

**North Carolina
Division of Water Resources
Ground Water Management Branch
2017 Annual Report**

Susan Laughinghouse, L.G.
North Carolina Department of
Environmental Quality
Division of Water Resources
August 2017



Z 47R, Rowland Station, Robeson County

TABLE OF CONTENTS

| | | |
|------|--|----|
| 1.0 | Introduction | 2 |
| 2.0 | Purpose and Scope | 2 |
| 3.0 | Background | 3 |
| 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 | 7 |
| 5.1 | Ground Water Data Collection | 7 |
| 5.2 | Triennial Chloride Sampling | 7 |
| 5.3 | Well Installation and Development | 9 |
| 5.4 | Well Maintenance | 11 |
| 5.5 | Acquired Network Wells | 12 |
| 5.6 | Automatic Water Level Recorders | 12 |
| 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 |
| 7.0 | Planned Activities | 14 |
| 7.1 | New Well Installation | 14 |
| 7.2 | Well Abandonment | 15 |
| 8.0 | Water Quality | 15 |
| 9.0 | Central Coastal Plain Capacity Use Area | 17 |
| 10.0 | Summary and Conclusions | 20 |

FIGURES

| | |
|----------|--|
| Figure 1 | North Carolina Division of Water Resources Monitoring Stations June 2017 |
| Figure 2 | Drought Indicator Wells |
| Figure 3 | Water Level Data Collected From 1967-2017 |
| Figure 4 | Chloride Decreases in the Cretaceous Lower Cape Fear Aquifer |
| Figure 5 | Orange Well Net Orange County 2017 |
| Figure 6 | Monitoring Well Network Guilford Counties 2017 |

TABLES

| | |
|---------|--|
| Table 1 | Site Susceptibility Rating |
| Table 2 | Site and Recorder Distribution by Region as of 6/30/17 |
| Table 3 | Solinst Telemetry System (STS) Distribution by Region as of 6/30/17 |
| Table 4 | Monitoring well Network Statistics (01-01-2005 through 06-30-2017) |
| Table 5 | Chloride Field Analysis from 2015 Sampling Event |
| Table 6 | Well Construction Information for New Well Installation, Acquired, and Re-Activated Wells in the 2017 FY |

TABLES (continued)

| | |
|----------|--|
| Table 7 | Well Development Information for 2017 FY |
| Table 8 | Automatic Water Level Recorders as of 6/30/2017 |
| Table 9 | Orange Well Net Monitoring Well Information |
| Table 10 | Orange Well Net Network Statistics |
| Table 11 | Guilford County Monitoring Well Information |
| Table 12 | Guilford County Monitoring Well Network Statistics |
| Table 13 | 2018 FY Network Expansions |
| Table 14 | Summary of Field Parameters |

APPENDICES

| | |
|------------|--------------------------------|
| Appendix A | Well Construction Records |
| Appendix B | Ground Water Sampling Protocol |

Acknowledgements

The author would like to thank colleagues in the North Carolina Division of Water Resources, Ground Water Management Branch, for providing summaries for their area of expertise, lists of works conducted in the 2017 FY including well repair and well development, and/or photographs for this report. Thanks are extended to Nat Wilson and Gabrielle Chianese for their contribution to the Central Coastal Plain Capacity Use Area Section, Amy Keyworth for her contribution to the Water Quality Section and Mark Durway for his contribution to the Chloride Section of this report. In addition, a special thanks to the Ground Water Monitoring Unit staff, Tony Butz, Danny Edwards, Kevin McVerry, and Aiken Small for their part in providing information and photographs to be incorporated in this report. A very special thanks to Nat Wilson for creating a website/database where all needed information and statistical information were easily accessed. In addition, gratitude and appreciation are extended to Nat Wilson for his patience, time, and review of this report.

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. 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 2017 Annual Report summarizes field activities and conclusions derived from activities performed or associated with the Ground Water Management Branch during the July 1, 2016 through June 30, 2017 fiscal year (2017 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 2017 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 thirty-eight percent (263 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 12 monitoring wells, many of which are also part of the DWR statewide network.



Bear Grass Station, K 21R, Martin County

4.0 DWR Statewide Monitoring Well Network Overview

4.1 Description

The monitoring well network currently consists of 665 wells at 229 monitoring stations (sites), divided into six regions, comprising 66 counties (Figure 1). There are 50 wells located in the Piedmont and Mountain physiographic provinces (Piedmont and Mountain) and 615 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.



Ivanhoe Station, Y 34P, Sampson County

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 2016 FY ([Figure 2](#)).

The East Bend VFD (F 62J1) well replaced the East Bend (F 61F3) well when F 61F3 was abandoned on April 4, 2014. DWR began collecting hourly data for well F 62J1 starting April 2, 2014. After the ground water data was collected for approximately two years it was concluded that the data from both wells could be combined into one record. This information is valuable in assessing how climatic conditions impact ground water supplies and assessing trends especially those related to drought. Thus, this data allowed DWR to designate well F 62J1 as a drought well.

Of the 229 monitoring stations, 81 are on State or Federal property, 58 are located on property owned by local governments, 86 are located on private property through agreements with 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 six regions ([Figure 1](#)). One staff member is responsible for each region. Staff member responsibilities include visiting the



**Down Hole Camera (Video-Logger)
Stillwell Building, Q 94J, Jackson County**

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 hours) via a cell phone modem apart from the Laurel Springs Station (C 31U1). The Laurel Springs Station transmits 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). [Table 3](#) summarizes STS system information.



**Depth to Water Level Measurement
Comfort Station, U 26J, Jones County**



Hobo and Barometer



**Solinst Telemetry System (STS)
Rowland Station, Z 47R, Robeson**



Lewiston Monitoring Station Including STS Solar Panel, H 22I, Bertie County

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 2017 to track salt water encroachment conditions prior to the 2018 CCPCUA assessment (see Section 9.0). Section 5.2 summarizes the 2015 chloride sampling event.



Chloride Sample Collection

5.0 Well Network Statistics

5.1 Ground Water Data Collection

Depth to ground water was measured in 654 wells in the 2017 FY. Table 4 contains DWR monitoring well network statistics from January 1, 2005 through June 30, 2017. Statistics may vary in comparison to previous 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 2015 represents the most water level data collected in any single year since starting the monitoring well network operation. The 2017 data was collected from January 1 through June 30, 2017.

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.

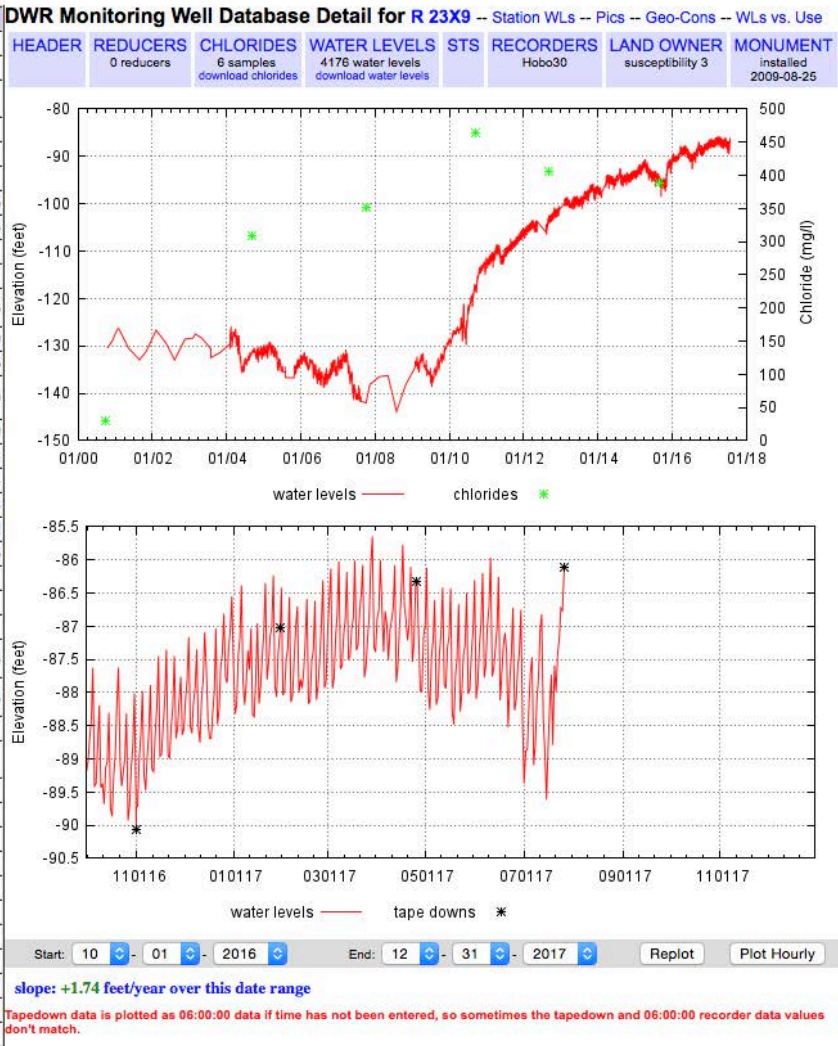
5.2 Chloride Sampling

A chloride sampling event was performed in 2015. Ground water from 258 wells within the network were sampled for chlorides using Quantab® chloride titrators between August 24, 2015 through October 29, 2015. Field data were collected for pH, conductivity, and salinity using YSI® portable probes.

The intention of the chloride sampling is to assess the position 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 sampling results are posted in the database and the DWR website. The following graph illustrates the typical database detail of parameters for a well hydrograph.

Division of Water Resources

| Field | Data |
|---|---|
| County | Craven |
| Quad Show Map | R 23X9 |
| Name | Cove City Cove City Site Map.pdf |
| USGS Netname | |
| USGS ID | |
| Region | 2 |
| Latitude | 35.172305 |
| Longitude | -77.311178 |
| Location Accuracy | G |
| Aquifer | Kucf |
| Land Surface <small>NED elevation = 44.79 feet</small> | 43.926 |
| Date Constructed | 09/29/2000 |
| Diameter | 4.5 |
| Outer Protective Casing Diameter | 0 |
| Depth | 869 |
| Casing Material | PVC |
| Top of Screen | 854 |
| Bottom of Screen | 864 |
| Screen Material | stainless steel |
| Yield | 0.5 |
| Exists? | y |
| Recorder Box? | dwr box |
| Recorder? | Hobo30 |
| Water Temp (degrees F) | 63.8 |
| Recorder Voltage (volts) | 3.43 |
| ID Engraved? | y |
| Sign? <small>Label (print landscape)</small> | y |
| Painted? | y |
| USGS Active? | n |
| Drought? | n |
| Topographic Setting | |
| Replacement | n |
| River Basin | Neuse |
| Install Recorder? | OK to install |
| Video? | y |
| Open Hole? | n |
| Latest Development | |
| Comments | |



Sampling results indicate that there continues to be concern for salt-water encroachment, especially near larger pumping centers located near the fresh water-salt water interface (250 parts per million (ppm) chloride is considered salt water). The 2015 chloride field sampling results associated with wells near larger pumping centers illustrate these types of issues:

- Chloride concentrations from September 9, 2015 in the lower Castle Hayne aquifer well Q16G4 at the Godley Station continue to indicate salt water intrusion with levels of 554 ppm which exceed the 250 ppm threshold for salt water. This station is located near PCS Phosphate Inc. at Aurora, NC in Beaufort County.
- Chloride concentrations from the Peedee aquifer well Y25Q4 at the Folkstone Station show an increase in chlorides from 227 ppm in September 2012 to 272 ppm on

September 1, 2015 exceeding the 250 ppm threshold for salt water. Even though the September 12, 2012 results indicate levels below 250 ppm, samples collected July 9, 2011 (296 ppm), September 25, 2007 (252 ppm), and September 14, 2004 (266 ppm) each indicated chloride levels exceeding the 250 ppm threshold for salt water. This station is located near the ONWASA Dixon well field in Onslow County.

