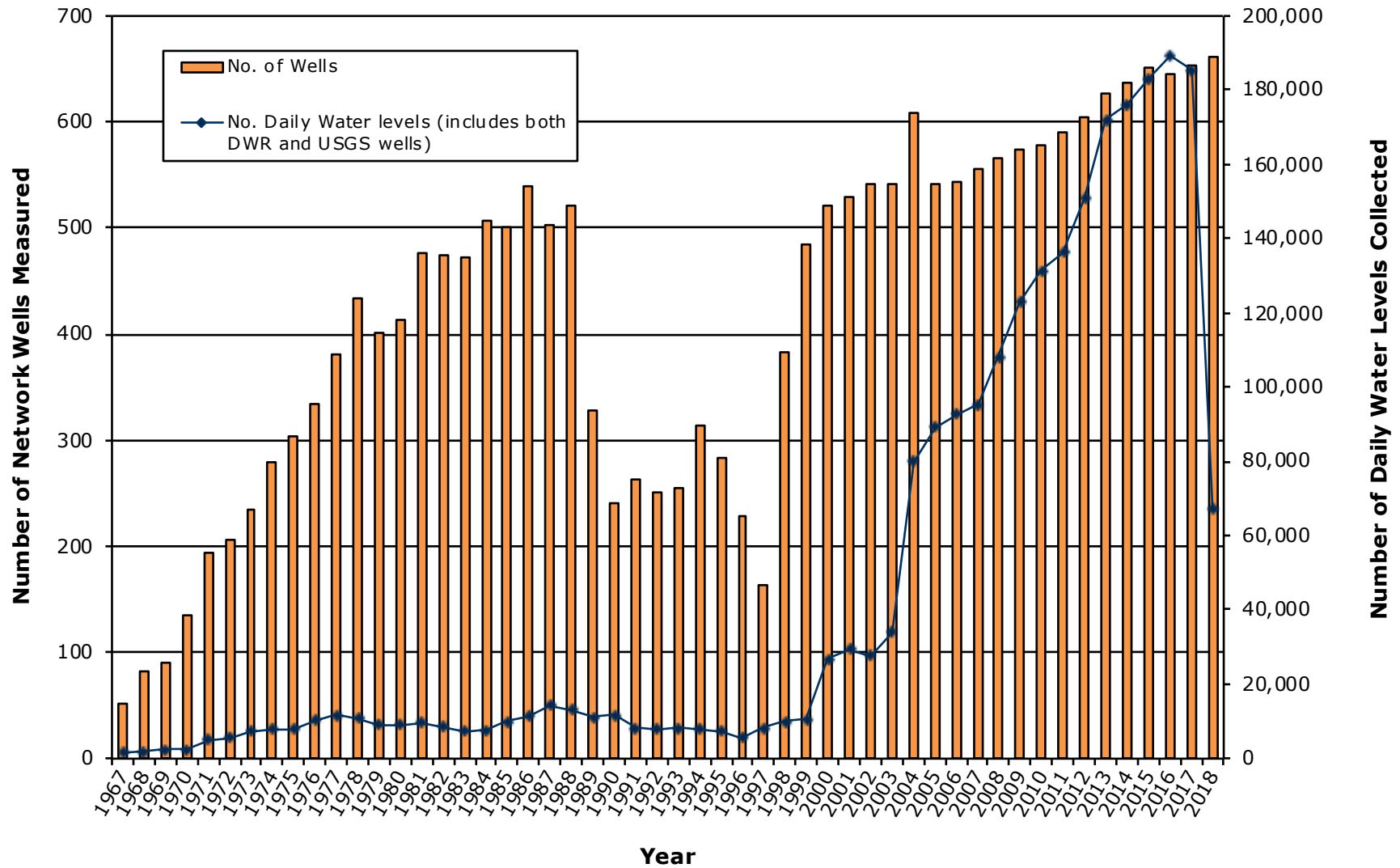
**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.



0 50 100 150 200 250 miles

**FIGURE 3**

Water Level Data Collected from 1967-2018 (Plot includes both DWR and USGS Data)

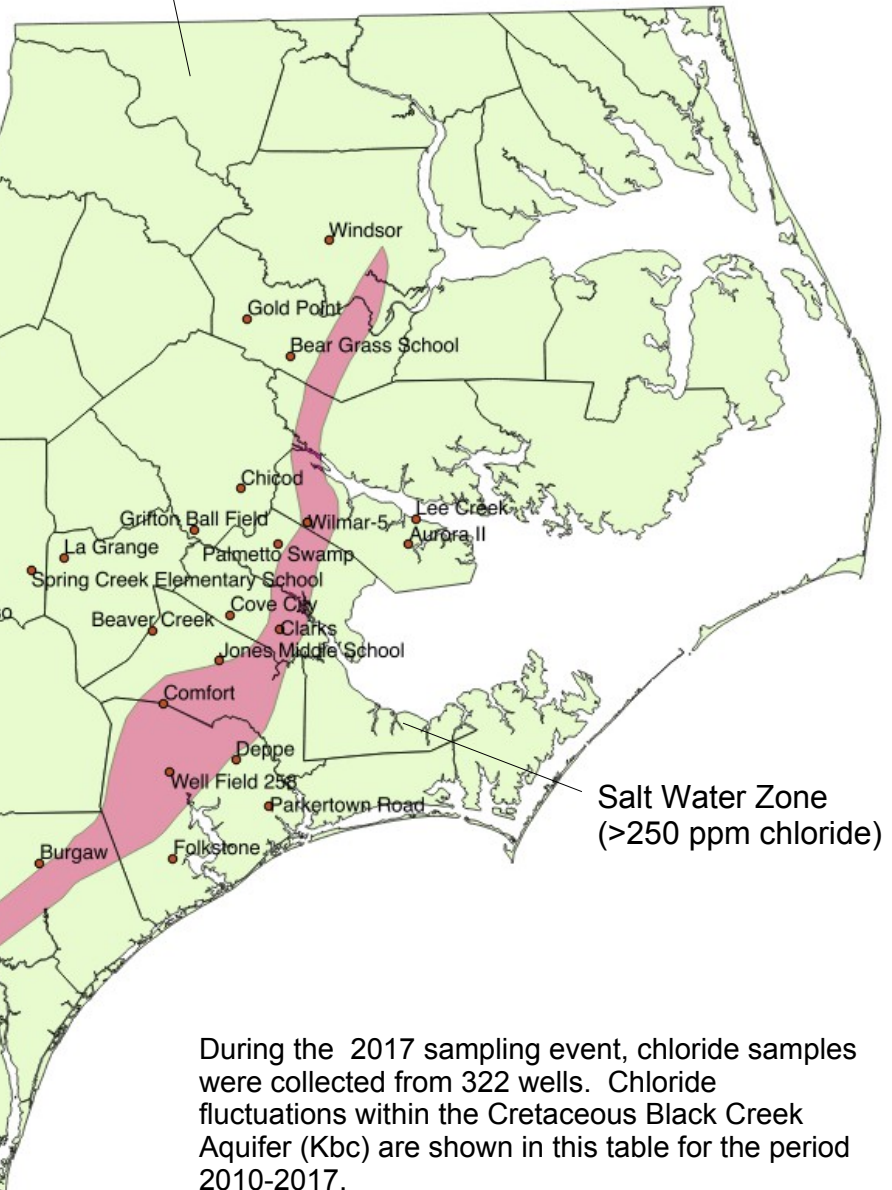


MONITORING STATION	2010	2012	2015	2017
	CHLORIDES (mg/l)			
Windsor	-	<28	<31	<26
Gold Point	<33	<28	<31	<31
Bear Grass Sch	<33	<28	<31	<26
Chicod	49	35	38	45
Lee Creek	6766	6888	7904	9056
Wilmar-5	400	434	-	496
Wilmar-9	239	194	-	188
Palmetto Swamp	49	35	38	45
Grifton Ball Field	<28	<28	<31	<32
Aurora II	6765	7562	9634	8124
La Grange	<33	<28	<31	<32
Spring Creek Elem Sch	-	-	<31	<32
Cove City	<33	<28	<31	<32
Clarks	54	179	144	136
Beaver Creek	<33	<28	<31	<32
Calypso	-	-	<30	<32
Jones Middle Sch	<33	<28	<31	<32
Comfort	<33	<28	<31	<32
Deppe	733	758	616	781
Six Runs	<33	<28	<31	<31
Well Field 258	<33	<28	<31	<32
Parkertown Road	5910	4596	4345	5077
Folkstone	1304	1062	1065	324
Burgaw	<33	<28	<31	<31
Kelly	-	-	38	53
Carver Moore	<33	<28	<31	<31
Lake Waccamaw	<33	42	<31	<32

## Figure 4 NCDWR - Ground Water Management Branch Chloride Levels in the Cretaceous Black Creek Aquifer 2018 Annual Report

**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.

Fresh Water Zone  
(<250 ppm chloride)



Salt Water Zone  
(>250 ppm chloride)

