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

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Z 47R, Rowland Station, Robeson County

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## 1.0 Introduction

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

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

Data collected from the network are available to the public through DWR's internet website, <u>www.ncwater.org</u>. 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.

#### 4.0 DWR Statewide Monitoring Well Network Overview

## 4.1 <u>Description</u>

The monitoring well network currently consists of 665 wells at 229 monitoring stations (sites), divided into six regions, comprising 66 counties (<u>Figure 1</u>). 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.



Bear Grass Station, K 21R, Martin 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 <u>Monitoring</u>

The statewide monitoring network is divided into six regions (<u>Figure 1</u>). 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. <u>Table 2</u> 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). <u>Table 3</u> 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 <u>Chloride Sampling</u>

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. <u>Table 4</u> 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. <u>Figure 3</u> 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 <u>Chloride Sampling</u>

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.





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 (<u>Figure 4</u>). 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.

<u>Table 5</u> summarizes the chloride field analysis to date for specific wells. Wells will be sampled for chlorides in September-October 2017.

## 5.3 <u>Well Installation and Development</u>

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 <u>Appendix A</u>.



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 <u>Table 7</u>.



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

## 5.4 <u>Well Maintenance</u>

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. <u>Table 6</u> includes the detailed information of the acquired monitoring wells. These wells are included in <u>Figure 1</u>.

5.6 <u>Automatic Water Level Recorders</u>

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 <u>Table 2</u>. <u>Table 8</u> lists the recorders present on network wells on as of June 30, 2017. STS system photographs are included in Section 4.2.

## 5.7 <u>Site Surveys</u>

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. <u>Table 9</u> summarizes the OWN well information. <u>Figure 5</u> 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. <u>Table 10</u> 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 <u>Guilford County Monitoring Well Network</u>

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. <u>Table 11</u> 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.

<u>Table 12</u> summarizes the Guilford County monitoring well statistics from 2008 through June 30, 2017. <u>Figure 6</u> 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 <u>New Well Installation</u>

Monitoring well network expansion efforts for the 2018 FY will be focused on Pender and Sampson counties. <u>Table 13</u> summarizes the potential upcoming expansion of the network in 2018 FY.

## 7.2 <u>Well Abandonment</u>

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 (Fl), lead, (Pb) iron (Fe), magnesium (Mg), mercury (Hg), nitrates (NO<sub>3</sub>), selenium (Se), silver (Ag), sodium (Na), zinc (Zn), pH, and bacterial indicators;
- Ammonium (NH<sup>4</sup>), Total Kjeldahl Nitrogen (TKN), organic Nitrogen, and Phosphate (PO<sup>4</sup>);
- Volatile Organic Compounds (VOCs), and Pesticides (also consult with area agricultural experts on local practices);
- Major ions (Na, calcium (Ca), potassium (K), manganese (Mn), sulfate (SO<sup>4</sup>), (carbon trioxide (CO<sup>3</sup>), bicarbonate (HCO<sup>3</sup>) 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 (<sup>0</sup>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 <u>Appendix B</u>. Field data information for the 2017 FY are included in <u>Table 14</u>. 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 <u>Central Coastal Plain Capacity Use Area</u> (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, <u>www.ncwater.org/CCPCUA</u>.

## **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, <u>www.ncwater.org</u>. 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



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# Figure 2: Drought Indicator Wells



700 200,000 No. of Wells 180,000 → No. Daily Water levels (includes 600 both DWR and USGS wells) Number of Daily Water Levels Collected 160,000 Number of Network Wells Measured 500 140,000 120,000 400 100,000 300 80,000 60,000 200 40,000 100 20,000 0 0 0.0

**FIGURE 3** Water Level Data Collected from 1967-2017 (Plot includes both DWR and USGS Data)



NCDENR Division of Water Resources NC Ground Water Resources Monitoring Well Network 2014 Annual Report



NC DWR Ground Water Monitoring Report, 2017





# TABLES

TABLE 1         Site Susceptibility Rating         North Carolina Division of Water Resources         Ground Water Management Branch         2017 Annual Report         Susceptibility Rating					
1	Secure—station is located on State or Federal government property				
2	Secure—station is located on local government or school property				
3	<b>Moderately secure</b> —station is located on private property, but landowner does not give any indication that land use or property ownership may change				
4	<b>Tenuous</b> —station is located on public or private property and landowner is giving indications that land use or property ownership may change				
5	<b>Imminent threat</b> —station is on public or private property and landowner desires abandonment of well station.				

TABLE 2 Site and Recorder Distribution by Region as of 6/30/17 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 3Solinst Telemetry System (STS) Distribution by Region as of 6/30/17North Carolina Division of Water ResourcesGround Water Management Branch2017 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 <b>R</b> 23X9						
North (	Carolina Division of Wa	ter 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 W	ater	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									
			201	7 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 Constr	ruction Infor	mation fo	r Wells Acquired i	n 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	Ту	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 netw	vork 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 netw	vork 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	er 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	,783 3,095 3,281 3,468 4,286 5,096 2,01										
Total hourly water levels	orders         -         -         38,802         66,689         74,065         78,636         83,090         102,643         121,985         48,124														

		Guilford ( North Ca Grou	TAB County Moni arolina Divis and Water M 2017 Ann	BLE 11 itoring Wel ion of Wate lanagemen uual Report	l Informati er Resource t Branch	on S									
Quad	d Station Name Date Installed Well Well Depth Depth (ft) (ft) (ft) (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	tal hourly 38,802 66,689 74,065 78,636 83,090 102,643 121,985 48,12													

TABLE 13 2018 EV Network Expansion												
	2 North Ca	ulo F Y Inclwork Expansion roling Division of Water Pesoure	05									
	Grou	ind Water Management Branch	cs									
	GIU	2017 Annual Report										
Proposed Station	County	Proposed Well Screens (ft bls)	Aquifer									
		20-30	Surficial									
Replacement of Topsail	Pender	120-130	Castle Hayne									
Beach Station		300-310	Peedee									
		600-610	Black Creek									
		20-30	Surficial									
Near Intersection of		41-51	Black Creek									
US Hwy 421 and US Hwy 13	Sampson	168-178	Upper Cape Fear									
		347	Pilot Hole (Estimated top of basement)									
		20-30	Surficial									
Near	Sampson	58-68	Black Creek									
Salemburg		129-139	Upper Cape Fear									
		368	Pilot Hole (Top of Basement)									
Additional Wells		20-30	Surficial									
Existing Turkey	Sampson	318-328	Upper Cape Fear									
Station		432-442	Lower Cape Fear									
		455	Pilot Hole (Estimated Depth)									
		20-30	Surficial									
		41-51	Castle Hayne									
Chinquapin Station	Duplin	165-175	Peedee									
Replacement		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 Wa	ter Manage	ment Brand	ch								
		201	7 Annual Re	eport	1								
Well	Station Name	County	Date	Temp <sup>0</sup> C	Conductivity (mS/cm)	<b>Dissolved Oxygen</b> (ppmv or mg/L)	pН						
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	A	Attempted but con	uld 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 Wate	er Managen	nent Brancl	h								
	T,	2017	Annual Ker	oort	~								
Well	Station Name	County	Date	<sup>o</sup> C	(mS/cm)	Dissolved Oxygen (ppmv or mg/L)	рН						
O 28K3	Snow Hill	Greene		Attempt	ed 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*	viil 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