- Chloride concentrations from the Upper Cape Fear aquifer well J22P5 at the Gold Point Station increased from 172 ppm on September 6, 2012 to 186 ppm on September 8, 2015. This station is located near the town of Robersonville in Martin County.
- Chloride concentrations from the Upper Cape Fear aquifer well R23X9 at the Cove City station decreased from 405 ppm on September 11, 2013 to 388 ppm on August 24, 2015. The well still exceeds the 250 ppm threshold for salt water. This well is located near the town of Cove City, North Carolina.

Twenty samples were collected from the Cretaceous Lower Cape Fear Aquifer (Klcf). Field results indicate that between 2012 and 2015, Klcf chloride levels decreased in eleven of the twenty wells ([Figure 4](#)). The anomalous decreases may be in response to recent pumping reductions within North Carolina's Central Coastal Plain Capacity Use Area and International Paper in Franklin, Virginia. This deviation from previous data trends is under investigation.

[Table 5](#) summarizes the chloride field analysis to date for specific wells. Wells will be sampled for chlorides in September-October 2017.

5.3 Well Installation and Development

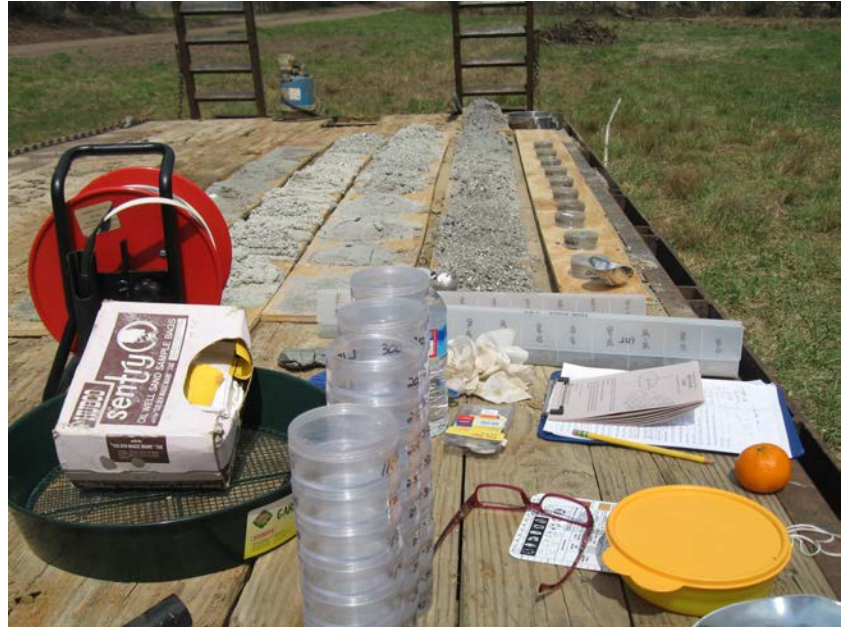
From March 2017 through May 2017, the following monitoring wells were installed using the mud rotary drilling method:

- Long Creek Station, Pender County, four wells (AA 32R1, AA 32R2, AA 32R3, and AA 32R4);
- Presidio Station, New Hanover County, three wells (EE 30P1, EE 30P2, and EE 30P3); and
- Myrtle Grove Station, New Hanover County, three wells (EE 30M1, EE 30M2, and EE 30M3).



**Well Installation, Ivanhoe Station,
Y 34P, Sampson County**

A pilot hole was advanced at each of the newly installed stations. Each pilot hole was advanced using the mud rotary drilling method. Samples of the drill cuttings were collected 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



**Samples Collected from Pilot Hole and Sample Containers
D Canal Road Station, L15T, Hyde County**

assess well screen intervals and the number of wells to be installed. The wells were installed using 4-inch PVC riser and 10 or 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 6 summarizes the monitoring well construction information. These wells are included in Figure 1. Well construction records for the 2017 FY installed wells are included in Appendix A.



**Mud Rotary Drilling using
Mud Circulation Tank
Farmville Station, M 27U, Pitt County**



**Mud Rotary Drilling using Mud Pits
Nakina Station, EE 390, Columbus**

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 develop the newly installed stations, as well as redevelop several other existing monitoring well stations in the 2018 FY. Monitoring wells developed in the 2017 FY are listed in [Table 7](#).



Well Development, Deep Creek Station, O 97L, Swain County

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.

There were no major well repairs in the 2017 FY.

5.5 Acquired Network Wells

DWR acquired two existing wells which were included into the monitoring well network in the 2017 FY. In addition, DWR re-activated the Farmville Monitoring Station. [Table 6](#) includes the detailed information of the acquired monitoring wells. These wells are included in [Figure 1](#).

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 2017 FY and are included in [Table 2](#). [Table 8](#) lists the recorders present on network wells on as of June 30, 2017. STS system photographs are included in Section 4.2.

5.7 Site Surveys

Concrete survey monuments have been installed at each of the 229 active monitoring well stations



**Well Development
Long Creek Station, AA 32R
Pender County**



**R10 Surveying, Wright Brothers
Memorial Station, H 4U, Dare**

within the network. Five of those stations have more than one monument.

Each of the installed monuments, except for the newly installed and acquired stations (Long Creek, Presidio, Myrtle Grove, and Fillingim Property) were 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, and the monitoring stations installed in the 2016 FY, in addition to select wells, were surveyed in October 2016. DWR was unable to get elevations at three monitoring stations (New Lake M12L, 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 fall of the 2018 FY to provide horizontal and vertical data on the newly installed, acquired, and re-activated monitoring well stations, as well as a select number of sites to obtain additional measurements.



**Installed Monument
Woody Creek Station, M 93L,
Haywood County**

6.0 Local Monitoring Well Network Information

6.1 Orange County Monitoring Well 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



**Leveling, Woody Creek, M 93L
Haywood County**

(informal) of DWR and Duke Forest. [Table 9](#) summarizes the OWN well information. [Figure 5](#) 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 10](#) is a summary of the OWN statistics from March 2010 through June 30, 2017. 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 Annuals 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 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 11](#) 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 the Global Water WL16 submersible transducer and is 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 12](#) summarizes the Guilford County monitoring well statistics from 2008 through June 30, 2017. [Figure 6](#) 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.

7.0 **Planned Activities**

7.1 [New Well Installation](#)

Monitoring well network expansion efforts for the 2018 FY will be focused on Pender and Sampson counties. [Table 13](#) summarizes the potential upcoming expansion of the network in 2018 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 2018 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 comply with 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:

- 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.



**Purging Well Prior to Sample Collection
Western Research Campus, M 25F
Pitt County**



**Ground Water Sample Collection
West Research Campus, M 25F, Pitt County**

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.

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 2017 FY, samples were collected from seventeen 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 (F), lead (Pb), iron (Fe), magnesium (Mg), mercury (Hg), nitrates (NO₃), selenium (Se), silver (Ag), sodium (Na), zinc (Zn), pH, and bacterial indicators;
- Ammonium (NH₄⁺), Total Kjeldahl Nitrogen (TKN), organic Nitrogen, and Phosphate (PO₄³⁻);
- 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 (SO₄²⁻), (carbon trioxide (CO₃²⁻), bicarbonate (HCO₃⁻) 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.

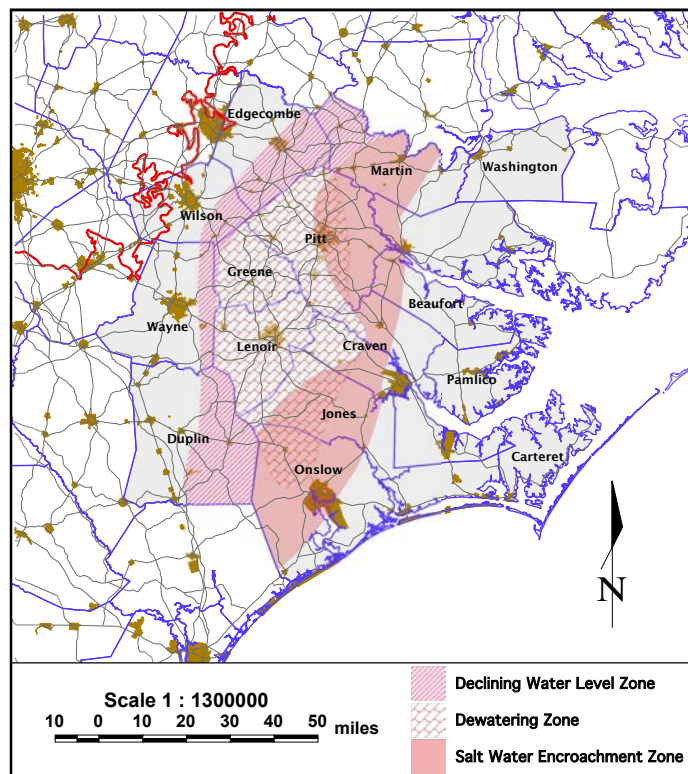
Ground water sampling protocol is included in [Appendix B](#). Field data information for the 2017 FY are included in [Table 14](#). Laboratory analytical results received for the 2017 FY are available upon request. In the 2018 FY, ground water samples will continue to be collected from wells in the monitoring well network and analyzed for the parameters referenced above. Analytical data will be available to the public through the DWR website in the 2018 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 natural 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).