Transition  
Zone

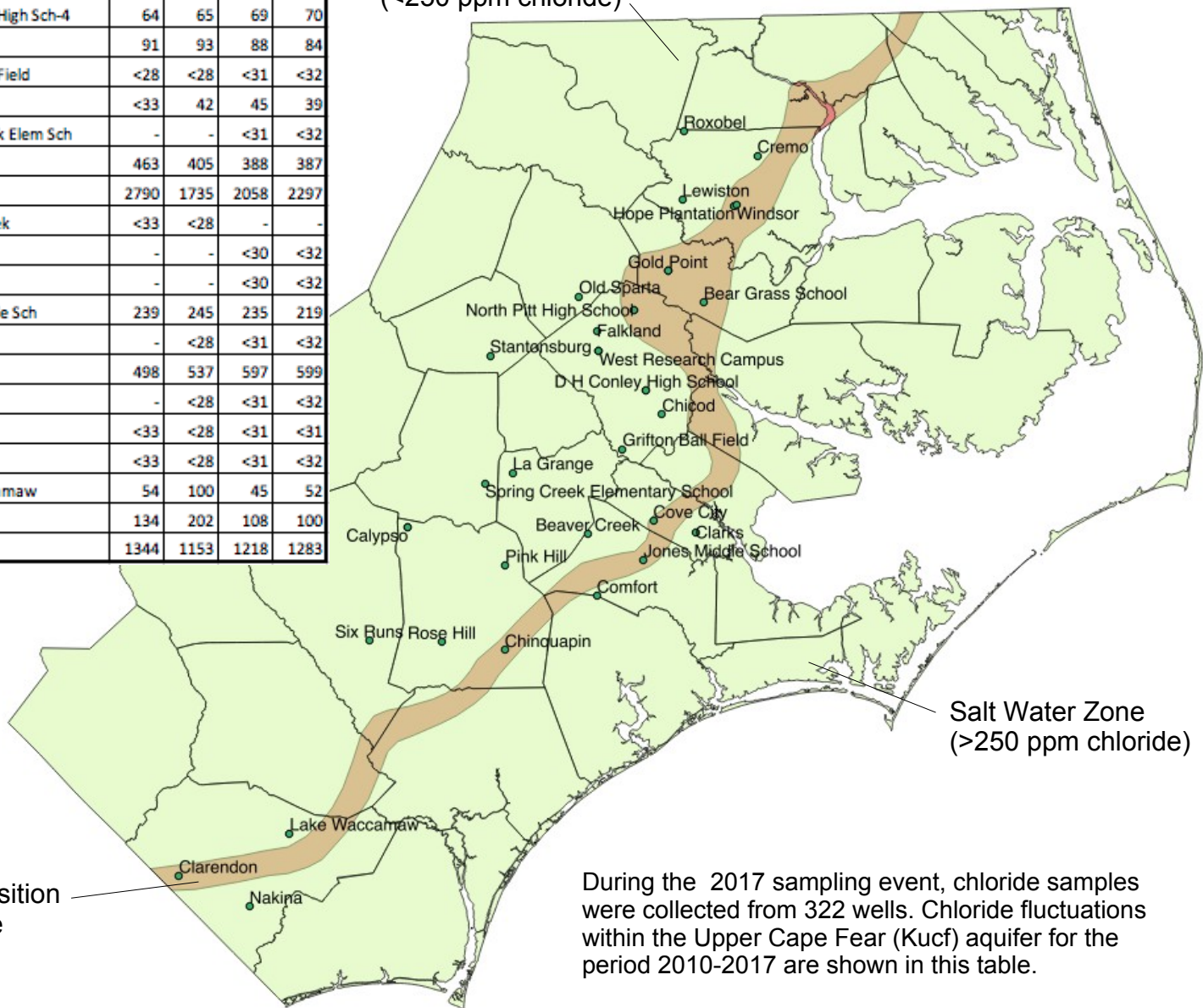
During the 2017 sampling event, chloride samples were collected from 322 wells. Chloride fluctuations within the Cretaceous Black Creek Aquifer (Kbc) are shown in this table for the period 2010-2017.

# Figure 5 NCDWR - Ground Water Management Branch Chloride Levels in the Cretaceous Upper Cape Fear Aquifer 2018 Annual Report

**NOTE: This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.**

MONITORING STATION	2010	2012	2015	2017
	CHLORIDES (mg/l)			
Cremona	<33	<28	<31	<26
Roxobel	<33	<28	<31	<26
Hope Plantation	<33	35	-	-
Windsor	-	236	144	194
Lewiston	<33	<28	<31	<26
Gold Point-1	<33	<28	<31	<31
Gold Point-5	54	172	186	164
Gold Point-7	372	343	362	416
Bear Grass School	<33	111	45	50
Old Sparta	<33	56	31	41
North Pitt High Sch-4	463	284	293	314
North Pitt High Sch-5	400	327	-	337
Falkland	<33	<28	<31	<32
West Research Campus-3	<33	<28	<31	<32
West Research Campus-4	<33	<28	<31	<32
West Research Campus-5	54	57	61	59
Stantonsburg	<33	49	<31	<31
D H Conley High Sch-2	<28	<28	<31	<32
D H Conley High Sch-4	64	65	69	70
Chicod	91	93	88	84
Grifton Ball Field	<28	<28	<31	<32
La Grange	<33	42	45	39
Spring Creek Elem Sch	-	-	<31	<32
Cove City	463	405	388	387
Clarks	2790	1735	2058	2297
Beaver Creek	<33	<28	-	-
Calypso-4	-	-	<30	<32
Calypso-2	-	-	<30	<32
Jones Middle Sch	239	245	235	219
Pink Hill	-	<28	<31	<32
Comfort	498	537	597	599
Rose Hill	-	<28	<31	<32
Six Runs	<33	<28	<31	<31
Chinquapin	<33	<28	<31	<32
Lake Waccamaw	54	100	45	52
Clarendon	134	202	108	100
Nakina	1344	1153	1218	1283

Fresh Water Zone  
(<250 ppm chloride)



Salt Water Zone  
(>250 ppm chloride)

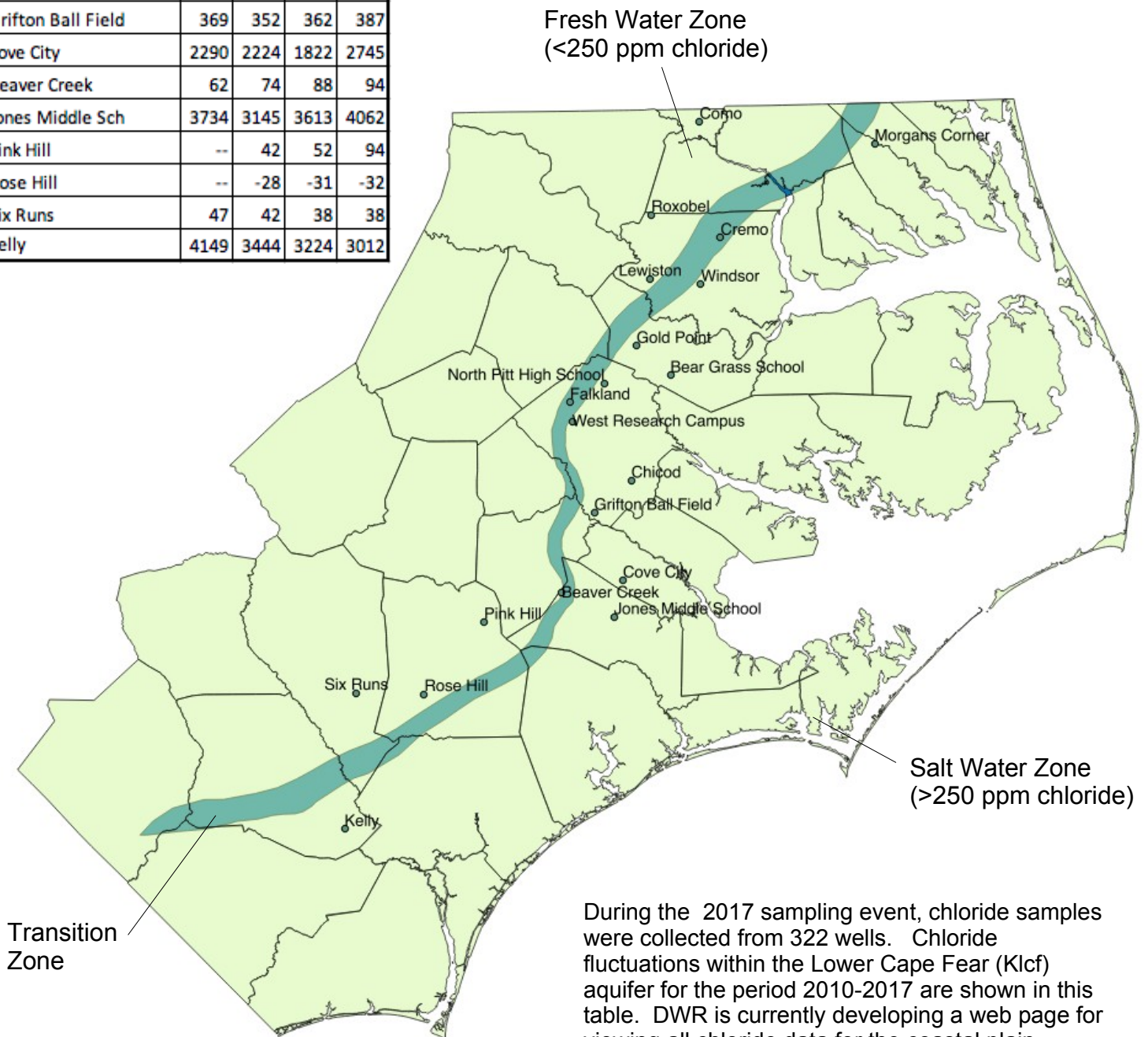
Transition  
Zone

During the 2017 sampling event, chloride samples were collected from 322 wells. Chloride fluctuations within the Upper Cape Fear (Kucf) aquifer for the period 2010-2017 are shown in this table.