	Summary of Field Par Noi	Tabl ameters (Mea rth Carolina I Ground Wat 2017	e 14 (contin Isured using Division of V er Managen Annual Rej	ued) 3 a Hydrola Vater Resou nent Brancl port	b Quanta-series urces h	meters)	
Well	Station Name	County	Date	Temp <sup>°</sup> C	Conductivity (mS/cm)	Dissolved Oxygen (ppmv or mg/L)	рН
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 R	ECORD	For Internal Use ONLY:									
1. Well Contractor Information:											
Jonathan Kamionka		14. WATEI	R ZONE	s		- 					
Wall Contractor Name		FROM	T0	ft	DESCRIPT	ION		1.			
3465 A		455 ***	480	ft.			sand	ls			
S403-A		15. OUTER	CASIN	G (for )	nulti-cased w	ells) (	R LINER (if	applicable			
Dillo Moll Drilling Co		FROM	TO	0 (101 1	DIAMETER		THICKNESS	MAT	ERIAL		
Bill's Well Drilling Co.		0 ft.	65	ft.	10	in.	sch40		PVC		
Company Name		FROM	TO	J OR T	DIAMETER	therma	THICKNESS	) 	ERIAL		
2. Well Construction Permit #:	e Variance Injection etc.)	+3 <sup>ft.</sup>	465	ft.	4.5	in.	SDR17		PVC		
3 Wall Line (check well was):	e, vanance, mjecnon, etc.j	475 <sup>ft.</sup>	480	ft.	4	in.	sch80		PVC		
Water Supply Well:		17. SCREE FROM	N TO		DIAMETER	SLOT	SIZE TH	ICKNESS	MATERIAL		
Agricultural	□Municinal/Public	465 ft.	475	ft. 4	in.	.0	020		SS		
Geothermal (Heating/Cooling Supply)	Residential Water Supply (single)	ft.	l	ft.	in.						
□ Industrial/Commercial	□Residential Water Supply (shared)	18. GROUT									
		FROM ft.	TO	ft.	MATERIAL		EMPLACEN	MENT MET	HOD & AMOUNT		
Non-Water Supply Well:			445	ft	bostant		pumped				
☑ Monitoring	□Recovery	445 ***	455	6	bentonite	9	pourea				
Injection Well:	Groundwater Percediation	10 SAND/(	DAVEL	IL.	(if applies)	(a)	THE STORE DESIGN		Second Contractory of the second		
		FROM	TO	TACE	MATERIAL	ie)	EMP	LACEMEN	T METHOD		
	Stormwater Drainage	455 ft.	560	ft.	#3 g	ravel	l	po	ured		
Experimental Technology		ft.		ft.							
Geothermal (Closed Loop)	20. DRILLI	NG LO	G (attac	h additional	sheets	if necessary)	ail/rack type	grain cira eta )			
Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)	ft.	10	ft.	DESCRIPTI		See Atta	ached	, grain size, etc.)		
4 Date Well(s) Completed: 4-7-17	Well ID# AA 32R2 - Pilot	ft.		ft.							
		ft.		ft.							
Sa. Well Location:	Long Crock Station	ft.		ft.							
	Long Creek Station	ft.		ft.							
Pacility/Owner Name	Facility ID# (if applicable)	ft. ft.									
23588 NC210 Currie, NC2	28435	ft.		ft.							
Physical Address, City, and Zip		21. REMAN	RKS	(1818)(d	+ CTAST -						
Pender											
County	Parcel Identification No. (PIN)										
5b. Latitude and Longitude in degrees/n (if well field, one lat/long is sufficient)	ninutes/seconds or decimal degrees:	22. Certific	ation:	/	1						
N	w	A	M	k.	12			4-7	-17		
		Signature of	ertified	Well Co	ontractor			Date			
o. is (are) the wen(s): Drermanent of		By signing th with 15A NC.	is form, . 4C 02C .	I hereby 0100 or	certify that 15A NCAC (	the we 02C .02	ll(s) was (wer 200 Well Cons	e) construction St	ted in accordance andards and that a		
7. Is this a repair to an existing well: If this is a repair, fill out known well construction	□ Yes or ⊠No information and explain the nature of the	copy of this re	cord has	been p	rovided to the	well o	wner.				
repair under #21 remarks section or on the back	of this form.	23. Site dia	gram or	r addit	ional well d	letails	: ide additions	al wall cit	a dataila or wall		
8. Number of wells constructed:		construction	details.	You	may also att	ach ac	ditional pag	es if nece:	ssary.		
For multiple injection or non-water supply wells submit one form.	ONLY with the same construction, you can	SUBMITT	AL INS	тист	IONS						
9. Total well depth below land surface:	560 (ft.)	(ft.) 24a. For All Wells: Submit this form within 30 days of completion of w							npletion of well		
10. Static water level below top of casing	;: <u>7.5</u> (ft.)	(ft.) Division of Water Resources, Information Processing Unit,									
If water level is above casing, use "+" $Q_7/Q$			1617	mail S	ervice Cen	ter, R	aleigh, NC 2	2/099-16			
11. Borehole diameter:	(in.)	24b. For In 24a above	ijection also sub	Wells omit a	ONLY: In copy of th	addit	tion to sendi m within 30	ng the for days of	m to the address in completion of we		
12. Well construction method: MUC F (i.e. auger, rotary, cable, direct push, etc.)	Rotary	construction to the following:									
FOR WATER SUPPLY WELLS ONLY	:		1636	Mail S	sources, U Service Cen	nderg ter, R	aleigh, NC 2	27699-163	froi Program, 86		
13a. Yield (gpm) 10	Method of test: pump	24c. For Wa	ater Su	pply &	Injection V	Vells:	. 20. 1		c		
13b. Disinfection type: HTH	Amount: 2 CUP	well constru constructed	t one c action to	opy of o the c	ounty healt	within h dep	1 30 days of artment of 1	t completi the count	on of y where		