CCPCUA Cretaceous Aquifer Zones

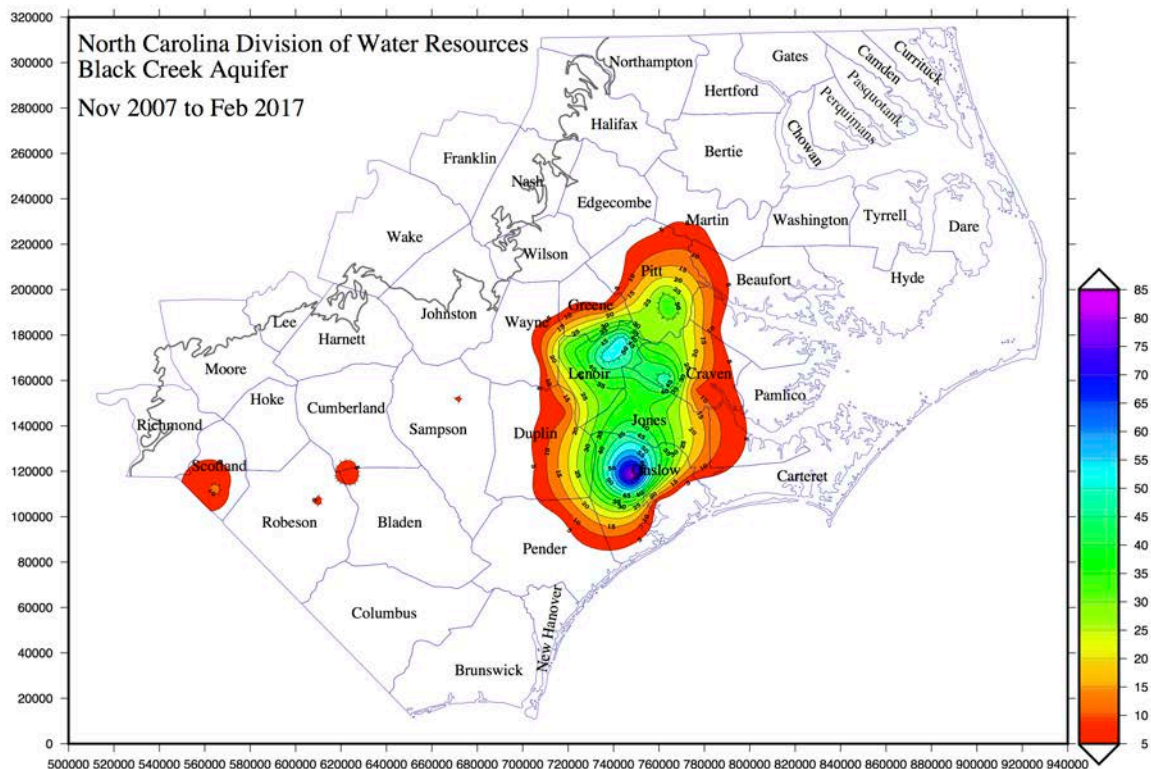


The following summarizes how these withdrawals are regulated:

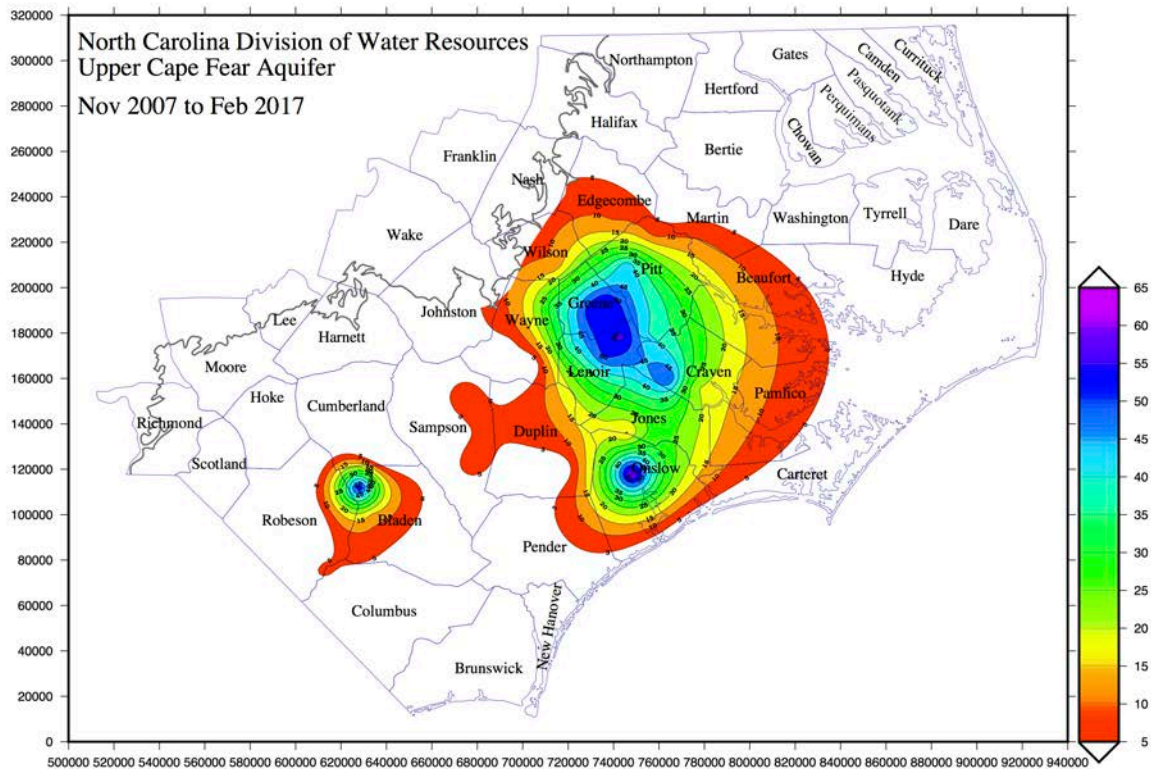
- Water withdrawal permits are required for ground water users who withdraw greater than 100,000 gallons of water per day;
- Annual registration and reporting of withdrawals is required for surface and ground water withdrawals greater than 10,000 gallons per day;
- Counties included in the CCPCUA are 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.

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 Nov. 2007 through Feb. 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 Nov. 2007 through Feb. 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 September 2016, the following six 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, and Fork Township Sanitary District.

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. Another formal assessment will be conducted in 2018. Reports referencing the CCPCUA rules can be viewed by visiting the DWR website, 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. 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 665 monitoring wells at 229 individual stations. From July 2016 through June 2017, ground water level data were collected from 654 wells within the network. These data include manual measurements taken quarterly from wells, plus hourly water levels collected using automatic data recorders from 515 wells.

Sixteen STS units have been installed as of 2017 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 258 wells in September-October 2015. Four additional samples were collected from the new well installation at Holly Shelter in June 2016. Sampling results indicated that there continues to be concern for saltwater encroachment especially near larger pumping centers located near the fresh-salt water interface. Decreases were observed in the Cretaceous, Lower Cape Fear aquifer in eleven of twenty wells. The anomalous decreases may be in response to recent pumping reductions within the CCPCUA and at International Paper in Franklin, Virginia. Chloride sampling will occur again in September-October 2017.

Ten monitor wells have been installed at three different stations during the 2017 FY. Four monitoring wells were installed at Long Creek (Pender County), three wells were installed at Presidio (New Hanover County), and three wells were installed at Myrtle Grove (New Hanover County). Borehole advancement and well installation included partial well development. Each site is scheduled for complete development and chloride sampling in the 2018 FY.

Two wells were acquired and added to the monitoring well network in the 2017 FY: Myrtle Grove (EE 30M4) and Fillingim Property (F 25Q1).

No wells were abandoned or received major repair during the 2017 FY.

There are two local networks whose water level data are currently being uploaded to the DWR database. The OWN in Orange County, and the Guilford 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 active wells with installed monuments during the 2017 FY. Plans are to survey the newly installed stations, monuments installed at most Camp Lejeune stations, and resurvey selected stations in the fall of the 2018 FY.

DWR has tentative plans to expand the monitoring well network by installing up to 30 wells at five sites in the 2018 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 2017 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 2013 data assessment, DWR did not pursue rule changes. Instead, DWR is 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: North Carolina Division of Water Resources Monitoring Stations July 2017