# Figure 6 NCDWR - Ground Water Management Branch Chloride Levels in the Cretaceous Lower Cape Fear Aquifer 2018 Annual Report

**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.

MONITORING STATION	2010	2012	2015	2017
	CHLORIDES (mg/l)			
Como	90	93	88	90
Morgans Corner	5096	5095	3853	3662
Roxobel	-33	28	-31	26
Crema	174	126	132	137
Lewiston	40	35	-31	-26
Windsor	--	1220	430	449
Gold Point	868	892	791	781
Bear Grass Sch	1023	2420	655	1283
North Pitt High Sch	798	758	655	645
Falkland	239	227	201	-32
West Research Campus	463	327	144	415
Chicod	814	758	430	781
Grifton Ball Field	369	352	362	387
Cove City	2290	2224	1822	2745
Beaver Creek	62	74	88	94
Jones Middle Sch	3734	3145	3613	4062
Pink Hill	--	42	52	94
Rose Hill	--	-28	-31	-32
Six Runs	47	42	38	38
Kelly	4149	3444	3224	3012



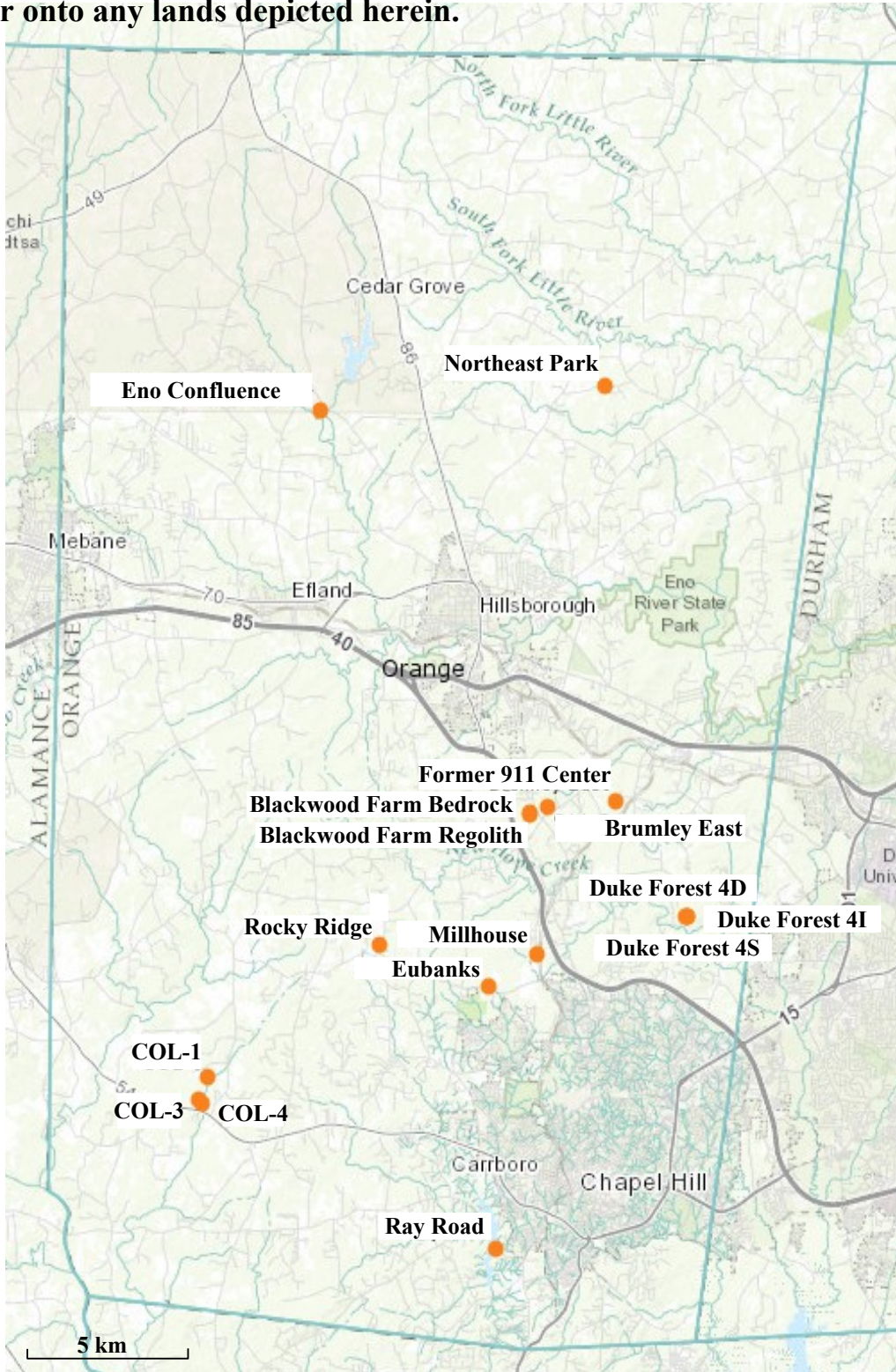
During the 2017 sampling event, chloride samples were collected from 322 wells. Chloride fluctuations within the Lower Cape Fear (Klcf) aquifer for the period 2010-2017 are shown in this table. DWR is currently developing a web page for viewing all chloride data for the coastal plain.



# Figure 7

## NCDWR - Ground Water Management Branch Site Map of Orange Well Net Cooperative Monitoring Well Network, Orange Co., NC 2018 Annual Report

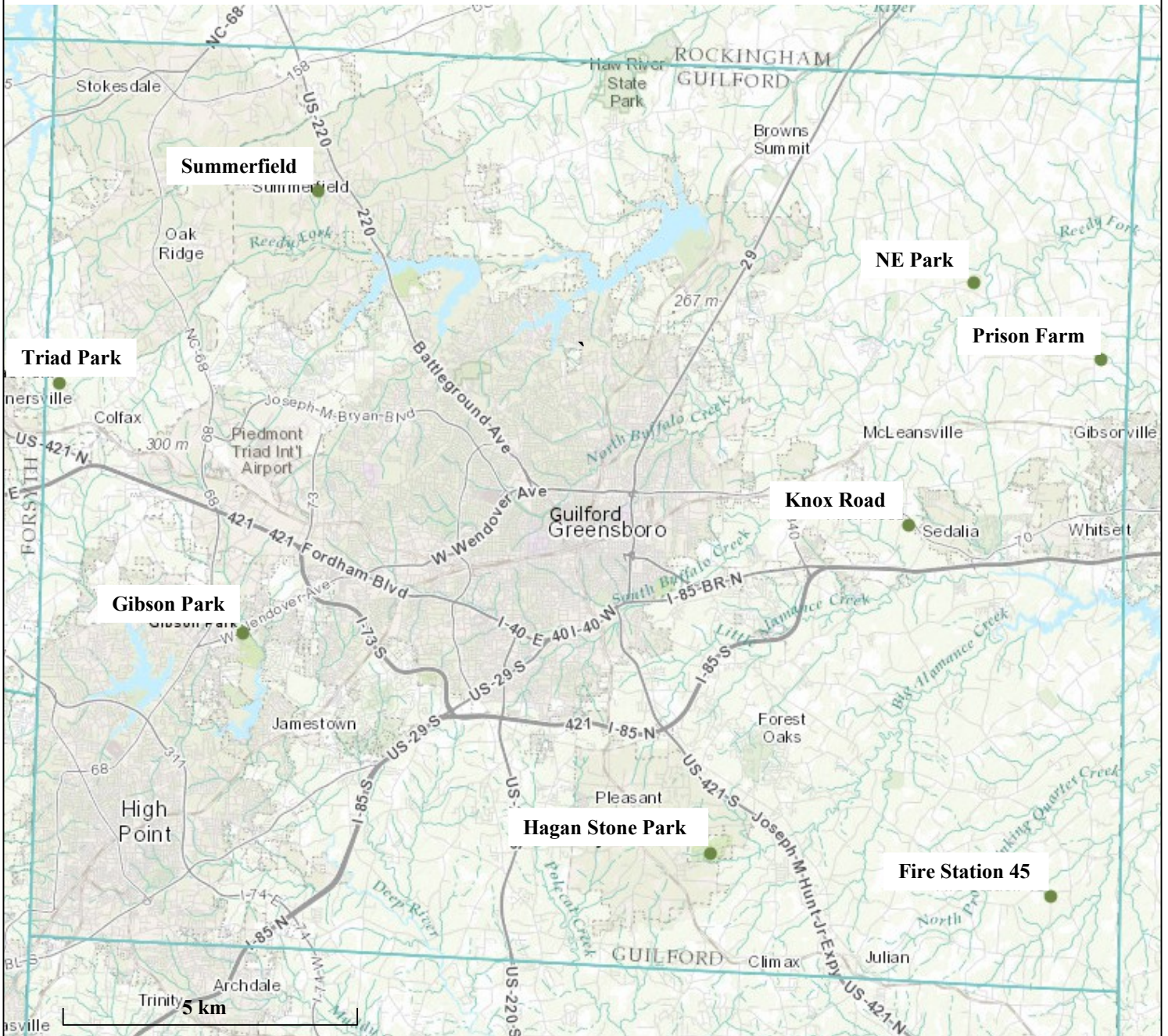
**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.



# Figure 8

## NCDWR - Ground Water Management Branch Site Map of Guilford County Cooperative Monitoring Well Network, Guilford Co., NC 2018 Annual Report