WELL CONSTRUCTION R This form can be used for single or multiple well	ECORD s	For Inte	rnal U	se ONL	Y:	N						
1. Well Contractor Information:												
Jonathan Kamionka		14. WA	ATER	ZONE	5	DESCRIPTI	ON			an Sta		
Well Contractor Name		210	ft.	235	ft.			s	sands			
3465-A			ft.		ft.							
NC Well Contractor Certification Number		15. OL	TER	CASIN	G (for 1	nulti-cased w	ells) O	R LINE	R (if appl	licable)	Here was shown	
Bill's Well Drilling Co.		FROM	ft.	10	ft.	DIAMETER	in.	THICK	VESS	MATE	RIAL	
Company Name		16. IN	NER	CASING	OR T	UBING (geot	herma	l closed-	-loop)	Cite M	AND THE PROPERTY OF	
2 Well Construction Permit #		FROM	ft.	TO	ft	DIAMETER	in.	THICK	NESS	MATE	RIAL	
List all applicable well permits (i.e. County, State	e, Variance, Injection, etc.)	+3	ft	220	ft	4.5	in.	SDF	<u> </u>		PVC	
3. Well Use (check well use):		230 17. SC	REEN	235		4		scr	180		PVC	
Water Supply Well:		FROM	64	то	D	IAMETER	SLOT	SIZE	THICKN	NESS	MATERIAL	
□Agricultural	DMunicipal/Public	220	n. /	230	n. 4		.0	20			SS	
□Geothermal (Heating/Cooling Supply)	□Residential Water Supply (single)		it.		ft.	in.						
□Industrial/Commercial	□Residential Water Supply (shared)	18. GF FROM	ROUT	то		MATERIAL		EMPL	ACEMEN	T METH	OD & AMOUNT	
□Irrigation		0	ft.	200	ft.	grout		pum	bed			
Non-water Supply Well:	-Passayary	200	ft.	210	ft.	bentonite	pentonite poured					
Injection Well:			ft.		ft.							
□Aquifer Recharge	□Groundwater Remediation	19. SA	ND/G	RAVEI	PACK	(if applicab	e)					
□Aquifer Storage and Recovery	□Salinity Barrier	FROM	6	TO	6	MATERIAL	1		EMPLAC	EMENT	METHOD	
□Aquifer Test	□Stormwater Drainage	210	n. 0	235		#3 g	ravel			pou	red	
DExperimental Technology	□Subsidence Control	20 00	II.		п. Э.(.)							
□Geothermal (Closed Loop)	□Tracer	FROM	ILLI	TO	r (attac	DESCRIPTI	ON (col	or, hardn	ess, soil/ro	ck type, p	grain size, etc.)	
Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)		ft.		ft.			See	Attach	ed		
4. Date Well(s) Completed: 4-14-17	AA 32R3	1. 	ft. ft.		ft. ft.							
5a. Well Location:			ft.		ft.							
NC-DENR	Long Creek Station		ft.		ft.							
Facility/Owner Name	Facility ID# (if applicable)		ft		ft							
23588 NC210 Currie, NC 2	28435		fr		ft			<u></u>				
Physical Address, City, and Zip		21 RF	MAR	KS		and the second	-044	-1. (A. 1. 1. 1.	1012/0101			
Pender												
County	Parcel Identification No. (PIN)											
5b. Latitude and Longitude in degrees/n (if well field, one lat/long is sufficient)	inutes/seconds or decimal degrees:	22. Cei	rtifica	tion:	/	11	_	/				
N	W		X	11		5				4-14	-17	
		Signatur	e of C	ertified	Well Co	ontractor				Date		
6. Is (are) the well(s): Permanent or	□ Temporary	By signi with 152	ng thi 1 NCA	s form, 1 C 02C .	hereby	certify that	the wei 2C .02	ll(s) was 200 Well	(were) co Construct	onstructe tion Star	ed in accordance adards and that a	
If this is a repair, fill out known well construction	information and explain the nature of the	сору ој 1	nis re	cora nas	been pi	roviaea to the	well o	wner.				
repair under #21 remarks section or on the back	of this form.	23. Site	e diag	ram or	addit	ional well d	etails	: ide addi	tional w	ell site	details or well	
8. Number of wells constructed:		constru	ction	details.	You	may also att	ach ad	ditional	pages if	f necess	ary.	
For multiple injection or non-water supply wells submit one form.	ONLY with the same construction, you can	SUBM	ITTA	L INS	TUCT	IONS						
9. Total well depth below land surface: For multiple wells list all depths if different (example)	235 (ft.) <i>pple- 3@200' and 2@100'</i> )	24a. <u>F</u> constru	or A ction	II Well to the f	<u>s</u> : Su ollowi	bmit this fo ng:	orm w	vithin 3	0 days c	of com	pletion of well	
10. Static water level below top of casing If water level is above casing. use "+"	: <u>6.5</u> (ft.)		Γ	Division 1617	of Wa Mail S	ater Resour Service Cen	ces, I ter, R	nforma aleigh,	tion Pro NC 2769	ocessing 99-1617	g Unit, 7	
11 Borehole diameter. 9-7/8	(in )	24h E	or In	iection	Welle	ONLY I	addit	tion to s	ending t	the form	n to the address in	
12. Well construction method: Mud F	Rotary	24a abo constru	ove, a ction	ilso sub to the f	omit a	copy of th	is for	n withi	n 30 da	ine form	completion of well	
(i.e. auger, rotary, cable, direct push, etc.)		Di	visio	n of W	ter D	Sources H	ndera	round	Injection	n Cont	ol Program	
FOR WATER SUPPLY WELLS ONLY	:		- 1310	1636	Mail S	Service Cen	ter, R	aleigh,	NC 2769	99-1636	ó i rograni,	
13a. Yield (gpm) <u>30+</u> N	Method of test: pump	24c. Fo	r Wa	iter Su	oply &	Injection V	Vells:	30 da	veofac	mplatia	n of	
13b. Disinfection type: HTH	Amount: 2 CUP	well co constru	onstru cted.	ction to	o the c	county healt	h dep	artment	of the	county	where	