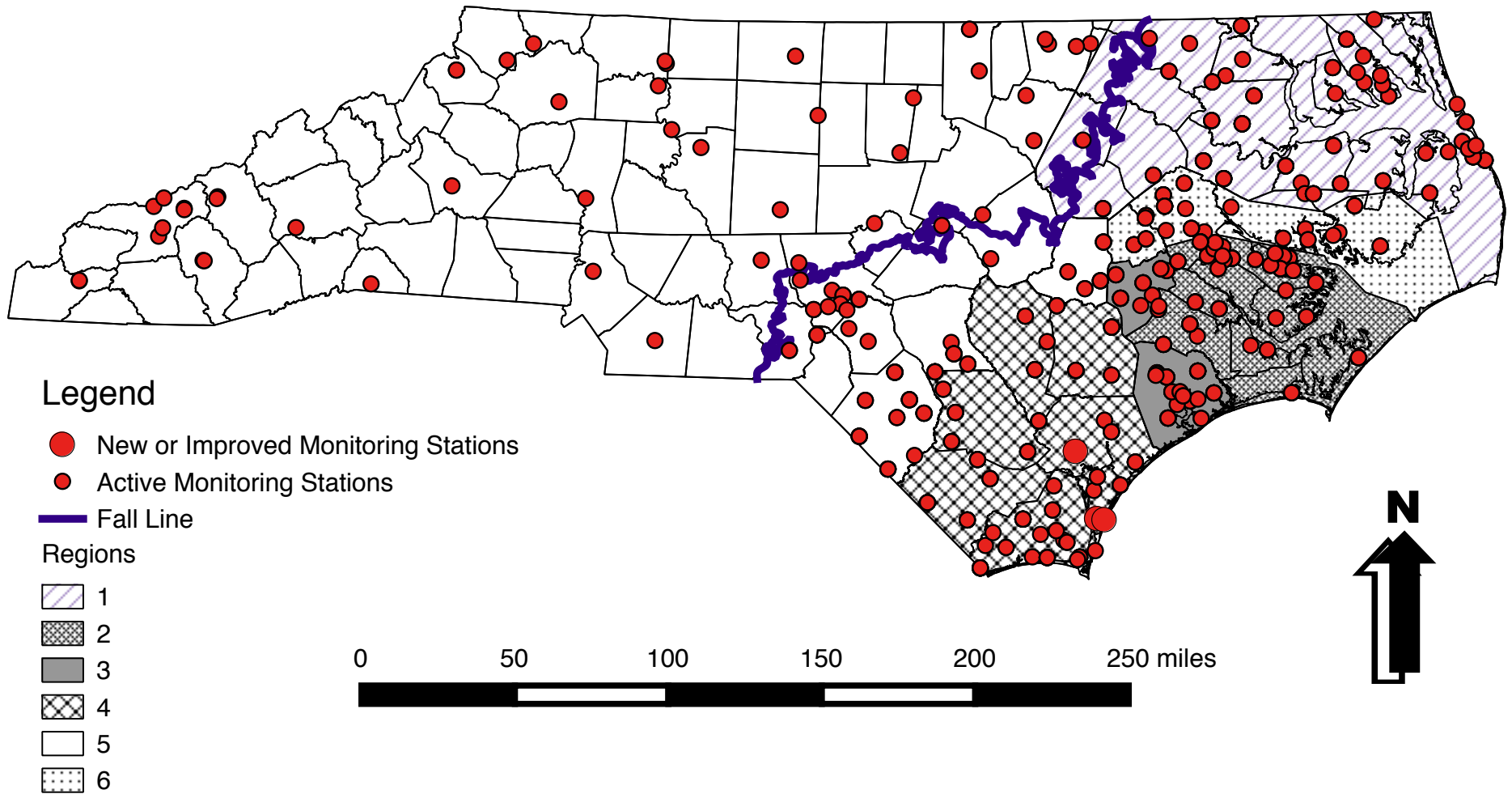


Figure 2: Drought Indicator Wells

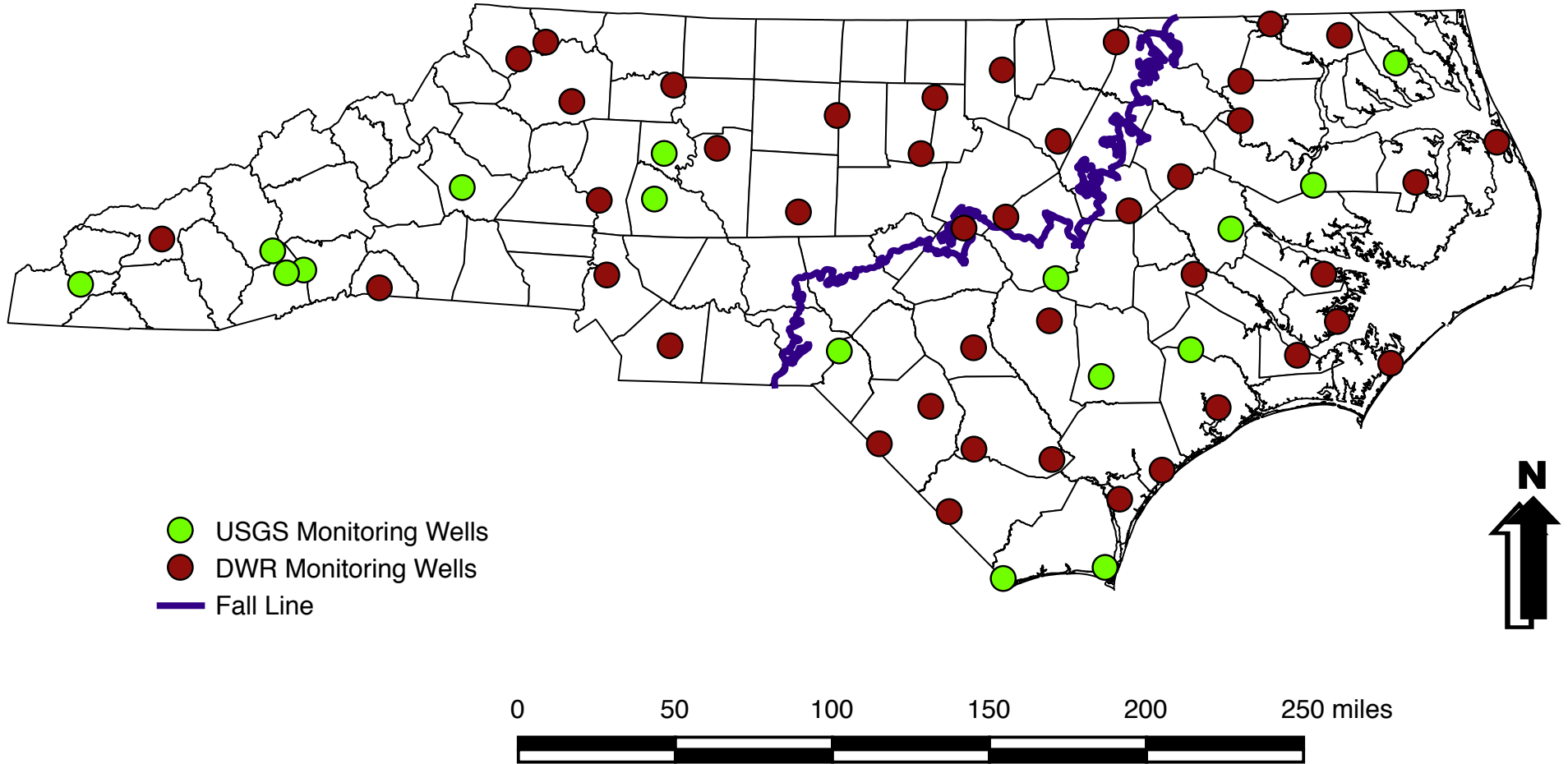
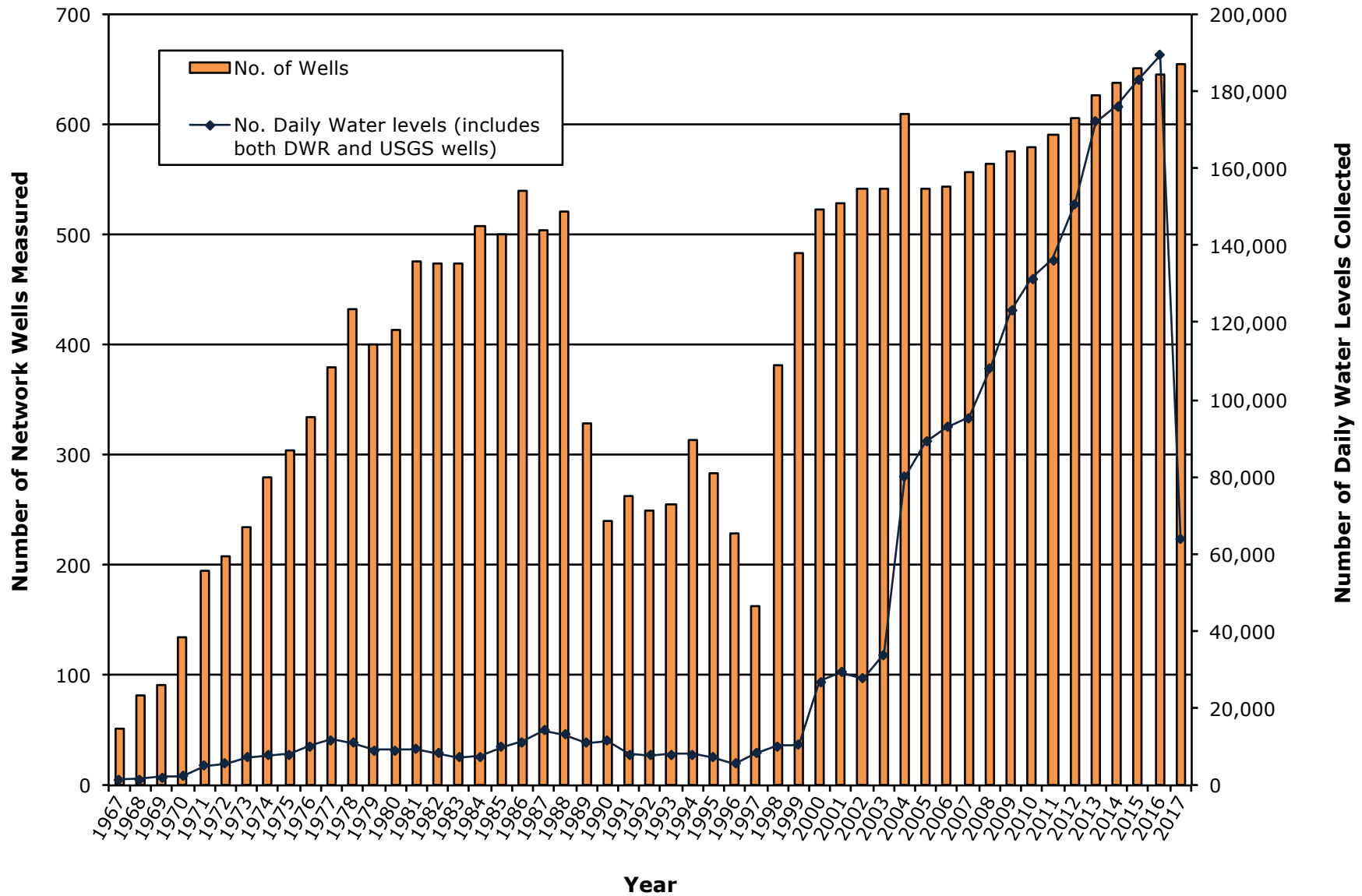


FIGURE 3

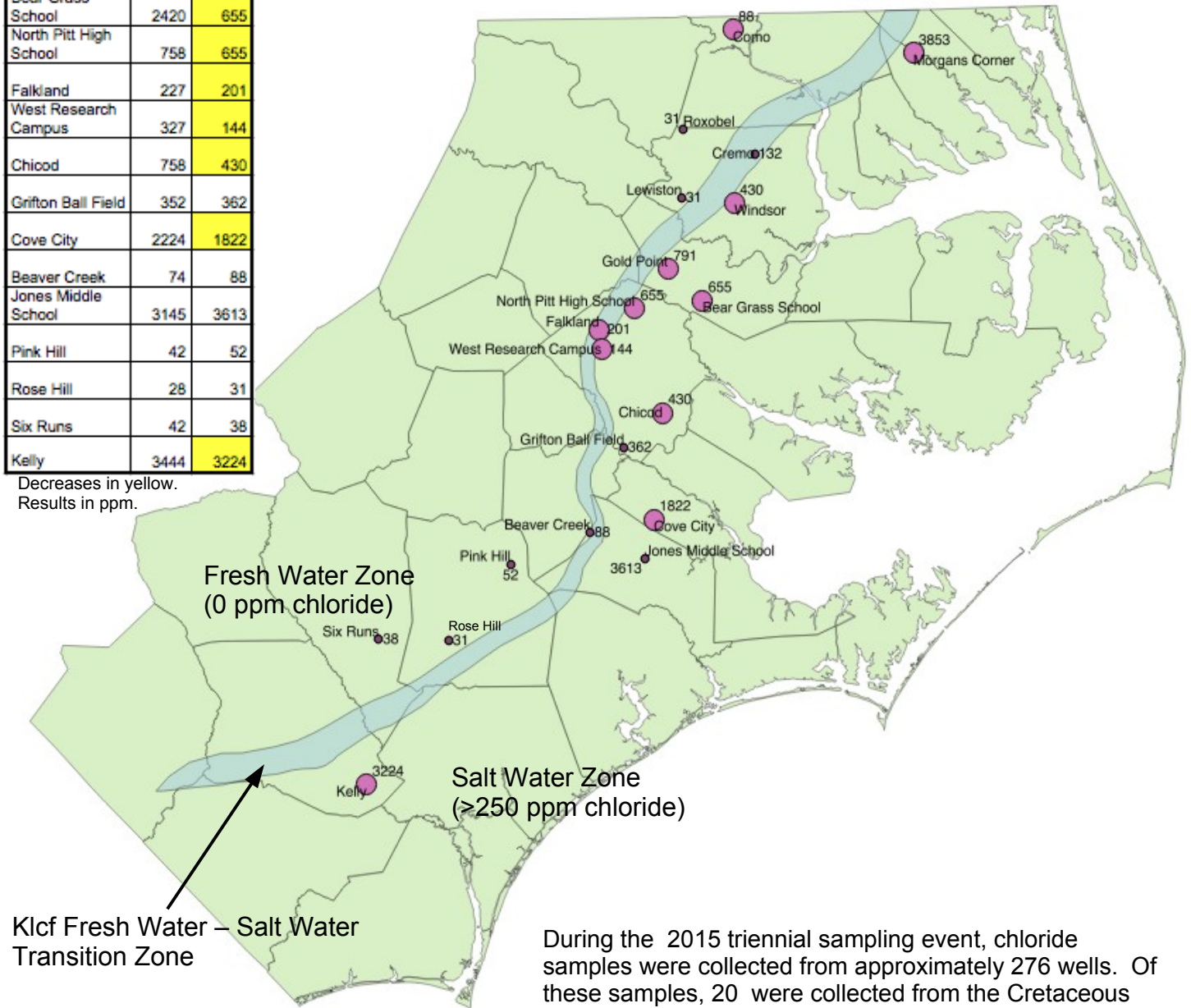
Water Level Data Collected from 1967-2017 (Plot includes both DWR and USGS Data)



| MONITORING STATION | CHLORIDES | |
|------------------------|-----------|------|
| | 2012 | 2015 |
| Como | 93 | 88 |
| Morgans Corner | 5095 | 3853 |
| Roxobel | 28 | 31 |
| Cremo | 126 | 132 |
| Lewiston | 35 | 31 |
| Windsor | 1220 | 430 |
| Gold Point | 892 | 791 |
| Bear Grass School | 2420 | 655 |
| North Pitt High School | 758 | 655 |
| Falkland | 227 | 201 |
| West Research Campus | 327 | 144 |
| Chicod | 758 | 430 |
| Griton Ball Field | 352 | 362 |
| Cove City | 2224 | 1822 |
| Beaver Creek | 74 | 88 |
| Jones Middle School | 3145 | 3613 |
| Pink Hill | 42 | 52 |
| Rose Hill | 28 | 31 |
| Six Runs | 42 | 38 |
| Kelly | 3444 | 3224 |

Decreases in yellow.
Results in ppm.