**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.

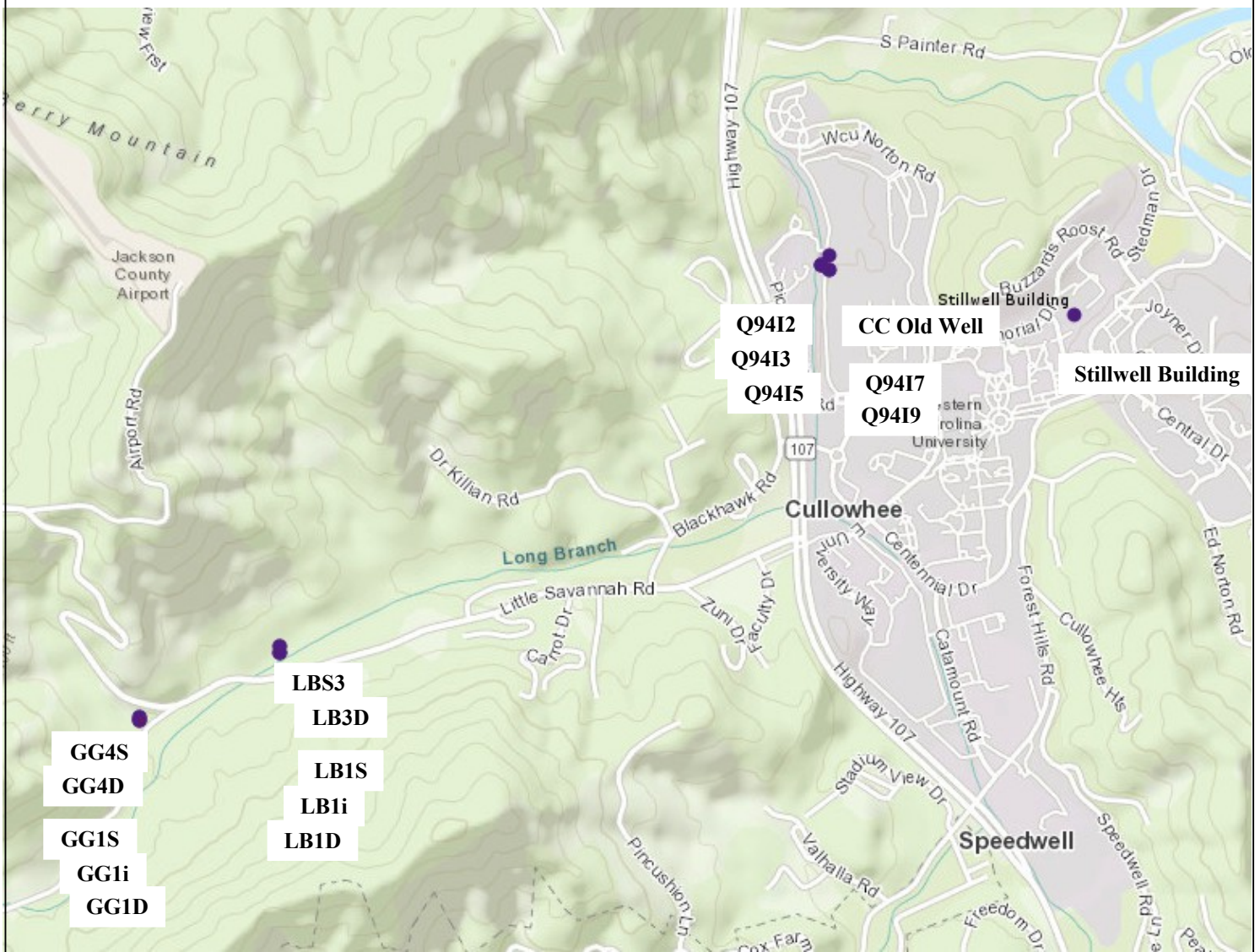


# Figure 9

## NCDWR - Ground Water Management Branch Site Map of Western Carolina Hydrological Research Station Cooperative Monitoring Well Network, Jackson County, NC 2018 Annual Report



**NOTE:** This map is for informational purposes only. It does not authorize any party to enter onto any lands depicted herein.



500 m

## **TABLES**

**TABLE 1**  
**Site Susceptibility Rating**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

Susceptibility Rating	Description
1	<b>Secure</b> —station is located on State or Federal government property
2	<b>Secure</b> —station is located on local government or school property
3	<b>Moderately secure</b> —station is located on private property, but landowner does not give any indication that land use or property ownership may change
4	<b>Tenuous</b> —station is located on public or private property and landowner is giving indications that land use or property ownership may change
5	<b>Imminent threat</b> —station is on public or private property and landowner desires abandonment of well station.

**TABLE 2**  
**Site and Recorder Distribution by Region as of 6/30/18**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

<b>Region</b>	<b>Parameter</b>	<b>Number</b>	<b>% of Region</b>	<b>% of Network</b>
	Wells	150		22.5
	Sites	56		24.5
1	Hobo	133	88.7	19.9
	Solinst	4	2.7	0.6
	All Recorders	133	88.7	19.9
	Wells	161		24.1
	Sites	38		16.6
2	Hobo	147	91.3	22.0
	Solinst	1	0.6	0.1
	All Recorders	147	91.3	22.0
3	No Wells			
	Wells	148		22.2
	Sites	44		19.2
4	Hobo	104	70.3	15.6
	Solinst	2	1.4	0.3
	All Recorders	104	70.3	15.6
	Wells	124		18.6
	Sites	68		29.7
5	Hobo	95	76.6	14.2
	Solinst	9	7.3	1.3
	All Recorders	95	76.6	14.2
	Wells	85		12.7
	Sites	23		10.0
6	Hobo	79	92.9	11.8
	Solinst	0	0.0	0.0
	All Recorders	79	92.9	11.8

These are counts of the number of wells which have at least one recorder of the stated variety. These numbers do not indicate the total number of recorders deployed. For example, there are always two Solinst recorders on a well and only one is counted per well. In addition, Solinst recorders are always installed on wells with Hobos, so the number of Solinst recorders does not increase the total number of wells with recorders.

**TABLE 3**  
**Solinst Telemetry System (STS) Distribution by Region as of 6/30/18**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

<b>Region</b>	<b>Station Name</b>	<b>Well Number</b>	<b>Date Installed</b>
1	Como	B 20U8	10/14/2014
1	Lewiston	H 22I3	06/20/2013
1	Manteo Airport	I 4W5	06/04/2014
1	Bunn	I 35K2	10/20/2016
2	Topsail Beach	BB 28J5	06/12/2014
4	Clarendon	DD 42N1	04/24/2014
4	Rowland	Z 47R5	04/24/2014
5	Laurel Springs	C 71U1	10/11/2016
5	Gibsonville	G 50W2	09/26/2016
5	Wilkesboro	G 69J1	11/22/2016
5	Troutman	L 67U2	8/27/2014
5	NC Zoo	M 53L1	06/19/2014
5	Bryson City	O 97W2	02/18/2014
5	Hornets Nest	Q 66C1	10/07/2014
5	Columbus	R 82I1	02/19/2014
5	Monroe	U 62A1	07/02/2014

**TABLE 4**  
**Monitoring Well Network Statistics (01-01-2005 through 06-30-2018)**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

<b>Parameter</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Number of monitored wells	542	544	556	566	575	579	591	605	626	637
Manual water levels (tapedowns)	2,633	2,744	2,626	2,469	2,562	2,905	2,624	2,952	3,265	2704
Daily water levels (automatic recorders)	89,088	92,827	95,329	107,969	122,962	131,317	136,208	150,912	172,111	176,111
Total hourly water levels	2,141,368	2,229,355	2,294,909	2,593,630	2,961,371	3,163,188	3,276,496	3,622,891	4,128,993	4,225,684
Chloride Samples	17	22	175	12	17	251	21	274	13	10
Geophysical & lithologic logs at new stations	2	1	3	1	1	0	2	1	1	1



<b>TABLE 4 (Continued)</b>				
<b>Monitoring Well Network Statistics (01-01-2005 through 06-30-2018)</b>				
<b>North Carolina Division of Water Resources</b>				
<b>Ground Water Management Branch</b>				
<b>2018 Annual Report</b>				
<b>Parameter</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
Number of monitored wells	651	652	664	661
Manual water levels (tapedowns)	3,142	2987	3475	2023
Daily water levels (automatic recorders)	182,907	189,302	185,364	67,441
Total hourly water levels	4,389,822	4,542,068	4,447,347	1,626,025
Chloride Samples	270	19	329	0
Geophysical & lithologic logs at new stations	2	2	3	1

**TABLE 5**  
**Well Construction Information for New Well Installation and Acquired Wells for the 2018 FY**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

Well ID	Station Name	Date Installed	Well Diameter (inches)	Well Depth (ft bls)	Screened Interval (x to y ft bls)	Measuring Pt (MP)(ft)	Aquifer	**Water Level Date Measured (from MP) (ft)
X 1901		04/11/2018	4	452	432-477	3.16	NDY	25.63 (08/06/2018)
X 1902		05/29/2018	4	355	340-350	3.00	NDY	26.99 (08/06/2018)
X 1903	WCWC	05/17/2018	4	290	275-285	3.00	NDY	27.13 (08/06/2018)
X 1904		05/22/2018	4	170	150-160	3.00	NDY	27.18 (08/06/2018)
X 1905		05/11/2018	4	110	90-100	3.04	NDY	10.45 (08/06/2018)
X1906		05/07/2018	4	35	25-35	3.00	NDY	6.51 (08/06/2018)
Well Construction Information for Wells Acquired in the 2018 FY								
W 2501		09/01/2016	6	910	885-905	NDY	NDY	23.65 (07/25/2018)
W 2502	Burton Park Boulevard	09/01/2016	6	825	800-820	NDY	NDY	117.84 (7/25/2018)
Q 2503		09/01/2016	6	615	590-610	NDY	NDY	113.31 (7/25/2018)

NDY – Not Determined Yet

\*\*Water Levels Reported from the Most Recent Date Water Level Collected (2019 FY)

**TABLE 6  
Well Development Information for 2018 FY  
North Carolina Division of Water Resources  
Ground Water Management Branch  
2018 Annual Report**

<b>Well ID</b>	<b>Station Name</b>	<b>Date Developed</b>
P 19M2	Cox Crossroads	06/18/2018 - 06/20/2018
P 19M5	Cox Crossroads	06/18/2018 - 06/20/2018
P 19M6	Cox Crossroads	06/18/2018 - 06/20/2018
K 26M1	Old Sparta	04/23/2018 - 04/26/2018
K 26M2	Old Sparta	04/23/2018 - 04/26/2018
K 26M3	Old Sparta	04/23/2018 - 04/26/2018
O 28K3	Snow Hill	12/19/2017 - 12/21/2017
O 28K4	Snow Hill	12/19/2017 - 12/21/2017
O 28K5	Snow Hill	12/19/2017 - 12/21/2017
O 28K6	Snow Hill	12/19/2017
L 25P1	Falkland	12/12/2017 - 12/13/2017
L 25P2	Falkland	12/12/2017 - 12/13/2017
L 25P3	Falkland	12/12/2017 - 12/13/2017
L 25P4	Falkland	12/12/2017 - 12/13/2017
L 25P5	Falkland	12/12/2017 - 12/13/2017
P 24O1	Grifton	10/11/2017
P 24O2	Grifton	10/11/2017
EE 30M1	Myrtle Grove	09/26/2017 - 09/28/2017
EE 30M2	Myrtle Grove	09/26/2017 - 09/28/2017
EE 30M3	Myrtle Grove	09/26/2017 - 09/28/2017
EE 30P1	Presidio	08/15/2017 - 08/16/2017
EE 30P2	Presidio	08/15/2017 - 08/16/2017
EE 30P3	Presidio	08/15/2017 - 08/16/2017
AA 32R1	Long Creek	07/10/2017 - 07/13/2017
AA 32R2	Long Creek	07/10/2017 - 07/13/2017
AA 32R3	Long Creek	07/10/2017 - 07/13/2017
AA 32R4	Long Creek	07/10/2017 - 07/13/2017

<b>TABLE 7</b> <b>Automatic Water Level Recorders as of 6/30/2018</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>	
Recorder Type	Number in Service*
HOBO U20 Water Level Logger (including separate barometer per station installed)	759 (includes 202 barometers)
Solinst Telemetry System (STS)	32 (includes 16 barologgers and 16 levelloggers)

**\*As of June 30, 2018**

Note: Due to the large number of recorders deployed by DWR, there are, at any given time, a number of units that are being serviced or replaced. These units are not reflected in the above totals.