WELL CONSTRUCTION R This form can be used for single or multiple well	ECORD Is	For Inte	ernal U	se ON	LY:							
1. Well Contractor Information:												
Jonathan Kamionka		14. W.	ATER	ZON	ES	DESCRIPT	ION					
Well Contractor Name		11	ft.	31	ft.	DESCRIPT	IUN		ands			
3465-A			ft.	01	ft.				anus			
NC Well Contractor Cartification Number		15. 01	JTER	CASI	NG (for	multi-cased v	vells) (	RLINE	R (if ann	icable)	Contraction of the state	
Rilla Mall Drilling Co		FROM		то		DIAMETER		THICKN	ESS	MATE	RIAL	
Bill's Well Dhilling Co.		16 10	it.	C. C. C. C.	it.		in.					
Company Name		16. IN FROM	NER	TO	G OR T	UBING (geo DIAMETER	therma	I closed- THICKN	loop) IESS	MATE	RIAL	
2. Well Construction Permit #:		+3	ft.	16	ft.	4.5	in.	SDF	R17		PVC	
List all applicable well permits (i.e. County, Stat	e, Variance, Injection, etc.)	26	ft.	31	ft.	4 <sup>in.</sup> sch80				PVC		
3. Well Use (check well use):		17. SC	REEN	1	151313		0.939		Nitra New		AN AN AREAD	
Water Supply Well:		FROM TO DIAMETER SLOT SIZE THICKNESS I							MATERIAL			
	□Municipal/Public	10	ft.	20	ft 4	in.	.0	20				
Geothermal (Heating/Cooling Supply)	□Residential Water Supply (single)	18 CE	POUT									
	□Residential Water Supply (shared)	FROM		то		MATERIAI		EMPL	ACEMENT	г метн	OD & AMOUNT	
Dirrigation		0	ft.	11	ft.	bentonite	Э	poure	ed			
Monitoring	Recovery		ft.		ft.							
Injection Well:			ft.		ft.							
□Aquifer Recharge	□Groundwater Remediation	19. SA	ND/G	RAVE	L PACH	(if applicab	le)	21082.22		1.4.19		
□Aquifer Storage and Recovery	□Salinity Barrier	FROM	6	TO	6	MATERIAI			EMPLAC	EMENT	METHOD	
□Aquifer Test	□Stormwater Drainage	11	n.	31		#3 g	ravel			pou	ed	
□Experimental Technology	□Subsidence Control		ft.		ft.							
Geothermal (Closed Loop)	□Tracer	20. DR FROM	ULLI	NG LC	G (attac	DESCRIPT	sheets	if necess	ary) ess. soil/ro	ck type, o	rain size, etc.)	
□Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)		ft.		ft.			See .	Attache	ed		
4. Date Well(s) Completed: 3-15-17	Well ID# AA 32R1		ft.		ft.							
5a. Well Location:			n. 6							_		
NC-DENR	Long Creek Station		It.		Ħ.							
Facility/Owner Name	Facility ID# (if applicable)		ft.		ft,		-					
23588 NC210 Currie NC 1	28435		ft.		ft.							
Physical Address City and Zin	20100		ft.		ft.							
Pender		21. RE	MAR	KS	1999		1.1	t hitten	NUMER OF			
	Parcal Identification No. (PIN)											
5b. Latitude and Longitude in degrees/n	ninutes/seconds or decimal degrees:	22 64			1							
(if well field, one lat/long is sufficient)	C.	22. Cei	$\hat{D}$	iuon:		/ /	/					
N	W		X	U	1	0				3-15	-17	
		Signator	e of C	ertified	Well Co	ontractor				Date		
<ul> <li>6. Is (are) the well(s):  Permanent or</li> <li>7. Is this a repair to an existing well:</li> </ul>	r 🗆 Temporary	By signi with 15A	ng thi. 1 NCA	s form, C 02C	I hereby	v certify that 15A NCAC (	the we 02C .02	ll(s) was 200 Well (	(were) co Construct	onstructe ion Stan	d in accordance dards and that a	
If this is a repair, fill out known well construction	n information and explain the nature of the	copy of 1		.0/ 11 /10	s been p	rovided to the	wento	wher.				
repair under #21 remarks section or on the back	of this form.	23. Site You ma	e diag	ram o	or addit	this page to	letails	: de addit	tional w	ell site	details or well	
8. Number of wells constructed:		constru	ction	detail	S. You	may also att	ach ad	ditional	pages if	necess	ary.	
For multiple injection or non-water supply wells submit one form.	ONLY with the same construction, you can	SUBM	ITTA	LIN	STUCT	IONS						
9. Total well depth below land surface: For multiple wells list all depths if different (example)	31 (ft.) mple- 3@200' and 2@100')	24a. <u>F</u> e constru	or Al ction	I We	l <u>ls</u> : Su followi	lbmit this fo ng:	orm w	rithin 30	) days o	of comp	oletion of well	
10. Static water level below top of casing	;: <u>9</u> (ft.)		D	ivisio	n of Wa	ater Resour	ces, In	nformat	tion Pro	cessing	Unit,	
9-7/8	<b>A</b> 150			1011	IVIAN C	owner cell	, ici, ici			-101/		
11. Borchole diameter:	(in.)	24b. <u>Fe</u> 24a abc	or In	ection lso su	1 Wells	ONLY: In	addit	ion to so n within	ending the arrive structure of the second structure of	he form	to the address in ompletion of well	
12. Well construction method: WIUC KOTARY (i.e. auger, rotary, cable, direct push, etc.)			construction to the following:							ompletion of wer		
FOR WATER SUPPLY WELLS ONLY		Di	visior	1 of W	ater Ro Mail S	esources, U Service Cen	nderg ter. P	round I aleigh N	njection	Contr	ol Program,	
13a. Yield (gpm) 10	Method of test: pump	24c. For Water Supply & Injection Wells:							200			
13h Disinfection type. HTH	Amount: 1 CUD	Also su well co	ubmit Instru	one	copy of to the c	this form county healt	within h dep	artment	ys of con of the c	npletio countv	n of where	
3b. Disinfection type: HIH Amount: 1 CUP			cted.			10				,		