FIGURE 4 CHLORIDE DECREASES in the Cretaceous Lower Cape Fear Aquifer



During the 2015 triennial sampling event, chloride samples were collected from approximately 276 wells. Of these samples, 20 were collected from the Cretaceous Lower Cape Fear Aquifer (Klcf). Testing showed that between 2012 and 2015, Klcf chloride levels decreased in eleven of the twenty wells. The anomalous decreases may be in response to recent pumping reductions within North Carolina's Central Coastal Plain Capacity Use Area and at International Paper in Franklin, Virginia. This deviation from previous data trends is under investigation.

Figure 5 Site Map Orange Well Net Orange County June 2017

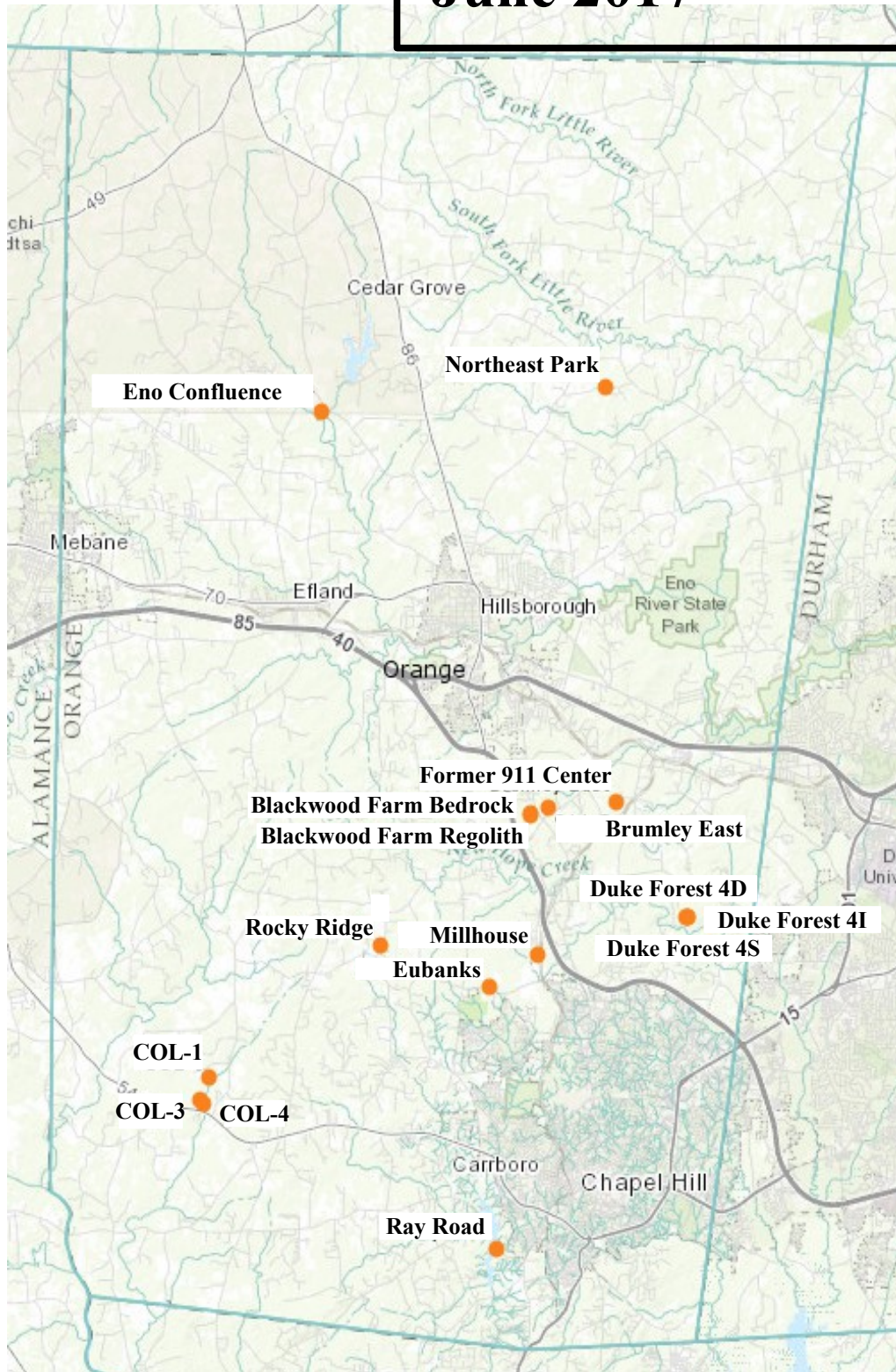
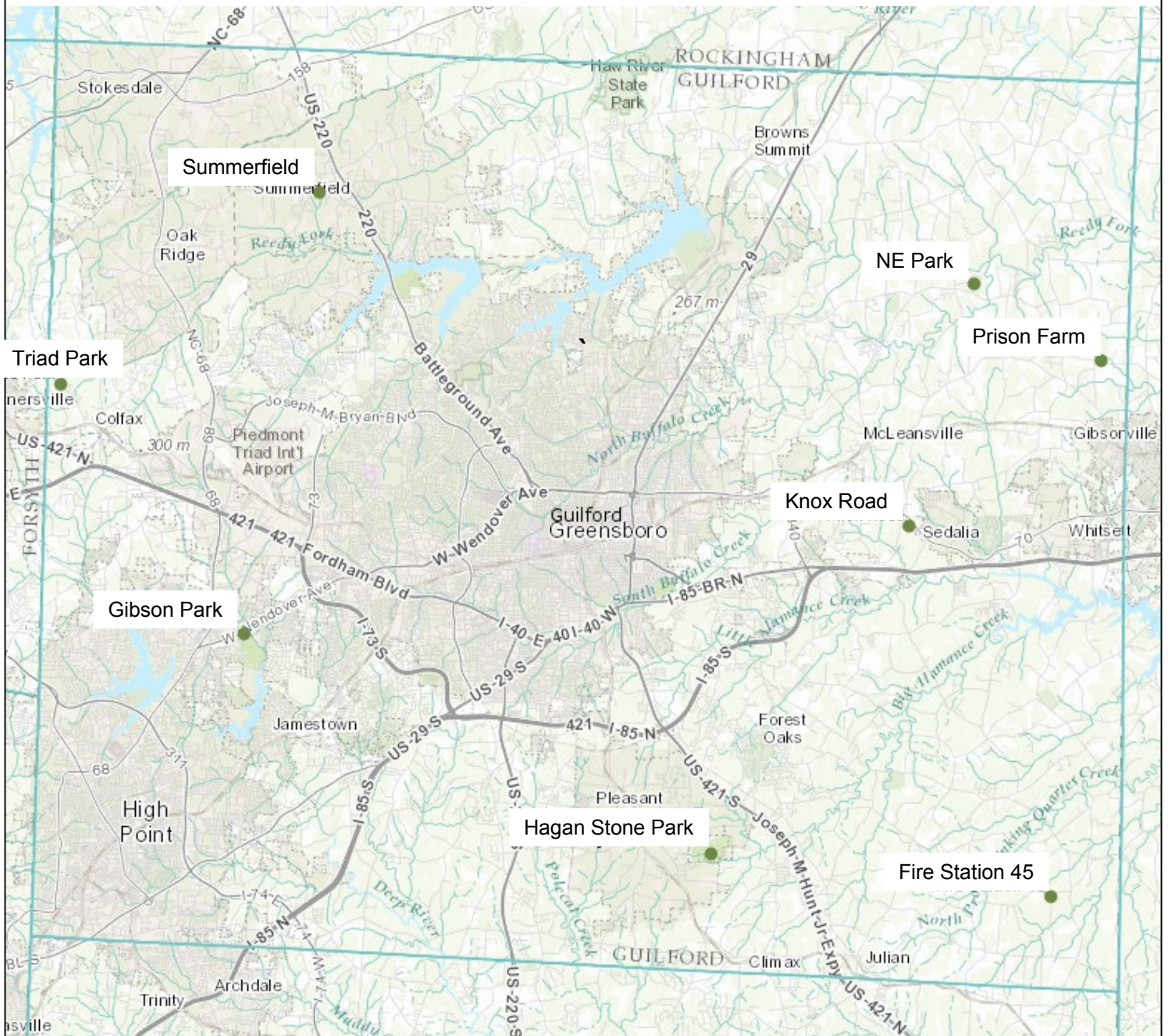


Figure 6 Site Map Monitoring Well Network Guilford County June 2017



TABLES

TABLE 1
Site Susceptibility Rating
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

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

TABLE 2
Site and Recorder Distribution by Region as of 6/30/17
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

| Region | Parameter | Number | % of Region | % of Network |
|---------------|------------------|---------------|--------------------|---------------------|
| | Wells | 139 | | 20.8 |
| | Sites | 49 | | 21.3 |
| 1 | Hobo | 124 | 89.2 | 18.6 |
| | Solinst | 4 | 2.9 | 0.6 |
| | All Recorders | 124 | 89.2 | 18.6 |
| | Wells | 142 | | 21.3 |
| | Sites | 31 | | 13.5 |
| 2 | Hobo | 128 | 90.1 | 19.2 |
| | Solinst | 0 | 0.0 | 0.0 |
| | All Recorders | 128 | 90.1 | 19.2 |
| | Wells | 74 | | 11.5 |
| | Sites | 22 | | 10.0 |
| 3 | Hobo | 57 | 74.0 | 8.5 |
| | Solinst | 0 | 0.0 | 0.0 |
| | All Recorders | 57 | 74.0 | 8.5 |
| | Wells | 149 | | 22.3 |
| | Sites | 42 | | 18.3 |
| 4 | Hobo | 85 | 57.0 | 12.7 |
| | Solinst | 2 | 1.3 | 0.3 |
| | All Recorders | 85 | 57.0 | 12.7 |
| | Wells | 110 | | 16.5 |
| | Sites | 67 | | 29.1 |
| 5 | Hobo | 91 | 82.7 | 13.6 |
| | Solinst | 10 | 9.1 | 1.5 |
| | All Recorders | 91 | 82.7 | 13.6 |
| | Wells | 51 | | 7.6 |
| | Sites | 18 | | 7.8 |
| 6 | Hobo | 40 | 78.4 | 6.0 |
| | Solinst | 0 | 0.0 | 0.0 |
| | All Recorders | 40 | 78.4 | 6.0 |