**TABLE 8**  
**Orange Well Net Monitoring Well Information**  
**Orange County, NC**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

Quad	Well Name	Total Depth (ft bgs)	Casing Depth (ft bgs)	Land Surface (ft)	Aquifer	Geology
G 44G1	Northeast Park NES	45	15	622	Bs	Epiclastics
G 45F1	Eno Confluence Property	192	37	611	Br	Felsic Tuff
H 44P1	Blackwood Farm Bedrock	302	100	556	Br	Felsic Lavas and Tuffs (Dacite)
H 44P2	Former 911 Center	400	85	581	Br	Altered Tuff
H 44P3	Blackwood Farm Regolith	45	15	556	Bs	Felsic Lavas and Tuffs (Dacite)
H 44R1	Brumley East	605	108	562.39	Br	Mafic Lavas and Tuffs
I 44B1	Duke Forest DF-4D	397.09	82.1	424.91	Br	Felsic Plutonics
I 44B2	Duke Forest DF-4S	25	15	428.81	Bs	Felsic Plutonics
I 44B3	Duke Forest DF-4I	41	26	426.77	Br	Felsic Plutonics
I 44F1	Millhouse Road	166	67	517	Br	Epiclastics
I 45G1	Rocky Ridge	Removed from network in 2012				
I 45J1	Eubanks Road	141	33	525		
I 46R1	Andrews Rd. (COL-1)	30	10	514	Bs	Felsic Tuff
I 46R2	Hwy 54 (COL-3)	40.5	25	516	Bs	Epiclastics
I 46W1	Orange Grove Rd (COL-4)	32	17	502	Bs	Epiclastics
J 45J1	Ray Road	Removed from network in 2012				

bgs – below ground surface

\*\* Estimated Elevation

**TABLE 9**  
**Orange Well Net Network Statistics (2008 through 06-30-2018)**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

<b>Parameter</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
Manual water levels (tapedowns)	3	18	49	68	59	54	52	75	71	80	26
Daily water levels (automatic recorders)	-	-	1,612	2,783	3,095	3,281	3,468	4,286	5,096	4,865	1,573
Total hourly water levels	-	-	38,802	66,689	74,065	78,636	83,090	102,643	121,985	116,515	37,516

<b>TABLE 10</b> <b>Guilford County Monitoring Well Information</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>								
<b>Quad</b>	<b>Station Name</b>	<b>Date Installed</b>	<b>Well Diameter (inches)</b>	<b>Well Depth (ft)</b>	<b>Casing Depth (ft)</b>	<b>Land Surface (ft)</b>	<b>Aquifer</b>	<b>City</b>
F 54O1	Summerfield (Jack Dent Park)	10/2/02	6.25	103	81	858.5	Br	Summerfield
G 50H1	Prison Farm	5/14/04	6.25	120	45	685	Br	Gibsonville
G 51B1	Northeast Park	6/24/15	6.125	100	77	683	Br	Gibsonville
G 56L1	Triad Park	10/9/02	6.25	140	0	925	Br	Colfax
H 51D1	Knox Road	10/9/02	-	-	39	715	Br	McLeansville
H 55L1	Gibson Park	4/15/03	6.25	205	79	813	Br	Jamestown
I 50P1	Station 45 (Humble Road)	12/15/04	6.25	180	124	679.5	Br	Liberty
I 52N1	Hagan Stone Park	05/17/03	6.125	100	52	755	Br	Pleasant Garden

<b>TABLE 11</b> <b>Guilford County Monitoring Well Network Statistics (2005 through 06-30-2018)</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>										
<b>Parameter</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
Manual water levels (tapedowns)	3	18	49	68	59	54	52	75	71	41
Daily water levels (automatic recorders)	-	-	1,612	2,783	3,095	3,281	3,468	4,286	5,096	2,013
Total hourly water levels	-	-	38,802	66,689	74,065	78,636	83,090	102,643	121,985	48,124



**TABLE 12**  
**Western Carolina Hydrological Research Station Network**  
**Monitoring Well Information**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

Quad	Station Name	Date Installed	Well Depth (meters)	Casing Depth (meters)	Screen (meters)	MP (meters above land surface)	Land Surface (NED Elevation) (meters)	Geology	Aquifer
Q 94H1	GG1S	11/30/2009	2.41	0.88	0.88-2.4	1.02	683.26	colluvium/saprolite	Bs
Q 94H2	GG1i	11/30/2009	4.42	3.81	3.81-4.42	0.99	683.26	saprolite	Bs
Q 94H3	GG1D	11/30/2009	7.56	6.95	6.95-7.56	0.97	683.26	saprolite	Bs
Q 94H11	GG4S	11/30/2009	2.83	1.31	1.31-2.83	0.89	682.93	colluvium/saprolite	Bs
Q 94H13	GG4D	11/30/1999	7.80	7.19	7.19-7.8	1.01	682.93	saprolite	Bs
Q 94H14	LB3S	11/30/1999	2.65	1.13	1.13-2.65	1.02	667.35	colluvium/saprolite	Bs
Q 94H16	LB3D	11/30/2009	5.43	4.82	4.82-5.43	1.05	667.35	saprolite	Bs
Q 94H22	LB1S	11/30/2009	2.47	0.94	0.94-2.46	1.00	667.15	colluvium/saprolite	Bs
Q 94H23	LB1i	11/30/1999	3.87	3.26	3.26-3.87	1.00	667.15	saprolite	Bs
Q 94H24	LB1D	11/30/1999	5.67	5.06	5.06-5.67	0.96	667.15	saprolite	Bs
Q 94I1	CC Old Well	11/22/2004	6.28	0.30	0.30-6.40	0.82	634.00	saprolite	Bs
Q 94I2	CC1S	11/30/2009	2.53	1.01	1.01-2.53	1.01	633.07	alluvium/saprolite	Bs
Q 94I3	CC1i	11/30/1999	3.29	2.99	2.99-3.29	1.05	633.07	saprolite	Bs
Q 94I5	CC1D	11/30/1999	5.64	5.33	5.33-5.63	1.02	633.07	saprolite	Bs
Q 94I7	CC2S	11/30/1999	2.68	1.16	1.16-2.68	0.98	634.15	alluvium/saprolite	Bs
Q 94I9	CC2D	11/30/2009	6.31	5.70	5.70-6.31	0.99	634.15	saprolite	Bs
Q 94J1	Stillwell Building	-	61.27	25.91	25.91-61.27	0.65	655.45	-	Br

Note: All monitoring wells are located in Jackson County, NC

<b>TABLE 13</b> <b>Western Carolina Hydrological Research Station Network Statistics (2011 through 06-30-2018)</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>								
<b>Parameter</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
Manual water levels (tapedowns)	238	628	661	469	422	486	662	270

<b>TABLE 14</b> <b>Network Expansion 2019 FY</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>			
<b>Proposed Station</b>	<b>County</b>	<b>Proposed Well Screens (ft bls)</b>	<b>Aquifer</b>
		20-30	Surficial
Replacement of Topsail Beach Station	Pender	120-130	Castle Hayne
		300-310	Peedee
		600-610	Black Creek
		20-30	Surficial
Near Intersection of US Hwy 421 and US Hwy 13	Sampson	41-51	Black Creek
		168-178	Upper Cape Fear
		347	Pilot Hole (Estimated top of basement)
		20-30	Surficial
Near Salemburg	Sampson	58-68	Black Creek
		129-139	Upper Cape Fear
		368	Pilot Hole (Top of Basement)
Additional Wells Existing Turkey Station	Sampson	20-30	Surficial
		318-328	Upper Cape Fear
		432-442	Lower Cape Fear
		455	Pilot Hole (Estimated Depth)
		20-30	Surficial
		41-51	Castle Hayne
Chinquapin Station Replacement	Duplin	165-175	Peedee
		212-222	Black Creek
		444-454	Upper Cape Fear
		618-628	Lower Cape Fear
		785	Pilot Hole (Estimated top of basement)