WELL CONSTRUCTION R This form can be used for single or multiple well:	ECORD	For In	ternal U	Jse ONLY	': ':						
1. Well Contractor Information:		L									
Jonathan Kamionka		14. V	VATEF	ZONES		DESCRIPT	ION	1.100	an na san sa s		
Well Contractor Name		380	ft.	405	ft.	<b>DECOURT</b>	1011		sands		
3465-A			ft.		ft.						
NC Well Contractor Certification Number		15. C	UTER	CASING	(for	nulti-cased wells) OR LINER (if applicable)					DIAL
Bill's Well Drilling Co.		0	ft.	40	ft.	10	in.	SC	h40	MATE	PVC
Company Name		16. II	NNER	CASING	OR T	UBING (geo	therma	l closed	osed-loop)		
2. Well Construction Permit #:		FROM	-3 ft. 390 ft. 4			DIAMETER 4 5	THICK	D17	MATERIAL PVC		
List all applicable well permits (i.e. County, State	, Variance, Injection, etc.)	400	ft.	405	ft.	4.0	in.	SC	SDR17 PVC		
3. Well Use (check well use):		17. S	17. SCREEN FROM TO DIAMETER SLOT SIZE						TOO .	T VC	
Water Supply Well:	D funicical/Datis	390	390 ft. 400 ft. 4 in020					THICKN	ESS	SS	
Geothermal (Heating/Cooling Supply)	Residential Water Supply (single)	000	ft.	f	t.	· in.	.01				
□Industrial/Commercial	Residential Water Supply (shirgle)	18. G	ROUT	•			1414-141		and the second	172.3%	No. 20 March 199
		FROM	ft.	TO	ft.	MATERIA	L	EMPI	LACEMENT	METH	OD & AMOUNT
Non-Water Supply Well:	<i>n</i>	270	ft.	370	ft	grout		pum	ipea		
☑ Monitoring	□Recovery	370	ft.	300	ft	bentonit	e	pour	rea		
□ Aquifer Recharge	Groundwater Remediation	19. S	AND/G	RAVEL	PACE	(if applical	ole)	-			
□Aquifer Storage and Recovery □Salinity Barrier			4	TO		MATERIA	L		EMPLACE	EMENT	METHOD
□Aquifer Test □Stormwater Drainage			ft.	405	it.	#3 g	gravel			pou	red
□Experimental Technology □Subsidence Control			ft.		ft.						
□Geothermal (Closed Loop)	□Tracer	20. DRILLING LOG (attach additional sheets if necessary)           FROM         TO           DESCRIPTION (color, hardness, soil/rock t					k type, j	grain size, etc.)			
□Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)	ft. ft. See Attached						ed			
4. Date Well(s) Completed: 4-13-17	_ <sub>Well ID#</sub> AA 32R4		ft. ft.		ft. ft.						
5a. Well Location:		0	ft.		ft.						
NC-DENR	Long Creek Station		ft.		ft.						
Facility/Owner Name	Facility ID# (if applicable)		ft.		ft.						
23588 NC210 Currie, NC 2	28435		ft.		ft.	-					
Physical Address, City, and Zip		21. R	EMAR	RKS			li anti			11 (M)	
Pender											
	Parcel Identification No. (PIN)										
(if well field, one lat/long is sufficient)	inutes/seconds or decimal degrees:	22. Co	ertifica	ation:	/	/	-				
N	W	6	1	//		//				4-13	-17
		Signan	are of C	ertified W	lell Ca	entractor				Date	
6. Is (are) the well(s): Deermanent or	□ I emporary	By sign	ning thi 5A NCA	s form, I	hereby	certify that	the well	l(s) wa: 00 Well	s (were) co l Constructi	nstructe	ed in accordance
7. Is this a repair to an existing well:	∃Yes or ⊠No	copy of	f this re	cord has l	been p	rovided to the	e well on	vner.	Constructi	on Star	aaras ana mara
repair under #21 remarks section or on the back of	information and explain the nature of the of the	23. Si	te diag	gram or	addit	ional well o	details:				
8. Number of wells constructed: 1		You n constr	nay us uction	e the bac details	ck of You	this page to may also at	o provid tach add	de add	litional we	ell site	details or well
For multiple injection or non-water supply wells ( submit one form.	DNLY with the same construction, you can	SUBN	AITTA	AL INST	UCT	IONS			5		
9. Total well depth below land surface: 405 (ft For multiple wells list all depths if different (example- 3@200' and 2@100')			For A uction	II Wells to the fo	: Su Ilowi	bmit this f ng:	òrm wi	ithin 3	80 days o	f com	oletion of well
10. Static water level below top of casing: If water level is above casing, use "+"		I	Division 1617 N	of Wa Aail S	ater Resou Service Cen	rces, In iter, Ra	iform: ileigh,	ntion Proc NC 2769	cessing 9-1617	Unit,	
11. Borehole diameter: 9-7/8	_ (in.)	24b. <u>1</u>	For In	jection V	Wells	ONLY: I	n additi	ion to	sending th	ne form	n to the address in
12. Well construction method: Mud R	otary	construction to the following:								completion of wel	
FOR WATER SUPPLY WELLS ONLY:		D	ivisio	n of Wat 1636 N	ter Ro Aail S	esources, U Service Cen	Indergi iter, Ra	round aleigh,	Injection NC 2769	Contr 9-1636	ol Program,
13a. Yield (gpm) 10	24c. <u>F</u>	'or Wa	ter Sup	ply &	Injection	Wells:	ο,	2			
HTH	2 0 0 0	Also :	submit	one co	py of	this form	within	30 da	ays of com	pletio	n of where
13b. Disinfection type:	Disinfection type: HTH Amount: 2 Cup				ule C	ounty neal	un uepa	aunen	i or the c	ounty	where