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 6/30/17
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

| Region | Station Name | Well Number | Date Installed |
|---------------|---------------------|--------------------|-----------------------|
| 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 |
| 4 | Topsail Beach | BB 28J5 | 06/12/2014 |
| 4 | Clarendon | DD 42N1 | 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 |
| 5 | Rowland | Z 47R5 | 04/24/2014 |

| TABLE 4 Monitoring Well Network Statistics (01-01-2005 through 06-30-2017) North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | | | | | | | | | |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Parameter | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| 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 | 2,563 | 2,911 | 2,628 | 2,955 | 3,269 | 2706 |
| 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 |

TABLE 4 (Continued)
Monitoring Well Network Statistics (01-01-2005 through 06-30-2017)
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

| Parameter | 2015 | 2016 | 2017 |
|---|-------------|-------------|-------------|
| Number of monitored wells | 651 | 652 | 654 |
| Manual water levels (tapedowns) | 3,143 | 2990 | 1691 |
| Daily water levels (automatic recorders) | 182,907 | 189,332 | 64,127 |
| Total hourly water levels | 4,389,822 | 4,542,068 | 1,549,249 |
| Chloride Samples | 271 | 19 | 7 |
| Geophysical & lithologic logs at new stations | 2 | 2 | 3 |

| TABLE 5 Chloride Field Analysis from 2015 Sampling Event Wells Q16G4, Y25Q4, J22P5 and R23X9 North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | |
|--|------------|----------------------|
| Station | Date | Chlorides (ppm) |
| | 09/09/2015 | 554 |
| | 09/21/2012 | 352 |
| Godley Station | 10/04/2010 | 531 |
| Q 16G4 | 10/01/2007 | 564 |
| | 09/15/2004 | 137 |
| | 10/07/1999 | 91 |
| | 07/14/1998 | 174 |
| | 02/23/1981 | No Reading Available |
| | 09/01/2015 | 272 |
| | 09/12/2012 | 227 |
| Folkstone Station | 07/09/2011 | 296 |
| Y 25Q4 | 09/25/2007 | 252 |
| | 09/14/2004 | 266 |
| | 10/12/1999 | 35 |
| | 08/06/1998 | 11 |
| | 09/25/1982 | No Reading Available |
| | 09/08/2015 | 186 |
| | 09/06/2012 | 172 |
| Gold Point Station | 10/04/2010 | 54 |
| J 22P5 | 09/24/2007 | 162 |
| | 09/30/2004 | BDL of 28 ** |
| | 09/15/2004 | BDL of 28 |
| | 06/10/2002 | 10 |
| | 08/24/2015 | 388 |
| | 09/11/2012 | 405 |
| Cove City Station | 09/20/2010 | 463 |
| R 23X9 | 10/05/2007 | 352 |
| | 09/13/2004 | 309 |
| | 10/04/2000 | 30 |
| Chloride Level for Salt Water | | 250 |

**Collected after well development

**TABLE 6
Well Construction Information for New Well Installation, Acquired, and Re-Activated Wells for the 2017 FY
North Carolina Division of Water Resources
Ground Water Management Branch
2017 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) |
|---|---------------------|-----------------------|-------------------------------|----------------------------|--|------------------------------|----------------|---|
| AA 32R1 | | 03/15/2017 | 4 | 31 | 16-26 | 2.79 | NDY | - |
| AA 32R2 | Long Creek (AA 32R) | 04/07/2017 | 4 | 560 | 465-475 | - | NDY | - |
| AA 32R3 | | 04/14/2017 | 4 | 235 | 220-230 | 2.75 | NDY | - |
| AA 32R4 | | 04/13/2017 | 4 | 405 | 390-400 | - | NDY | - |
| EE 30P1 | | 05/11/2017 | 4 | 312 | 250-270 | - | NDY | - |
| EE 30P2 | Presidio (EE 30P) | 05/08/2017 | 4 | 30 | 19-29 | - | NDY | - |
| EE 30P3 | | 05/12/2017 | 4 | 170 | 155-165 | - | NDY | - |
| EE 30M1 | | 05/15/2017 | 4 | 41 | 27-37 | - | NDY | - |
| EE 30M2 | Myrtle Grove | 05/19/2017 | 4 | 320 | 250-270 | - | NDY | - |
| EE 30M3 | | 05/23/2017 | 4 | 175 | 160-170 | - | NDY | - |
| Wells Construction Information for Wells Acquired in 2017 FY | | | | | | | | |
| EE 30M4 | Myrtle Grove | 05/15/2017 | 2.5 | 162 | - | - | NDY | - |
| F 25Q1 | Fillingim Property | 03/15/2017 | 36 | 29 | 0-29 (open hole) | 1.20 | Bs | 24.33 (04/17/2017) |
| Wells Construction Information for Wells that Moved to Active in 2017 FY | | | | | | | | |
| M 27U7 | | 06/12/2017 | 6 | 60 | 50-60 | 0.45 | Ty | 9.44 (06/12/2017) |
| M 27U8 | Farmville | 06/12/2017 | 6 | 100 | 90-100 | 0.83 | Kbc | 18.15 (06/12/2017) |
| M 27U11 | | 06/13/2017 | 1.25 | 18 | 15-18 | 0.38 | S | 8.6 (06/13/2017) |

NDY – Not Determined Yet

| TABLE 7 Well Development Information for 2017 FY North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | |
|--|--------------------------|-------------------------|
| Well ID | Station Name | Date Developed |
| W 26D5 | Chinquapin | 07/12/2016 - 07/13/2016 |
| R 31C1 | Sleepy Creek | 09/27/2016 - 09/28/2016 |
| R 31C3 | Sleepy Creek | 09/27/2016 - 09/28/2016 |
| Z 41U1 | Bladenboro | 10/04/2016 - 10/05/2016 |
| Z 42U2 | Bladenboro | 10/04/2016 - 10/05/2016 |
| Z 41U3 | Bladenboro | 10/04/2016 - 10/05/2016 |
| Z 41U4 | Bladenboro | 10/05/2016 |
| CC 30E1 | Northern Regional Park | 10/25/2016 - 10/27/2016 |
| CC 30E2 | Northern Regional Park | 10/25/2016 - 10/27/2016 |
| CC 30E3 | Northern Regional Park | 10/25/2016 - 10/27/2016 |
| N 95G1 | Smokemont Campground G1 | 03/21/2017 |
| O 97L1 | Deep Creek | 03/22/2017 |
| N 95G2 | Smokemont Ranger Station | 03/23/2017 |
| M 93 R1 | Woody Creek | 04/26/2017 |

| TABLE 8 Automatic Water Level Recorders as of 6/30/2017 North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | |
|---|-------------------------------|
| Recorder Type | Number in Service* |
| HOBO U20 Water Level Logger (including separate barometer per station installed) | 713 (includes 198 barometers) |
| Solinst Telemetry System (STS) | 16 |

***As of June 30, 2017**

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 9
Orange Well Net Monitoring Well Information)
Orange County, NC
North Carolina Division of Water Resources
Ground Water Management Branch
2017 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 10
Orange Well Net Network Statistics (2008 through 06-30-2017)
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

| Parameter | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 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 11 Guilford County Monitoring Well Information North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | | | | | | | |
|--|------------------------------|----------------|------------------------|-----------------|-------------------|-------------------|---------|-----------------|
| Quad | Station Name | Date Installed | Well Diameter (inches) | Well Depth (ft) | Casing Depth (ft) | Land Surface (ft) | Aquifer | City |
| 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 |

| TABLE 12 Guilford County Monitoring Well Network Statistics (2005 through 06-30-2017) North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | | | | | | | | | |
|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Parameter | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| 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 13
2018 FY Network Expansion
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

| Proposed Station | County | Proposed Well Screens (ft bls) | Aquifer |
|---|---------------|---------------------------------------|--|
| | | 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 | | 20-30 | Surficial |
| Existing Turkey Station | Sampson | 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) |

| Table 14 Summary of Field Parameters (Measured using a Hydrolab Quanta-series meters) North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | | | | | | |
|---|----------------------------|---------|----------|--|-------------------------|------------------------------------|------|
| Well | Station Name | County | Date | Temp °C | Conductivity (mS/cm) | Dissolved Oxygen (ppmv or mg/L) | pH |
| S 35Q5 | Halls | Sampson | 7/7/16 | 18.83 | 0.094 | 0.09 | 5.30 |
| R 29T5 | Moss Hill | Lenoir | 8/2/16 | 19.76 | 0.293 | 0.18 | 6.94 |
| R 29T8 | Moss Hill | Lenoir | 8/2/16 | 19.03 | 0.251 | 0.08 | 7.46 |
| Q 27R4 | Kinston Yard | Lenoir | 9/7/16 | 19.75 | 0.247 | 0.13 | 8.02 |
| Q 27R7 | Kinston Yard | Lenoir | 9/7/16 | 19.95 | 0.250 | 0.00 | 7.94 |
| Q 27R10 | Kinston Yard | Lenoir | 9/7/16 | 19.33 | 0.196 | 0.04 | 7.93 |
| T 29G5 | Pink Hill | Duplin | 9/13/16 | 19.24 | 0.219 | 0.04 | 7.75 |
| LW MW-3I | Lake Wheeler | Wake | 10/13/16 | 18.72 | 0.098 | 6.42 | 5.33 |
| LW MW2-S | Lake Wheeler | Wake | 10/19/16 | 20.70 | 0.172 | 7.37 | 4.63 |
| LW MW3-S | Lake Wheeler | Wake | 10/19/16 | 18.96 | 0.134 | 7.23 | 4.31 |
| R 48G1 | Southern Pines Water Plant | Moore | 11/2/16 | 20.03 | 0.104 | 0.07 | 6.14 |
| R 48G2 | Southern Pines Water Plant | Moore | 11/2/16 | 20.64 | 0.028 | 0.30 | 6.05 |
| DF-1I | Duke Forest | Orange | 12/1/16 | 15.67 | 0.124 | 6.69 | 5.76 |
| DF-2I | Duke Forest | Orange | 12/1/16 | 15.11 | 0.098 | 5.55 | 5.51 |
| T 29G3 | Pink Hill | Duplin | 3/2/17 | 17.95 | 0.191 | 0.06 | 7.69 |
| T 29G7 | Pink Hill | Duplin | 3/2/17 | Attempted but could not collect a sample | | | |
| T 29G11 | Pink Hill | Duplin | 3/2/17 | 16.84 | 0.090 | 0.18 | 4.91 |
| R 31C1 | Sleepy Creek | Wayne | 3/6/17 | 17.78 | 0.060 | 0.07 | 5.96 |
| R 31C3 | Sleepy Creek | Wayne | 3/6/17 | 18.43 | 0.054 | 0.03 | 5.44 |
| R 29T4 | Moss Hill | Lenoir | 3/8/17 | 20.15 | 0.169 | 0.04 | 6.78 |
| R 29T6 | Moss Hill | Lenoir | 3/8/17 | 19.11 | 0.105 | 0.06 | 6.04 |