<b>Table 15</b> <b>Summary of Field Parameters (Measured using a Hydrolab Quanta-series meters)</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>							
Well	Station Name	County	Date	Temp °C	Conductivity (mS/cm)	Dissolved Oxygen (ppmv or mg/L)	pH
S 35Q5	Halls	Sampson	7/7/2016	18.83	0.094	0.09	5.30
R 29T5	Moss Hill	Lenoir	8/2/2016	19.76	0.293	0.18	6.94
R 29T8	Moss Hill	Lenoir	8/2/2016	19.03	0.251	0.08	7.46
Q 27R4	Kinston Yard	Lenoir	9/7/2016	19.75	0.247	0.13	8.02
Q 27R7	Kinston Yard	Lenoir	9/7/2016	19.95	0.250	0.00	7.94
Q 27R10	Kinston Yard	Lenoir	9/7/2016	19.33	0.196	0.04	7.93
T 29G5	Pink Hill	Duplin	9/13/2016	19.24	0.219	0.04	7.75
LW MW-3I	Lake Wheeler	Wake	10/13/2016	18.72	0.098	6.42	5.33
LW MW2-S	Lake Wheeler	Wake	10/19/2016	20.70	0.172	7.37	4.63
LW MW3-S	Lake Wheeler	Wake	10/19/2016	18.96	0.134	7.23	4.31
R 48G1	Southern Pines Water Plant	Moore	11/2/2016	20.03	0.104	0.07	6.14
R 48G2	Southern Pines Water Plant	Moore	11/2/2016	20.64	0.028	0.30	6.05
DF-1I	Duke Forest	Orange	12/1/2016	15.67	0.124	6.69	5.76
DF-2I	Duke Forest	Orange	12/1/2016	15.11	0.098	5.55	5.51
T 29G3	Pink Hill	Duplin	3/2/2017	17.95	0.191	0.06	7.69
T 29G7	Pink Hill	Duplin	3/2/2017	Attempted but could not collect a sample			
T 29G11	Pink Hill	Duplin	3/2/2017	16.84	0.090	0.18	4.91
R 31C1	Sleepy Creek	Wayne	3/6/2017	17.78	0.060	0.07	5.96
R 31C3	Sleepy Creek	Wayne	3/6/2017	18.43	0.054	0.03	5.44
R 29T4	Moss Hill	Lenoir	3/8/2017	20.15	0.169	0.04	6.78
R 29T6	Moss Hill	Lenoir	3/8/2017	19.11	0.105	0.06	6.04

<b>Table 15 (continued)</b> <b>Summary of Field Parameters (Measured using a Hydrolab Quanta-series meters)</b> <b>North Carolina Division of Water Resources</b> <b>Ground Water Management Branch</b> <b>2018 Annual Report</b>							
Well	Station Name	County	Date	Temp °C	Conductivity (mS/cm)	Dissolved Oxygen (ppmv or mg/L)	pH
O 28K3	Snow Hill	Greene	Attempted but could not collect a sample				
O 28K4	Snow Hill	Greene	3/30/2017	18.40	0.112	1.27	6.01
O 28K6	Snow Hill	Greene	3/30/2017	16.98	0.305	0.13	6.25
O 28K3	Snow Hill	Greene	4/4/2017	19.48	0.627	0.05	8.43
O 28K5	Snow Hill	Greene	4/4/2017	19.48	0.099	0.12	6.21
Mill St. Creek*	Snow Hill	Greene	4/4/2017	21.56	0.097	7.20	5.51
Contentnea Creek*	Snow Hill	Greene	4/4/2017	19.84	0.073	5.09	5.19
O 27J8	Eastern Correctional Institute	Greene	4/11/2017	15.96	0.066	8.3	5.33
O 27J10	Eastern Correctional Institute	Greene	4/11/2017	17.12	0.250	0.27	6.91
O 27J11	Eastern Correctional Institute	Greene	4/11/2017	19.48	0.429	0.03	7.98
O 27J8	Eastern Correctional Institute	Greene	4/18/2017	17.88	0.066	7.03	5.10
O 27J9	Eastern Correctional Institute	Greene	4/18/2017	17.90	0.403	0.12	7.40
O 27J10	Eastern Correctional Institute	Greene	4/18/2017	17.59	0.253	0.06	6.48
AA 39V1	Carver Moore	Columbus	4/27/2017	19.01	0.348	0.11	7.52
AA 39V4	Carver Moore	Columbus	4/27/2017	19.80	0.241	0.03	7.61
AA 35N1	Kelly	Bladen	5/2/2017	20.53	0.036	2.81	6.00
AA 35N2	Kelly	Bladen	5/2/2017	20.39	10.67	0.04	7.86
AA 35N3	Kelly	Bladen	5/2/2017	19.89	0.463	0.06	7.41
AA 35N4	Kelly	Bladen	5/2/2017	19.67	0.032	2.47	5.08
AA 35N5	Kelly	Bladen	5/2/2017	20.62	0.568	0.07	8.29
AA 35N6	Kelly	Bladen	5/2/2017	19.74	1.480	0.10	8.26

\*Two surface water samples were collected near the Snow Hill monitoring station to compare water chemistry

**Table 15 (continued)**  
**Summary of Field Parameters (Measured using a Hydrolab Quanta-series meters)**  
**North Carolina Division of Water Resources**  
**Ground Water Management Branch**  
**2018 Annual Report**

<b>Well</b>	<b>Station Name</b>	<b>County</b>	<b>Date</b>	<b>Temp °C</b>	<b>Conductivity (mS/cm)</b>	<b>Dissolved Oxygen (ppmv or mg/L)</b>	<b>pH</b>
AA 35N1	Kelly	Bladen	5/11/2017	20.74	0.037	2.80	5.23
AA 35N5	Kelly	Bladen	5/11/2017	21.08	0.563	0.10	8.20
AA 35N6	Kelly	Bladen	5/11/2017	19.62	1.47	0.04	8.59
Z 41U1	Bladenboro	Bladen	5/16/2017	18.18	0.378	0.06	6.79
Z 41U4	Bladenboro	Bladen	5/16/2017	18.78	0.413	0.16	7.28
M 25F1	West Research Campus	Pitt	6/1/2017	17.36	0.019	1.97	3.78
M 25F2	West Research Campus	Pitt	6/1/2017	17.52	0.258	0.04	6.22
M 25F3	West Research Campus	Pitt	6/1/2017	19.25	0.326	0.00	6.68
M 27U14	Farmville Marlboro Rd.	Pitt	6/6/2017	20.22	0.273	0.10	6.77
M 27U15	Farmville Marlboro Rd.	Pitt	6/6/2017	18.77	0.515	0.16	7.52
M 27U17	Farmville Marlboro Rd.	Pitt	6/6/2017	18.26	0.086	0.08	4.39
M 27U7	Farmville	Pitt	6/22/2017	19.33	0.177	0.30	5.85
M 27U15	Farmville Marlboro Rd.	Pitt	6/27/2017	20.86	0.515	0.24	6.82
M 27U16	Farmville Marlboro Rd.	Pitt	6/27/2017	19.35	0.207	0.11	6.29

## **APPENDICES**

**APPENDIX A**

**WELL CONSTRUCTION RECORDS**



**WCWC MONITORING STATION  
X 1901, X 1902, X 1903, X 1904, X 1905, X 1906**

# WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

## I. Well Contractor Information:

**Bobby L Harrell**

Well Contractor Name

**2936-A**

NC Well Contractor Certification Number

**MAGETTE WELL & PUMP COMPANY**

Company Name

## 2. Well Construction Permit #:

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

## 3. Well Use (check well use):

### Water Supply Well:

- Agricultural  Municipal/Public  
 Geothermal (Heating/Cooling Supply)  Residential Water Supply (single)  
 Industrial/Commercial  Residential Water Supply (shared)  
 Irrigation

### Non-Water Supply Well:

- Monitoring  Recovery

### Injection Well:

- Aquifer Recharge  Groundwater Remediation  
 Aquifer Storage and Recovery  Salinity Barrier  
 Aquifer Test  Stormwater Drainage  
 Experimental Technology  Subsidence Control  
 Geothermal (Closed Loop)  Tracer  
 Geothermal (Heating/Cooling Return)  Other (explain under #21 Remarks)

4. Date Well(s) Completed: **4/11/18** Well ID# **WCWC MW4**

### 5a. Well Location:

**WCWC**

**(PLANT)**

Facility/Owner Name

Facility ID# (if applicable)

**OFF HWY 24 NEWPORT NC**

Physical Address, City, and Zip

**CARTERET**

County

Parcel Identification No. (PIN)

### 5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:

(if well field, one lat/long is sufficient)

**34.715304** N **-76.984891** W

6. Is (are) the well(s):  Permanent or  Temporary

7. Is this a repair to an existing well:  Yes or  No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: **1**

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: **452** (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: **24.11** (ft.)

If water level is above casing, use "+"

11. Borehole diameter: **9.5** (in.)

12. Well construction method: **ROTARY**

(i.e. auger, rotary, cable, direct push, etc.)

### FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) **60** Method of test: **3 HR TEST**

13b. Disinfection type: **HTH** Amount: **2 LBS**

For Internal Use ONLY:

### 14. WATER ZONES

FROM	TO	DESCRIPTION
432 ft.	447 ft.	Fine sand shells and limestone
ft.	ft.	

### 15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+1 ft.	70 ft.	10 in.	SCH 40	PVC

### 16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	343 ft.	4.5 in.	SDR 17	PVC
343 ft.	432 ft.	4 in.	SCH 80	PVC

### 17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
432 ft.	477 ft.	4 in.	.040	HEAVY	SS
ft.	ft.	in.			

### 18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
0 ft.	405 ft.	neat cement	pump
405 ft.	411 ft.	bentonite pella	tremie
ft.	ft.		