of well

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

1. Well Contractor Information:	WELL CONSTRUCTION R This form can be used for single or multiple well	ECORD s	For Int	ternal (	Jse ONL	.Y:						
Jonathan Karmionka         Wel Contrast New Well Contrast Certification Number Bill's Well Drilling Co.       Sand & Clay         Bill's Well Drilling Co.       An analysis of the second of the New (d spatiant)         Company Name       Contrast Certification Number Bill's Well Drilling Co.       Now Well Contrast Certification Number Bill's Well Drilling Co.       Now Well Contrast Certification Number Bill's Well Drilling Cost Company Num Partners, Injection Residual Water Supply Glaph (Single)       Now Well Contrast Certification Number Bill's Well Drilling Cost Company Num Partners, Injection Residual Water Supply Glaph (Single)       Now Well Contrast Certification Number Bill's Well Drilling Cost Company Number Damage Disordered Remodulation Disordered Remodulation Commercial Contrast Supply Glaph (Single)       Now Well Contrast Supply Certification Number Bill's Well Drilling Cost Company Number Damage Disordered Remodulation Disordered Remodulatin Disord Remodulation Disordered Remodulatin Disord Re	1. Well Contractor Information:							-				
Well Constructions Visue $\frac{250}{n}$ $\frac{1}{270}$ $$	Jonathan Kamionka		14. W	ATE	ZONE	S	DESCRIPT	TON				
3465-A         NC With Connector Configution Number         Bill's Well DDHIling Co.         Company Name         Ved Construction Fermit 8:         Ved Construction Fermit 8:         Ved Construction Fermit 8:         List of applicable will gravity bill.         Construction Fermit 8:         List of applicable will gravity bill.         Construction Fermit 8:         List of applicable will gravity bill.         Construction Fermit 8:         List of applicable will gravity bill.         Construction Fermit 8:         Constructin Fer	Well Contractor Name		250	ft.	270	ft.	DESCRIT	ION	San	d & Cla	av	
New Weil Drilling Co.         Bill's Weil Drilling Co.         Seconsprission         1       Seconsprission         2. Weil Construction Fermiting         1. Weil Drilling Co.         2. Weil Construction Fermiting         Construction Fermiting         Description         Construction Fermiting         Description         Construction Fermiting         Distruction Fermiting      <	3465-A			ft.	1	ft.					.,	
Bill's Well Drilling Co.         Company Name         <	NC Well Contractor Certification Number		15. 0	UTER	CASIN	G (for	multi-cased y	wells) (	R LINE	R (if appl	icable)	
Image of Color Defining Sect.	Bill's Well Drilling Co		FROM	đ ft	TO	ft	DIAMETE	R	THICKN	ESS	MATE	RIAL
Avail Construction Permit 8:       In advantation	Company Name		16.10	INER	CASIN	CORT	TIBING (geo	therm	SCN al closed-	40		PVC
2. Well control for any loc location of provide different location of the construction of the c	2 W-U Constanting Barris H		FROM	4	TO	o on i	DIAMETE	R	THICKN	ESS	MATE	RIAL
3. Well Use (check well use):       270 fb. [275 fb. [4 fb. [4 fb. [275 fb. [4 fb. [275 fb. [275 fb. [4 fb. [275 fb.	List all applicable well permits (i.e. County, Stat	e, Variance, Injection, etc.)	+3	ft.	250	ft.	4.5	in.	SDF	217		PVC
Water Supply Well:       Disal relation of the well ():       Disal relation of the well ():       Disal relation of the well ():       Disal relation well relation re	3. Well Use (check well use):		270 17. Se	fi.	275 N	ft.	4	in.	sch	80	100	PVC
Claptical mail       Claptical problem       Clapt	Water Supply Well:	× , ,	FROM TO DIAMETER SLOT SIZE THICKNESS							ESS	MATERIAL	
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Industrial Commercial       IResidential Water Supply (shared)         Prirginion       10       10       MATTERIAL       EMPLACEMENT METHOD & AMOUNT         Non-Water Supply Well:       0       n.       23.0       h. Dentonine       poured         DAquider Storge and Recovery       Isleniny Barrier       0       n.       23.0       h. Dentonine       poured         Daquider Storge and Recovery       Isleniny Barrier       0       n.	Geothermal (Heating/Cooling Supply)	□Residential Water Supply (single)		ft.		ft.	in.					
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Non-Water Supply Well:         Definition of the set of			0	ft.	230	ft.	bentonit	e	Dum	ed		op a chiothi
Colorentry       Clear overy         Construction       Clear overy         Presidion       Clear overy         Presidion       Clear overy         Presidion       Clear overy         New       Hancever         New       Hancever         New       Hancever         New       Hancever         New       Hancever         New       Hancever         New       Hanceve	Non-Water Supply Well:		230	ft.	240	ft.	hentonit	0	nour	h		
Implementation       Implementation         Implementation       Implementa	EMonitoring	□Recovery	230	ft	2.40	ft	Dentonit	0	poure		-	
Capture Instance and Recovery       Distance Instance Influence         Capture Storms and Recovery       Distance Instance Influence         Capture Storms and Recovery       Distance Instance Influence         Capture Storms and Recovery       Distance Instance Influence         Contermal (Heating/Cooling Return)       Dither (explain under #21 Remarks)         Coentermal (Heating/Cooling Return)       Dither (explain under #21 Remarks)         A. Date Well(s) Completed:       5-11-17         Well Ibaction:       EE 30 (P1)         NC-DENR       Presidio         Presidio Dr, Wilmington, NC 28412       n. n.         Physical Address, City, and Zip       n. n.         New Hancover       N         New Hancover       N         New Hancover       Statistication No. (PRN)         St. Latistude and Longitude in degrees/minutes/seconds or decimal degrees:       11. Remarks second or distored and conduct was statisticant of mominutes/seconds or distored and conduct was statisticant or manuscenton spanning degrees (Instance)         N       N       Static and second and equivies (Static and equivies)         Number 121 remarks section or and beak of this form.       Static and equivies (Static and equivies)         Number 227 S       (n. n.         Number 221 remarks section or and beak of this form.       Statis a requir, the statis decima on disclasto	DAnuifer Recharge	DGroundwater Pamadistion	10 6	AND	DAVE	PACE	(if any line)		V-IIII		Sec. 1	Contractor and the second
Image: Intervention to the state of the state construction of the	DAmifer Storage and Recovery	Insolution Register	FROM	1	TO	TACK	MATERIA	L		EMPLACI	EMENT	METHOD
Dependent Test       Distributed and lange         Disperimental Technology       Distributed and construction         Disperimental Technology       Distributed and construction         Discretification       Distributed and construction         A Date Well(s) Completed:       5-11-17         Well Location:       EE 30 (%)         NC-DENR       Presidio         Part Well(s) Completed:       5-11-17         Well Location:       EE 30 (%)         NC-DENR       Presidio         Presidio Dr, Wilmington, NC 28412       n. n.         Physical Address, City, and Zip       n. n.         New Hanover       20. Certification:         County       Parcel Identification No. (PIN)         St. Latitude and Longitude in degrees/initute/seconds or decimal degrees:       1. REMARKS         20. Certification:       2. Certification:         21. REMARKS       Statitude and Longitude in degrees/initute/seconds or decimal degrees:         1// this is a repair to an existing well:       Yes or ZiNo         1// this is a repair to an existing well:       Yes or ZiNo         8. Number of wells constructed:       1         For multiple wills in the back of this preside in the nature of the multiple injection or non-structure ingene interestry;         9. Total well depth below ton of casing: </td <td>DAquifer Test</td> <td></td> <td>240</td> <td>ft.</td> <td>275</td> <td>ft.</td> <td>#3 9</td> <td>grave</td> <td></td> <td></td> <td>pou</td> <td>red</td>	DAquifer Test		240	ft.	275	ft.	#3 9	grave			pou	red