| Table 14 (continued) Summary of Field Parameters (Measured using a Hydrolab Quanta-series meters) North Carolina Division of Water Resources Ground Water Management Branch 2017 Annual Report | | | | | | | |
|---|--------------------------------|----------|--|------------|-------------------------|------------------------------------|------|
| 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 | 3/30/17 | 18.40 | 0.112 | 1.27 | 6.01 |
| O 28K6 | Snow Hill | Greene | 3/30/17 | 16.98 | 0.305 | 0.13 | 6.25 |
| O 28K3 | Snow Hill | Greene | 4/4/17 | 19.48 | 0.627 | 0.05 | 8.43 |
| O 28K5 | Snow Hill | Greene | 4/4/17 | 19.48 | 0.099 | 0.12 | 6.21 |
| Mill St. Creek* | Snow Hill | Greene | 4/4/17 | 21.56 | 0.097 | 7.20 | 5.51 |
| Contentnea Creek* | Snow Hill | Greene | 4/4/17 | 19.84 | 0.073 | 5.09 | 5.19 |
| O 27J8 | Eastern Correctional Institute | Greene | 4/11/17 | 15.96 | 0.066 | 8.3 | 5.33 |
| O 27J10 | Eastern Correctional Institute | Greene | 4/11/17 | 17.12 | 0.250 | 0.27 | 6.91 |
| O 27J11 | Eastern Correctional Institute | Greene | 4/11/17 | 19.48 | 0.429 | 0.03 | 7.98 |
| O 27J8 | Eastern Correctional Institute | Greene | 4/18/17 | 17.88 | 0.066 | 7.03 | 5.10 |
| O 27J9 | Eastern Correctional Institute | Greene | 4/18/17 | 17.90 | 0.403 | 0.12 | 7.40 |
| O 27J10 | Eastern Correctional Institute | Greene | 4/18/17 | 17.59 | 0.253 | 0.06 | 6.48 |
| AA 39V1 | Carver Moore | Columbus | 4/27/17 | 19.01 | 0.348 | 0.11 | 7.52 |
| AA 39V4 | Carver Moore | Columbus | 4/27/17 | 19.80 | 0.241 | 0.03 | 7.61 |
| AA 35N1 | Kelly | Bladen | 5/2/17 | 20.53 | 0.036 | 2.81 | 6.00 |
| AA 35N2 | Kelly | Bladen | 5/2/17 | 20.39 | 10.67 | 0.04 | 7.86 |
| AA 35N3 | Kelly | Bladen | 5/2/17 | 19.89 | 0.463 | 0.06 | 7.41 |
| AA 35N4 | Kelly | Bladen | 5/2/17 | 19.67 | 0.032 | 2.47 | 5.08 |
| AA 35N5 | Kelly | Bladen | 5/2/17 | 20.62 | 0.568 | 0.07 | 8.29 |
| AA 35N6 | Kelly | Bladen | 5/2/17 | 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 14 (continued)
Summary of Field Parameters (Measured using a Hydrolab Quanta-series meters)
North Carolina Division of Water Resources
Ground Water Management Branch
2017 Annual Report

| Well | Station Name | County | Date | Temp °C | Conductivity (mS/cm) | Dissolved Oxygen (ppmv or mg/L) | pH |
|-------------|------------------------|---------------|-------------|--------------------|---------------------------------|--|-----------|
| AA 35N1 | Kelly | Bladen | 5/11/17 | 20.74 | 0.037 | 2.80 | 5.23 |
| AA 35N5 | Kelly | Bladen | 5/11/17 | 21.08 | 0.563 | 0.10 | 8.20 |
| AA 35N6 | Kelly | Bladen | 5/11/17 | 19.62 | 1.47 | 0.04 | 8.59 |
| Z 41U1 | Bladenboro | Bladen | 5/16/17 | 18.18 | 0.378 | 0.06 | 6.79 |
| Z 41U4 | Bladenboro | Bladen | 5/16/17 | 18.78 | 0.413 | 0.16 | 7.28 |
| M 25F1 | West Research Campus | Pitt | 6/1/17 | 17.36 | 0.019 | 1.97 | 3.78 |
| M 25F2 | West Research Campus | Pitt | 6/1/17 | 17.52 | 0.258 | 0.04 | 6.22 |
| M 25F3 | West Research Campus | Pitt | 6/1/17 | 19.25 | 0.326 | 0.00 | 6.68 |
| M 27U14 | Farmville Marlboro Rd. | Pitt | 6/6/17 | 20.22 | 0.273 | 0.10 | 6.77 |
| M 27U15 | Farmville Marlboro Rd. | Pitt | 6/6/17 | 18.77 | 0.515 | 0.16 | 7.52 |
| M 27U17 | Farmville Marlboro Rd. | Pitt | 6/6/17 | 18.26 | 0.086 | 0.08 | 4.39 |
| M 27U7 | Farmville | Pitt | 6/22/17 | 19.33 | 0.177 | 0.30 | 5.85 |
| M 27U15 | Farmville Marlboro Rd. | Pitt | 6/27/17 | 20.86 | 0.515 | 0.24 | 6.82 |
| M 27U16 | Farmville Marlboro Rd. | Pitt | 6/27/17 | 19.35 | 0.207 | 0.11 | 6.29 |

APPENDICES

APPENDIX A

WELL CONSTRUCTION RECORDS

**LONG CREEK MONITORING STATION
AA 32R1, AA 32R2, AA 32R3, AA32R4**

WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 4-7-17 Well ID# AA 32R2 - Pilot

5a. Well Location:

NC-DENR

Long Creek Station

Facility/Owner Name

Facility ID# (if applicable)

23588 NC210 Currie, NC 28435

Physical Address, City, and Zip

Pender

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 560 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 7.5 (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 WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 10 Method of test: pump

13b. Disinfection type: HTH Amount: 2 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------|
| 455 ft. | 480 ft. | sands |
| ft. | ft. | |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|-------|--------|----------|-----------|----------|
| 0 ft. | 65 ft. | 10 in. | sch40 | PVC |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|----------|
| +3 ft. | 465 ft. | 4.5 in. | SDR17 | PVC |
| 475 ft. | 480 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 465 ft. | 475 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 445 ft. | grout | pumped |
| 445 ft. | 455 ft. | bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 455 ft. | 560 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:

 4-7-17
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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 4-14-17 Well ID# AA 32R3

5a. Well Location:

NC-DENR

Long Creek Station

Facility/Owner Name

Facility ID# (if applicable)

23588 NC210 Currie, NC 28435

Physical Address, City, and Zip

Pender

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 235 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 6.5 (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 WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 30+ Method of test: pump

13b. Disinfection type: HTH Amount: 2 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------|
| 210 ft. | 235 ft. | sands |
| 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. | 220 ft. | 4.5 in. | SDR17 | PVC |
| 230 ft. | 235 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 220 ft. | 230 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 200 ft. | grout | pumped |
| 200 ft. | 210 ft. | Bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 210 ft. | 235 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:

Signature of Certified Well Contractor _____ Date 4-14-17

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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 3-15-17 Well ID# AA 32R1

5a. Well Location:

NC-DENR

Long Creek Station

Facility/Owner Name

Facility ID# (if applicable)

23588 NC210 Currie, NC 28435

Physical Address, City, and Zip

Pender

County

Parcel Identification No. (PIN)

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

N 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: 31 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 9 (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 WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 10 Method of test: pump

13b. Disinfection type: HTH Amount: 1 cup

For Internal Use ONLY:

14. WATER ZONES

Table with columns: FROM, TO, DESCRIPTION. Row 1: 11 ft. to 31 ft. sands

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

Table with columns: FROM, TO, DIAMETER, THICKNESS, MATERIAL. Row 1: ft. to ft. in. to

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

Table with columns: FROM, TO, DIAMETER, THICKNESS, MATERIAL. Rows: +3 ft. to 16 ft. 4.5 in. SDR17 PVC; 26 ft. to 31 ft. 4 in. sch80 PVC

17. SCREEN

Table with columns: FROM, TO, DIAMETER, SLOT SIZE, THICKNESS, MATERIAL. Row 1: 16 ft. to 26 ft. 4 in. .020 SS

18. GROUT

Table with columns: FROM, TO, MATERIAL, EMPLACEMENT METHOD & AMOUNT. Row 1: 0 ft. to 11 ft. bentonite poured

19. SAND/GRAVEL PACK (if applicable)

Table with columns: FROM, TO, MATERIAL, EMPLACEMENT METHOD. Row 1: 11 ft. to 31 ft. #3 gravel poured

20. DRILLING LOG (attach additional sheets if necessary)

Table with columns: FROM, TO, DESCRIPTION (color, hardness, soil/rock type, grain size, etc.). Row 1: ft. to ft. See Attached

21. REMARKS

22. Certification:

Signature of Certified Well Contractor: [Signature] Date: 3-15-17

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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 4-13-17 Well ID# AA 32R4

5a. Well Location:

NC-DENR

Long Creek Station

Facility/Owner Name

Facility ID# (if applicable)

23588 NC210 Currie, NC 28435

Physical Address, City, and Zip

Pender

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 405 (ft.)

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

10. Static water level below top of casing: .7 (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 WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 10 Method of test: pump

13b. Disinfection type: HTH Amount: 2 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------|
| 380 ft. | 405 ft. | sands |
| ft. | ft. | |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|-------|--------|----------|-----------|----------|
| 0 ft. | 40 ft. | 10 in. | sch40 | PVC |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|----------|
| +3 ft. | 390 ft. | 4.5 in. | SDR17 | PVC |
| 400 ft. | 405 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 390 ft. | 400 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 370 ft. | grout | pumped |
| 370 ft. | 380 ft. | bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 380 ft. | 405 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:


4-13-17
 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.

**PRESIDIO MONITORING STATION
EE 30P1, EE 30P2, EE 30P3**

WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 5-11-17

Well ID# EE 30P2

5a. Well Location:

NC-DENR

Presidio

Facility/Owner Name

Facility ID# (if applicable)

105 Presidio Dr, Wilmington, NC 28412

Physical Address, City, and Zip

New Hanover

County

Parcel Identification No. (PIN)

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

N _____ 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: 275 (ft.)