### 19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
411 ft.	452 ft.	#2 SP	TREMIE
ft.	ft.		

### 20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0 ft.	60 ft.	fine sand, shells
60 ft.	72 ft.	same with clay
72 ft.	125 ft.	sand shells
125 ft.	145 ft.	same with clay
145 ft.	195 ft.	sand shells limestone
195 ft.	300 ft.	limestone and sand
300 ft.	460 ft.	sand limestone shells some clay

### 21. REMARKS

\*16. 447' TO 452' 4" SCH10 SS

SP CAPACITY 1 GPM / FT DD

### 22. Certification:

*Bobby Harrell*

**4/19/18**

Signature of Certified Well Contractor

Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

### 23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

### SUBMITTAL INSTRUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,  
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,  
1636 Mail Service Center, Raleigh, NC 27699-1636

### 24c. For Water Supply & Injection Wells:

Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

**WELL CONSTRUCTION RECORD (GW-1)**

**1. Well Contractor Information:**

**Jeovany Bautista**

Well Contractor Name

**4125 A**

NC Well Contractor Certification Number

**A C Schultes of Carolina, Inc.**

Company Name

**2. Well Construction Permit #:**

List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

**3. Well Use (check well use):**

**Water Supply Well:**

- Agricultural  Municipal/Public
- Geothermal (Heating/Cooling Supply)  Residential Water Supply (single)
- Industrial/Commercial  Residential Water Supply (shared)
- Irrigation

**Non-Water Supply Well:**

- Monitoring  Recovery

**Injection Well:**

- Aquifer Recharge  Groundwater Remediation
- Aquifer Storage and Recovery  Salinity Barrier
- Aquifer Test  Stormwater Drainage
- Experimental Technology  Subsidence Control
- Geothermal (Closed Loop)  Tracer
- Geothermal (Heating/Cooling Return)  Other (explain under #21 Remarks)

4. Date Well(s) Completed: 5/29/18 Well ID# X1902

**5a. Well Location:**

**NC DEQ**

**WCWC**

Facility/Owner Name

Facility ID# (if applicable)

**4102 NC-24 Newport, NC 28570**

Physical Address, City, and Zip

**Carteret**

County

Parcel Identification No. (PIN)

**5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:**

(if well field, one lat/long is sufficient)

**34.715696** N **-76.986060** W

6. Is(are) the well(s)  Permanent or  Temporary

7. Is this a repair to an existing well:  Yes or  No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. For Geoprobe/DPT or Closed-Loop Geothermal Wells having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled: \_\_\_\_\_

9. Total well depth below land surface: 355 (ft.)  
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 25 (ft.)  
If water level is above casing, use " "

11. Borehole diameter: 9 7/8 (in.)

12. Well construction method: Mud Rotary  
(i.e. auger, rotary, cable, direct push, etc.)

For Internal Use Only:

14. WATER ZONES					
FROM	TO	DESCRIPTION			
340 ft.	350 ft.	Sand			
ft.	ft.				
15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
0 ft.	35 ft.	10 in.	Sch 80	PVC	
16. INNER CASING OR TUBING (geothermal closed-loop)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
+3 ft.	340 ft.	4 in.	SDR 17	PVC	
350 ft.	355 ft.	4 in.	SCH 80	PVC	
17. SCREEN					
FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
340 ft.	350 ft.	4 in.	.020		SS
ft.	ft.	in.			
18. GROUT					
FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT		
0 ft.	328 ft.	Bentonite	pumped		
328 ft.	330 ft.	Bentonite	poured		
ft.	ft.				
19. SAND/GRAVEL PACK (if applicable)					
FROM	TO	MATERIAL	EMPLACEMENT METHOD		
330 ft.	355 ft.	#1 gravel	poured		
ft.	ft.				
20. DRILLING LOG (attach additional sheets if necessary)					
FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)			
0 ft.	32 ft.	Sand			
32 ft.	45 ft.	Clay			
45 ft.	110 ft.	Sand, shell			
110 ft.	141 ft.	Clay			
141 ft.	355 ft.	Limestone, Sand			
ft.	ft.				
ft.	ft.				
21. REMARKS					

**22. Certification:**

Jeovany Bautista  
Signature of Certified Well Contractor

5-31-18  
Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

**23. Site diagram or additional well details:**

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

**SUBMITTAL INSTRUCTIONS**

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,  
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,  
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

**FOR WATER SUPPLY WELLS ONLY:**

13a. Yield (gpm) \_\_\_\_\_ Method of test: \_\_\_\_\_

13b. Disinfection type: \_\_\_\_\_ Amount: \_\_\_\_\_

**WELL CONSTRUCTION RECORD (GW-1)**

**1. Well Contractor Information:**

**Jeovany Bautista**

Well Contractor Name

4125 A

NC Well Contractor Certification Number

**A C Schultes of Carolina, Inc.**

Company Name

**2. Well Construction Permit #:**

List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

**3. Well Use (check well use):**

**Water Supply Well:**

- Agricultural  Municipal/Public
- Geothermal (Heating/Cooling Supply)  Residential Water Supply (single)
- Industrial/Commercial  Residential Water Supply (shared)
- Irrigation

**Non-Water Supply Well:**

- Monitoring  Recovery

**Injection Well:**

- Aquifer Recharge  Groundwater Remediation
- Aquifer Storage and Recovery  Salinity Barrier
- Aquifer Test  Stormwater Drainage
- Experimental Technology  Subsidence Control
- Geothermal (Closed Loop)  Tracer
- Geothermal (Heating/Cooling Return)  Other (explain under #21 Remarks)

4. Date Well(s) Completed: 5/17/18 Well ID# X1903

**5a. Well Location:**

NC DEQ

WCWC

Facility/Owner Name

Facility ID# (if applicable)

4102 NC-24 Newport, NC 28570

Physical Address, City, and Zip

Carteret

County

Parcel Identification No. (PIN)

**5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:**  
(if well field, one lat/long is sufficient)

34.715696 N -76.986060 W

6. Is(are) the well(s)  Permanent or  Temporary

7. Is this a repair to an existing well:  Yes or  No  
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. For Geoprobe/DPT or Closed-Loop Geothermal Wells having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled: \_\_\_\_\_

9. Total well depth below land surface: 290 (ft.)  
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 25.75 (ft.)  
If water level is above casing, use "+"

11. Borehole diameter: 9 7/8 (in.)

12. Well construction method: Mud Rotary  
(i.e. auger, rotary, cable, direct push, etc.)

For Internal Use Only:

14. WATER ZONES					
FROM	TO	DESCRIPTION			
275 ft.	285 ft.	Sand			
ft.	ft.				
15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
0 ft.	35 ft.	10 in.	Sch 80	PVC	
16. INNER CASING OR TUBING (geothermal closed-loop)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
+3 ft.	275 ft.	4 in.	SDR 17	PVC	
285 ft.	290 ft.	4 in.	SCH 80	PVC	
17. SCREEN					
FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
275 ft.	285 ft.	4 in.	.020		SS
ft.	ft.	in.			
18. GROUT					
FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT		
0 ft.	265 ft.	Bentonite	pumped		
265 ft.	267 ft.	Bentonite	poured		
ft.	ft.				
19. SAND/GRAVEL PACK (if applicable)					
FROM	TO	MATERIAL	EMPLACEMENT METHOD		
267 ft.	290 ft.	#1 gravel	poured		
ft.	ft.				
20. DRILLING LOG (attach additional sheets if necessary)					
FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)			
0 ft.	32 ft.	Sand			
32 ft.	45 ft.	Clay			
45 ft.	110 ft.	Sand, shell			
110 ft.	141 ft.	Clay			
141 ft.	290 ft.	Limestone, sand			
ft.	ft.				
ft.	ft.				
21. REMARKS					

**22. Certification:**

Jeovany Bautista  
Signature of Certified Well Contractor

5-31-18  
Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

**23. Site diagram or additional well details:**

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

**SUBMITTAL INSTRUCTIONS**

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,  
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,  
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

**FOR WATER SUPPLY WELLS ONLY:**

13a. Yield (gpm) \_\_\_\_\_ Method of test: \_\_\_\_\_

13b. Disinfection type: \_\_\_\_\_ Amount: \_\_\_\_\_

**WELL CONSTRUCTION RECORD (GW-1)**

**1. Well Contractor Information:**

**Jeovany Bautista**

Well Contractor Name

4125 A

NC Well Contractor Certification Number

**A C Schultes of Carolina, Inc.**

Company Name

**2. Well Construction Permit #:**

List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

**3. Well Use (check well use):**

<b>Water Supply Well:</b>	
<input type="checkbox"/> Agricultural	<input type="checkbox"/> Municipal/Public
<input type="checkbox"/> Geothermal (Heating/Cooling Supply)	<input type="checkbox"/> Residential Water Supply (single)
<input type="checkbox"/> Industrial/Commercial	<input type="checkbox"/> Residential Water Supply (shared)
<input type="checkbox"/> Irrigation	
<b>Non-Water Supply Well:</b>	
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Recovery
<b>Injection Well:</b>	
<input type="checkbox"/> Aquifer Recharge	<input type="checkbox"/> Groundwater Remediation
<input type="checkbox"/> Aquifer Storage and Recovery	<input type="checkbox"/> Salinity Barrier
<input type="checkbox"/> Aquifer Test	<input type="checkbox"/> Stormwater Drainage
<input type="checkbox"/> Experimental Technology	<input type="checkbox"/> Subsidence Control
<input type="checkbox"/> Geothermal (Closed Loop)	<input type="checkbox"/> Tracer
<input type="checkbox"/> Geothermal (Heating/Cooling Return)	<input type="checkbox"/> Other (explain under #21 Remarks)

4. Date Well(s) Completed: 5/22/18 Well ID# X1904

**5a. Well Location:**

NC DEQ

WCWC

Facility/Owner Name

Facility ID# (if applicable)

4102 NC-24 Newport, NC 28570

Physical Address, City, and Zip

Carteret

County

Parcel Identification No. (PIN)

**5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:**

(if well field, one lat/long is sufficient)

34.715696 N -76.986060 W

6. Is (are) the well(s)  Permanent or  Temporary

7. Is this a repair to an existing well:  Yes or  No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. For Geoprobe/DPT or Closed-Loop Geothermal Wells having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled: \_\_\_\_\_

9. Total well depth below land surface: 170 (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 26.34 (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 9 7/8 (in.)

12. Well construction method: Mud Rotary

(i.e. auger, rotary, cable, direct push, etc.)