Dispersive Name       Dispersive Control         Geothermal (Closed Loop)       DTracer         Box Mell Location:       Description (DTracer)         NC-DENR       Presidio         Filing/Cover Name       Facility (Dir (Topplicable)         105 Presidio Dr, Wilmington, NC 28412       n. n.         Physical Address, City, and Zip       N         New Hanover       n. n.         County       Parcel Identification No. (PIN)         5h. Laftude and Longitude in degrees/minutes/seconds or decimal degrees:       2. Certification:         1/ the if a negarized and scattered to a coordance with MARKS       Date         8. Number of wells constructed: 1       You must be back of this form. I hareby certify that the well(g) was (were) constructed in accordance with MARKS         9. Total well depth below hand surface: 275       (n.)         10. Static wast level below top of casing: 16.5       (n.)         11. Borehole diameter: 10	DExperimental Technology	DSubsidence Control		ft.		ft.						
Deconstruction       Consolution       Consolution <td>DGeothermal (Closed Loop)</td> <td></td> <td>20. D</td> <td>RILLI</td> <td>NG LO</td> <td>G (attac</td> <td>ch additional</td> <td>l sheets</td> <td>if necess</td> <td>ary)</td> <td></td> <td></td>	DGeothermal (Closed Loop)		20. D	RILLI	NG LO	G (attac	ch additional	l sheets	if necess	ary)		
2. Determine (realing coding, exemin)       20040 (explain dude 121 Realines)         4. Date Well(s) Completed:       5-11-17         Well Dottion:       EE 30 P1         NC-DENR       Presidio         Provide I dottion:       Facility ID# (f applicable)         105 Presidio Dr, Wilmington, NC 28412       ft         Physial Address, City, and Zip       ft         New Hanover       ft         Commy       Pacel Identification No. (PIN)         5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       ft         (if well field, one halfong is sufficient)       Y         Stel far the well(s): @Permanent or ITemporary       Y         7. Is this a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well:       Yes or gENo         (fib is a repair to an existing well: <td>Geothermal (Heating/Cooling Return)</td> <td>Dother (explain under #21 Remerke)</td> <td>FROM</td> <td>ft.</td> <td>то</td> <td>ft.</td> <td>DESCRIPT</td> <td>ION (co</td> <td>lor, hardn</td> <td>Attoob</td> <td>ck type, j</td> <td>grain size, etc.)</td>	Geothermal (Heating/Cooling Return)	Dother (explain under #21 Remerke)	FROM	ft.	то	ft.	DESCRIPT	ION (co	lor, hardn	Attoob	ck type, j	grain size, etc.)
4. Date Well(s) Completed:       5-11-17       Well Dig 12-30-22         5. Well Location:       The Completed:       The Completed:       The Completed:         5. Well Location:       Presidid       The Completed:       The Completed:         105 Presidio Dr, Wilmington, NC 28412       The Completed:       The Completed:       The Completed:         Physical Address, City, and Zip       The Completed:       The Completed:       The Completed:         So. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       The Completed:       The Completed:         So. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       The Completed:       The Completed:         So. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       The Completed:       The Completed:         So. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       The Completed:       The Completed:         So. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       The Completed:       The Completed:         So. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       The Completed:       The Completed:         So: fare the well(s):: CiPernanent or CiPerporary       The So and the form:       The Completed:       The Completed:         So: mather diverse constructed:       The Completed:       The Completed:       The Com	Locouleman (nearing/cooling Return)		J	ft.	<u> </u>	ft.			See	Allache	ea	
Sa. Well Location:       DEC SOPY         NC-DENR       Presidio         Pacility/Ower Name       Pacility (DB (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, ose lationg is sufficient)         N	4. Date Well(s) Completed: 5-11-17	Well ID# EE 30P2	-	ft.	-	ft.						
NC-DENR       Presidio         Facility/Domen Name       Facility/Domen Name         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         St. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       22. Certification:         7. Is this a repair to an existing well:       UYes or gINo         (The to a provide dimension ond explain the nature of the repair under 32 remarks section or on the back of this form.       5-11-17         To multiple trijection or non-water supply wells ONLY with the same construction, formation ond explain this form.       5-11-17         For multiple trijection or non-water supply wells ONLY with the same construction, formation of explain this form.       5-11-17         To multiple trijection or non-water supply wells ONLY with the same construction, formation ond explain the nature of the submit on gform.       21. Bernale well (9) wells constructed:         To multiple wells list all deptis of different (example - 3@200° and 2@100°)       (fr.)         10. Static wate leve below to of casing:       16.5         (fr.)       (fr.)         11. Borehole diameter:       10         (gr. watered is all deptis of	5a. Well Location:	LE JOPI		ft.		ft.						
Facility/Owner Name       Facility/ID# (if applicable)         105 Presidio Dr, Wilmington, NC 28412         Physical Address, City, and Zip         New Hanover         County         Sb. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:         (if well field, one lat/loag is sufficient)         N       Yes         Network Section on on behock of this form.         Number of wells constructed:       10         For multiple wild: behow land surface:       275         (fit)       16.5         (fit)       16.5         (fit)       16.5         (fit)       16.5         (fit)       16.5         (fit)	NC-DENR	Presidio	-	ft.	-	ft						
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 lai/long is sufficient)       N         N       N         Yes       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         N       N         Nomber of wells constructed:       1         Commuter Will constructed:       1         So mutufe Will differen (cample- 3@200° and 2@100°)       (in.)         12. Well construction method:       Mud Rotary (ic. auger, rotary, cable, direct push, etc.)         FOR WATER SUPPLY WELLS ONLY:       1         13b. Disinfection type:       HTH         Amount:       1 Cup         13b. Disinfection type:       HTH         A ried (gpm) <t< td=""><td>Facility/Owner Name</td><td>Facility ID# (if applicable)</td><td></td><td>0</td><td></td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Facility/Owner Name	Facility ID# (if applicable)		0		6						
Physical Address, City, and Zip       It       It       It         New Hanover       21. REMARKS         County       Parcel Identification No. (PIN)         Sb. Latitude and Longitude in degrees/minutes/seconds or decimal degrees: (if well field, one lat/long is sufficient)       22. Certification:	105 Presidio Dr, Wilmingto	on, NC 28412		n. 0	-	n.	·					
New Hanover         County       Parcel Identification No. (PIN)         5b. Latitude and Longitude in degrees/minutes/seconds or decimal degress: (if well field, one lat/long is sufficient)       N         Sb. Latitude and Longitude in degrees/minutes/seconds or decimal degress: (if well field, one lat/long is sufficient)       N         Sc. Certification:       Sc. Certification:         Multiple injection or non-water supply wells ONLY with the same construction, spour car submit one form.       Sc. Ter Minutes/Sc. 2020 Well Construction Standards and that a copy of this record has been provided to the well owner.         9. Total well depth below land surface:       275         9. Total well depth below top of casing:       16.5         10. Static water level below top of casing:       16.5         11. Borehole diameter:       10         12. Well construction method:       Mud Rotary         (cs. super, rotary, cable, direct push, etc.)       Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617         24b. For Interction Wells ONLY:       In addition to sending the form to the address in 1636 Mail Service Center, Raleigh, NC 27699-1636         24c. For Water Rsupply & Injection or the county where 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 Source County health department of the county where constructi	Physical Address, City, and Zip			II.		u.						