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

10. Static water level below top of casing: 16.5 (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

12. Well construction method: Mud Rotary

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

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 1 Method of test: bail

13b. Disinfection type: HTH Amount: 1 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------|
| 250 ft. | 270 ft. | Sand & Clay |
| ft. | ft. | |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|-------|--------|----------|-----------|----------|
| 0 ft. | 60 ft. | 10 in. | sch40 | PVC |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|----------|
| +3 ft. | 250 ft. | 4.5 in. | SDR17 | PVC |
| 270 ft. | 275 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 250 ft. | 270 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 230 ft. | bentonite | pumped |
| 230 ft. | 240 ft. | bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 240 ft. | 275 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:

Signature of Certified Well Contractor  Date 5-11-17

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 INSTUCTIONS

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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 5-8-17 Well ID# EE 30P4

5a. Well Location: EE 30P2

NC-DENR Presidio

Facility/Owner Name Facility ID# (if applicable)

105 Presidio Dr, Wilmington, NC 28412

Physical Address, City, and Zip

New Hanover

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 30 (ft.)
For multiple wells list all depths if different (example - 3@200' and 2@100')

10. Static water level below top of casing: 3.8 (ft.)
If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

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

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 10 Method of test: pump

13b. Disinfection type: HTH Amount: 1 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|--------|--------|-------------|
| 19 ft. | 29 ft. | Sands |
| 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. | 19 ft. | 4.5 in. | SDR17 | PVC |
| 29 ft. | 30 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|--------|--------|----------|-----------|-----------|----------|
| 19 ft. | 29 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|-------|--------|-----------|-----------------------------|
| 0 ft. | 19 ft. | bentonite | poured |
| ft. | ft. | | |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|--------|--------|-----------|--------------------|
| 19 ft. | 30 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:

Signature of Certified Well Contractor:  Date: 5-8-17

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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 5-12-17 Well ID# EE 30P3

5a. Well Location:

NC-DENR Presidio
 Facility/Owner Name Facility ID# (if applicable)
105 Presidio Dr, Wilmington, NC 28412
 Physical Address, City, and Zip
New Hanover
 County Parcel Identification No. (PIN)

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

_____ N _____ 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: 170 (ft.)
 For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 22 (ft.)
 If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

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

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 20+ Method of test: pump

13b. Disinfection type: HTH Amount: 1 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------------|
| 155 ft. | 165 ft. | Limestone & sands |
| ft. | ft. | |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|-------|--------|----------|-----------|----------|
| 0 ft. | 55 ft. | 10 in. | sch40 | PVC |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|----------|
| +3 ft. | 155 ft. | 4.5 in. | SDR17 | PVC |
| 165 ft. | 170 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 155 ft. | 165 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 135 ft. | bentonite | pumped |
| 135 ft. | 145 ft. | bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 145 ft. | 170 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:


 Signature of Certified Well Contractor Date
5-12-17

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 INSTUCTIONS

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.

BILL'S WELL DRILLING CO.
 800 McArthur Road
 Fayetteville, North Carolina 28311
 Office (910) 488-3740 Fax (910) 488-3687
 billswater@nc.rr.com
 www.billswelldrilling.com



Date: Spring 2017

| Presidio - Lithology New Brunswick Co | | |
|--|-----|---|
| From | To | Formation Description |
| 0 | 25 | Brown Medium Sand |
| 25 | 26 | Brown Clay |
| 26 | 31 | Gray Medium Sand |
| 31 | 40 | Medium & Coarse Gray Sand |
| 40 | 50 | Sand & Sandstone |
| 50 | 60 | Gray & Green Clay |
| 60 | 62 | Green Clay |
| 62 | 64 | Sand |
| 64 | 66 | Gray & Green Clay |
| 66 | 67 | Sandstone |
| 67 | 70 | Limestone |
| 70 | 80 | Limestone & White Clay |
| 80 | 90 | Fossil Sandstone |
| 90 | 100 | Sand & Mudstone |
| 100 | 110 | Mudstone |
| 110 | 120 | Mudstone w/Fine Sand |
| 120 | 135 | Mudstone |
| 135 | 139 | Gray Clay |
| 139 | 140 | Limestone, Mudstone, Clay |
| 140 | 150 | Limestone, Mudstone, Clay |
| 150 | 160 | Hard Gray Limestone, Sandstone |
| 160 | 170 | Gray Sandstone, Shells |
| 170 | 180 | Sandstone, Shells, Fine Sand |
| 180 | 200 | Limestone & Fine Sand |
| 200 | 210 | Clay w/Dark Gray & Green Limestone |
| 210 | 220 | Clay, Shell, Limestone |
| 220 | 230 | Clay |
| 230 | 240 | Clay & Limestone |
| 240 | 250 | Clay & Limestone |
| 250 | 260 | Dark Gray & Light Gray Clay & Limestone |
| 260 | 280 | Dark Gray Clay |
| 280 | 300 | Dark Gray Clay |
| 300 | 310 | Clay |
| 310 | 320 | Limestone |

Jonathan Kamionka
3465-A

**MYRTLE GROVE MONITORING STATION
EE 30M1, EE 30M2, EE 30M3**

WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 5-15-17 Well ID# EE 30M1

5a. Well Location:

NC-DENR

Myrtle Grove

Facility/Owner Name

Facility ID# (if applicable)

250 Shannon Dr, Wilmington, NC 28409

Physical Address, City, and Zip

New Hanover

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 41 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 8 (ft.)
If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

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

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 10 Method of test: pump

13b. Disinfection type: HTH Amount: 1 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|--------|--------|-------------|
| 27 ft. | 37 ft. | Sands |
| 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 |
|--------|--------|----------|-----------|----------|
| +4 ft. | 27 ft. | 4.5 in. | SDR17 | PVC |
| 37 ft. | 41 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|--------|--------|----------|-----------|-----------|----------|
| 27 ft. | 37 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|-------|--------|-----------|-----------------------------|
| 0 ft. | 20 ft. | bentonite | poured |
| ft. | ft. | | |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|--------|--------|-----------|--------------------|
| 20 ft. | 41 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:

Signature of Certified Well Contractor [Signature] Date 5-15-17

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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: 5-19-17 Well ID# EE 30M2

5a. Well Location:

NC-DENR

Myrtle Grove

Facility/Owner Name

Facility ID# (if applicable)

250 Shannon Dr, Wilmington, NC 28409

Physical Address, City, and Zip

New Hanover

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 275 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

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

11. Borehole diameter: 10 (in.)

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

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 1 Method of test: bail

13b. Disinfection type: HTH Amount: 2 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------|
| 250 ft. | 270 ft. | Sand & Clay |
| ft. | ft. | |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|-------|--------|----------|-----------|----------|
| 0 ft. | 75 ft. | 10 in. | sch40 | PVC |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|----------|
| +4 ft. | 250 ft. | 4.5 in. | SDR17 | PVC |
| 270 ft. | 275 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 250 ft. | 270 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 230 ft. | bentonite | pumped |
| 230 ft. | 240 ft. | bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 240 ft. | 275 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:



Signature of Certified Well Contractor

5-19-17

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

This form can be used for single or multiple wells

1. Well Contractor Information:

Jonathan Kamionka

Well Contractor Name

3465-A

NC Well Contractor Certification Number

Bill's Well Drilling Co.

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: | |
| <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 | |
| Non-Water Supply Well: | |
| <input checked="" type="checkbox"/> Monitoring | <input type="checkbox"/> Recovery |
| Injection Well: | |
| <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: 5-23-17 Well ID# EE 30M3

5a. Well Location:

NC-DENR

Myrtle Grove

Facility/Owner Name

Facility ID# (if applicable)

250 Shannon Dr, Wilmington, NC 28409

Physical Address, City, and Zip

New Hanover

County

Parcel Identification No. (PIN)

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

_____ N _____ 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: 175 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

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

11. Borehole diameter: 10 (in.)

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

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) 20+ Method of test: blow

13b. Disinfection type: HTH Amount: 1 cup

For Internal Use ONLY:

14. WATER ZONES

| FROM | TO | DESCRIPTION |
|---------|---------|-------------|
| 160 ft. | 170 ft. | Sands |
| ft. | ft. | |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|-------|--------|----------|-----------|----------|
| 0 ft. | 75 ft. | 10 in. | sch40 | PVC |

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

| FROM | TO | DIAMETER | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|----------|
| +3 ft. | 160 ft. | 4.5 in. | SDR17 | PVC |
| 170 ft. | 175 ft. | 4 in. | sch80 | PVC |

17. SCREEN

| FROM | TO | DIAMETER | SLOT SIZE | THICKNESS | MATERIAL |
|---------|---------|----------|-----------|-----------|----------|
| 160 ft. | 170 ft. | 4 in. | .020 | | SS |
| ft. | ft. | in. | | | |

18. GROUT

| FROM | TO | MATERIAL | EMPLACEMENT METHOD & AMOUNT |
|---------|---------|-----------|-----------------------------|
| 0 ft. | 150 ft. | bentonite | pumped |
| 150 ft. | 155 ft. | bentonite | poured |
| ft. | ft. | | |

19. SAND/GRAVEL PACK (if applicable)

| FROM | TO | MATERIAL | EMPLACEMENT METHOD |
|---------|---------|-----------|--------------------|
| 155 ft. | 175 ft. | #3 gravel | poured |
| ft. | ft. | | |

20. DRILLING LOG (attach additional sheets if necessary)

| FROM | TO | DESCRIPTION (color, hardness, soil/rock type, grain size, etc.) |
|------|-----|---|
| ft. | ft. | See Attached |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |
| ft. | ft. | |

21. REMARKS

22. Certification:

Signature of Certified Well Contractor _____ Date 5-23-17

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.

BILL'S WELL DRILLING CO.
 800 McArthur Road
 Fayetteville, North Carolina 28311
 Office (910) 488-3740 Fax (910) 488-3687
 billswater@nc.rr.com
 www.billswelldrilling.com



Date: Spring 2017

| Myrtle Grove - Lithology New Brunswick Co | | |
|--|-----|---|
| From | To | Formation Description |
| 0 | 1 | Topsoil |
| 1 | 28 | Gray Sand w/Wood |
| 28 | 30 | Wood, Clay, Shells |
| 30 | 31 | Sand |
| 31 | 37 | Wood |
| 37 | 47 | Gray & Brown Mud, Sand |
| 47 | 58 | Gray Sand, Mud, Wood, Gravel |
| 58 | 72 | Mud, Sand |
| 72 | 90 | Gray Limestone, Gravel |
| 90 | 95 | Gray Limestone, Gravel |
| 95 | 102 | Sand |
| 102 | 110 | Gray Clay |
| 110 | 120 | Gray Clay |
| 120 | 135 | Light Gray, Black & Green & White Limestone |
| 135 | 140 | White Clay |
| 140 | 145 | White Limestone |
| 145 | 152 | White, Black & Green Limestone |
| 152 | 155 | Dark Gray Clay |
| 155 | 160 | Light Gray Limestone |
| 160 | 170 | Light Gray Limestone w/Sand Streaks |
| 170 | 180 | Dark Gray Limestone |
| 180 | 190 | Dark Gray Limestone |
| 190 | 200 | Dark Gray Clay w/Limestone and Sand |
| 200 | 220 | Dark Gray Clay w/Limestone and Sand |
| 220 | 230 | Gray Clay w/Fine Sand |
| 230 | 240 | Gray Clay |
| 240 | 250 | Gray Clay w/Sand |
| 250 | 260 | Gray Clay w/Fine S&P Sand |
| 260 | 270 | Gray Clay, Limestone, Fine S&P Sand |
| 270 | 280 | Gray Clay, Limestone, Fine Sand |
| 280 | 290 | Gray Clay, Limestone |
| 290 | 300 | Dark Gray Clay |
| 300 | 310 | Light & Dark Gray Clay |

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 comprise 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.

| Table of Sampling Parameters | |
|--|---|
| Parameter Group | Parameters |
| 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