<b>FOR WATER SUPPLY WELLS ONLY:</b>	
13a. Yield (gpm) _____	Method of test: _____
13b. Disinfection type: _____	Amount: _____

For Internal Use Only:

14. WATER ZONES					
FROM	TO	DESCRIPTION			
155 ft.	165 ft.	Sand			
ft.	ft.				
15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
0 ft.	35 ft.	10 in.	Sch 80	PVC	
16. INNER CASING OR TUBING (geothermal closed-loop)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
+3 ft.	155 ft.	4 in.	SDR 17	PVC	
165 ft.	170 ft.	4 in.	SCH 80	PVC	
17. SCREEN					
FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
150 ft.	160 ft.	4 in.	.020		SS
ft.	ft.	in.			
18. GROUT					
FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT		
0 ft.	143 ft.	Bentonite	pumped		
143 ft.	145 ft.	Bentonite	poured		
ft.	ft.				
19. SAND/GRAVEL PACK (if applicable)					
FROM	TO	MATERIAL	EMPLACEMENT METHOD		
145 ft.	170 ft.	#1 gravel	poured		
ft.	ft.				
20. DRILLING LOG (attach additional sheets if necessary)					
FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)			
0 ft.	32 ft.	Sand			
32 ft.	45 ft.	Clay			
45 ft.	110 ft.	Sand, shell			
110 ft.	141 ft.	Clay			
141 ft.	170 ft.	Limestone, sand			
ft.	ft.				
ft.	ft.				
21. REMARKS					

**22. Certification:**

Jeovany Bautista 5-31-18  
 Signature of Certified Well Contractor Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

**23. Site diagram or additional well details:**

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

**SUBMITTAL INSTRUCTIONS**

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,  
 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,  
 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

**WELL CONSTRUCTION RECORD (GW-1)**

**1. Well Contractor Information:**

**Jeovany Bautista**

Well Contractor Name

**4125 A**

NC Well Contractor Certification Number

**A C Schultes of Carolina, Inc.**

Company Name

**2. Well Construction Permit #:**

List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

**3. Well Use (check well use):**

**Water Supply Well:**

- Agricultural  Municipal/Public
- Geothermal (Heating/Cooling Supply)  Residential Water Supply (single)
- Industrial/Commercial  Residential Water Supply (shared)
- Irrigation

**Non-Water Supply Well:**

- Monitoring  Recovery

**Injection Well:**

- Aquifer Recharge  Groundwater Remediation
- Aquifer Storage and Recovery  Salinity Barrier
- Aquifer Test  Stormwater Drainage
- Experimental Technology  Subsidence Control
- Geothermal (Closed Loop)  Tracer
- Geothermal (Heating/Cooling Return)  Other (explain under #21 Remarks)

4. Date Well(s) Completed: 5/11/18 Well ID# X1905

**5a. Well Location:**

**NC DEQ**

**WCWC**

Facility/Owner Name

Facility ID# (if applicable)

**4102 NC-24 Newport, NC 28570**

Physical Address, City, and Zip

**Carteret**

County

Parcel Identification No. (PIN)

5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees: (if well field, one lat/long is sufficient)

**34.715696** N **-76.986060** W

6. Is (are) the well(s)  Permanent or  Temporary

7. Is this a repair to an existing well:  Yes or  No  
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. For Geoprobe/DPT or Closed-Loop Geothermal Wells having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled:

9. Total well depth below land surface: 110 (ft.)  
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 11.84 (ft.)  
If water level is above casing, use "+"

11. Borehole diameter: 9 7/8 (in.)

12. Well construction method: Mud Rotary  
(i.e. auger, rotary, cable, direct push, etc.)

For Internal Use Only:

14. WATER ZONES					
FROM	TO	DESCRIPTION			
90 ft.	100 ft.	Sand			
ft.	ft.				
15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
ft.	ft.	in.			
16. INNER CASING OR TUBING (geothermal closed-loop)					
FROM	TO	DIAMETER	THICKNESS	MATERIAL	
+3 ft.	90 ft.	4 in.	SDR 17	PVC	
100 ft.	105 ft.	4 in.	SCH 80	PVC	
17. SCREEN					
FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
90 ft.	100 ft.	4 in.	.020		SS
ft.	ft.	in.			
18. GROUT					
FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT		
0 ft.	78 ft.	Bentonite	pumped		
78 ft.	80 ft.	Bentonite	poured		
ft.	ft.				
19. SAND/GRAVEL PACK (if applicable)					
FROM	TO	MATERIAL	EMPLACEMENT METHOD		
80 ft.	110 ft.	#1 gravel	poured		
ft.	ft.				
20. DRILLING LOG (attach additional sheets if necessary)					
FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)			
0 ft.	32 ft.	Sand			
32 ft.	45 ft.	Clay			
45 ft.	110 ft.	Sand, shell			
ft.	ft.				
ft.	ft.				
ft.	ft.				
ft.	ft.				
21. REMARKS					

**22. Certification:**

Jeovany Bautista  
Signature of Certified Well Contractor

5-31-18

Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

**23. Site diagram or additional well details:**

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

**SUBMITTAL INSTRUCTIONS**

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,  
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,  
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

**FOR WATER SUPPLY WELLS ONLY:**

13a. Yield (gpm) \_\_\_\_\_ Method of test: \_\_\_\_\_

13b. Disinfection type: \_\_\_\_\_ Amount: \_\_\_\_\_

WELL CONSTRUCTION RECORD (GW-1)

1. Well Contractor Information:

Jeovany Bautista

Well Contractor Name

4125 A

NC Well Contractor Certification Number

A C Schultes of Carolina, Inc.

Company Name

2. Well Construction Permit #:

List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

3. Well Use (check well use):

Water Supply Well:

- Agricultural, Municipal/Public, Geothermal (Heating/Cooling Supply), Residential Water Supply (single), Industrial/Commercial, Residential Water Supply (shared), Irrigation

Non-Water Supply Well:

- Monitoring, Recovery

Injection Well:

- Aquifer Recharge, Groundwater Remediation, Aquifer Storage and Recovery, Salinity Barrier, Aquifer Test, Stormwater Drainage, Experimental Technology, Subsidence Control, Geothermal (Closed Loop), Tracer, Geothermal (Heating/Cooling Return), Other (explain under #21 Remarks)

4. Date Well(s) Completed: 5/7/18 Well ID# X1906

5a. Well Location:

NC DEQ

WCWC

Facility / Owner Name

Facility ID# (if applicable)

4102 NC-24 Newport, NC 28570

Physical Address, City, and Zip

Carteret

County

Parcel Identification No. (PIN)

5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:

34.715696 N -76.986060 W

6. Is(are) the well(s) [X] Permanent or [ ] Temporary

7. Is this a repair to an existing well: [ ] Yes or [X] No

8. For Geoprobe/DPT or Closed-Loop Geothermal Wells having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled:

9. Total well depth below land surface: 35 (ft.)

10. Static water level below top of casing: 7.32 (ft.)

11. Borehole diameter: 9 7/8 (in.)

12. Well construction method: Mud Rotary

FOR WATER SUPPLY WELLS ONLY: 13a. Yield (gpm) Method of test: 13b. Disinfection type: Amount:

For Internal Use Only:

14. WATER ZONES table with columns FROM, TO, DESCRIPTION. 15. OUTER CASING table with columns FROM, TO, DIAMETER, THICKNESS, MATERIAL. 16. INNER CASING table with columns FROM, TO, DIAMETER, THICKNESS, MATERIAL. 17. SCREEN table with columns FROM, TO, DIAMETER, SLOT SIZE, THICKNESS, MATERIAL. 18. GROUT table with columns FROM, TO, MATERIAL, EMPLACEMENT METHOD & AMOUNT. 19. SAND/GRAVEL PACK table with columns FROM, TO, MATERIAL, EMPLACEMENT METHOD. 20. DRILLING LOG table with columns FROM, TO, DESCRIPTION. 21. REMARKS

22. Certification:

Signature of Certified Well Contractor: Jeovany Bautista

Date: 5-31-18

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTRUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

**APPENDIX B**

**GROUND WATER SAMPLING PROTOCOL**



## Ground Water Sampling Protocol

Samples for the ambient monitoring program were collected in accordance with DWR procedures outlines in NCDWQ/APS 2006 to ensure that high quality, defensible data was collected. To ensure that only newly recharged groundwater was being sampled, wells were pumped until three well volumes had been removed. Where a well’s total volume was too high to feasibly pump out three volumes, wells were purged until water quality parameters (temperature, pH, specific conductance, and dissolved oxygen) of purge water stabilized. Both submersible and peristaltic pumps were used in the field at the sampler’s discretion depending on the total depth of the well and the hydraulic head difference to be overcome when pumping from the water table to the surface. To prevent contamination introduced while sampling, nitrile gloves were worn during all sampling events. Pumps were decontaminated after each use. In addition, blanks and duplicate samples were collected to provide information on the Trip blanks were taken on each sampling trip, and equipment blanks were run through all equipment then analyzed. Field duplicates were taken to compromise 10% of the total samples collected.

The groundwater was analyzed for a broad suite of water quality and water chemistry parameters (table xx). Data from the ambient monitoring program may be used to characterize groundwater throughout the state as well as to address the concerns other programs and projects. Within DWR these concerns include for example saltwater intrusion due to over-pumping, the source of organic nitrogen found in surface water bodies, the impact of concentrated farming activities on drinking water supplies, and the levels of naturally occurring contaminants such as metals. Since most of these wells are somewhat geographically isolated from human activities, the water collected is more likely to represent ambient conditions and not contamination.

<b>Table of Sampling Parameters</b>	
<b>Parameter Group</b>	<b>Parameters</b>
Private Well Analytes (15A NCAC 18A .3803)	arsenic, barium, cadmium, chromium, copper, fluoride, lead, iron, magnesium, manganese, mercury, nitrate, nitrite, selenium, silver, sodium, zinc, pH
Nutrients*	Ammonia, total kjeldahl nitrogen, organic nitrogen, phosphorus
Metals (Dissolved and Total)*	Aluminum, antimony, beryllium, boron, calcium, cobalt, lithium, molybdenum, nickel, potassium, strontium, thallium, tin, titanium, vanadium
Major Ions	Bromide, chloride, fluoride, sulfate, carbonate, bicarbonate
Field Parameters	Specific conductivity, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature
Organic Compounds	Volatile organic compounds, Semi-volatile organic compounds, Pesticides
Other	Alkalinity, total organic carbon, turbidity, total dissolved solids, silica, sulfide

\*In addition to those required by 15A NCAC 18A .3803

References:

DCDWQ/APS, 2006, Quality Assurance/Quality Control and Standard Operating Procedures Manual for Sample Collection, December 2006

15a NCAC 18a Section .3800 - Private Drinking Water Well Sampling, .3803 - Sample Analysis