County       Parcel Identification No. (PIN)         Sb. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:       (if well field, one lat/long is sufficient)	New Hanover		21. R	EMAR	CKS		3					BOOREON NEED
5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:         (if well field, one lat/long is sufficient)	County	Parcel Identification No. (PIN)										
In wend head, one hadding is sufficient?	5b. Latitude and Longitude in degrees/m	inutes/seconds or decimal degrees:	22. Ce	ertific	ation:		-					
N       Sector       N       Sector       Sector       Sector       Sector       Sector       Sector       Date         6. Is (arc) the well(s): Dependent or Dependent of the sector       Date       Date       Date         7. Is this a repair to an existing well: Dependent on ad explain the nature of the provide of this form.       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.         8. Number of wells constructed: 1       Site diagram or additional well details:         You may use the back of this page to provide additional pages if necessary.       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')       (ft.)         10. Static water level below top of casing: 16.5       (ft.)         11. Borehole diameter: 10       (in.)         12. Well construction method: Mud Rotary       Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1637         13a. Yield (gpm) 1       Method of test: bail         13b. Disinfection type: HTH       Amount: 1 Cup         13b. Disinfection type: HTH       Amount: 1 cup	(in well need, one labiong is sufficient)			0	1 .	11	-					
6. Is (are) the well(s): ☑Permanent or □Temporary       Signature of Certified Well Contractor       Date         7. Is this a repair to an existing well: □Yes or ☑No       With is a repair to an existing well: □Yes or ☑No       By signing this form. I hereby certify that the well(s) was (were) construction for accordance with 15A NCAC 02C. 0100 or 15A NCAC 02C. 000 Well Construction Standards and that a copy of this record has been provided to the well owner.         8. Number of wells constructed: 1	N	w	-	V	21	1cm	n				5-11	-17
7. Is this a repair to an existing well:       □Yes or ⊡No         17. Is this 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.       3. Site diagram or additional well details:         8. Number of wells constructed:       1         For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.       3. Site diagram or additional well details:         9. Total well depth below land surface:       27.5         9. Total well depths if different (example-3@200° and 2@100°)       (ft.)         10. Static water level below top of casing:       16.5         11. Borehole diameter:       10         12. Well construction method:       Mud Rotary         (i.e. auger, rotary, cable, direct push, etc.)       Division of Water Resources, Information 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:         13a. Yield (gpm)       1       Method of test:       bail         13b. Disinfection type:       HTH       Amount:       1 cup	6. Is (are) the well(s): @Permanent or	□Temporary	Signatu By sign	ire of C	certified	Well Co I hereb	ontractor	the we	Il(s) was	(were) co	Date	ed in accordance
7. Is first a repair to an existing weil:       If veis a repair (and existing wei	7 Is this a remain to an existing well-		with 15	A NC	AC 02C .	0100 or	15A NCAC	02C .02	200 Well	Construct	ion Star	dards and that a
repair under #21 remarks section or on the back of this form.       23. Site diagram or additional well details:         8. Number of wells constructed:       1         For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.       23. Site diagram or additional well details:         9. Total well depth below land surface:       275       (ft.)         For multiple wells list all depths if different (example-3@200' and 2@100')       (ft.)         10. Static water level below top of casing:       16.5       (ft.)         11. Borehole diameter:       10       (in.)         12. Well construction method:       Mud Rotary       (in.)         (i.e. auger, rotary, cable, direct push, etc.)       Method of test:       bail         13b. Disinfection type:       1       Method of test:       bail         13b. Disinfection type:       HTH       Amount:       1 cup	If this is a repair, fill out known well construction	information and explain the nature of the	copy of	this re	cord has	s been p	rovided to the	e well o	wner.			
<ul> <li>8. Number of wells constructed: 1</li> <li>For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.</li> <li>9. Total well depth below land surface: 275 (fr.)</li> <li>9. Total well depth below land surface: 275 (fr.)</li> <li>10. Static water level below top of casing: 16.5 (fr.)</li> <li>11. Borehole diameter: 10 (in.)</li> <li>12. Well construction method: Mud Rotary (i.e. auger, rotary, cable, direct push, etc.)</li> <li>FOR WATER SUPPLY WELLS ONLY:</li> <li>13a. Yield (gpm) 1 Method of test: bail 13b. Disinfection type: HTH Amount: 1 Cup</li> <li>13b. Disinfection type: HTH Amount: 1 Cup</li> </ul>	repair under #21 remarks section or on the back	of this form.	23. Sit	te dia	gram of	r addit	tional well	details	i ida addii	tion of mo	all size	d
For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.       SUBMITTAL INSTUCTIONS         9. Total well depth below land surface:       275       (ft.)         For multiple wells list all depths if different (example-3@200' and 2@100')       (ft.)       SUBMITTAL INSTUCTIONS         10. Static water level below top of casing:       16.5       (ft.)         If water level is above casing use "+"       16.5       (ft.)         12. Well construction method:       Mud Rotary       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 we construction to the following:         FOR WATER SUPPLY WELLS ONLY:       13a. Yield (gpm) 1       Method of test: bail       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         24e. For Water Supply & Injection Wells:       Amount: 1 Cup       Amount: 1 Cup	8. Number of wells constructed: 1		constr	uction	details	You	may also at	tach ac	ditional	pages if	necess	arv.
9. Total well depth below land surface:       275       (ft.)         For multiple wells list all depths if different (example-3@200° and 2@100°)       (ft.)         10. Static water level below top of casing:       16.5       (ft.)         If water level is above casing, use "+"       (in.)       Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617         11. Borehole diameter:       10       (in.)         12. Well construction method:       Mud Rotary         (ic. auger, rotary, cable, direct push, etc.)       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         FOR WATER SUPPLY WELLS ONLY:       Dail         13b. Disinfection type:       HTH         Amount:       1 cup	For multiple injection or non-water supply wells submit one form.	ONLY with the same construction, you can	SUBN	IITT/	AL INS	TUCI	IONS			1-0		
For multiple wells list all depths if different (example- 3@200° and 2@100°)       In Static water level below top of casing: 16.5 (ft.)         10. Static water level below top of casing: 16.5 (ft.)       Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617         11. Borehole diameter: 10 (in.)       (in.)         12. Well construction method: (it. auger, rotary, cable, direct push, etc.)       Mud Rotary         FOR WATER SUPPLY WELLS ONLY:       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         13b. Disinfection type: HTH Amount: 1 CUP       Amount: 1 CUP	9. Total well depth below land surface:	275 (ft)	24a. I	For A	ll Well	s: Su	bmit this f	form w	vithin 30	days o	f com	pletion of well
10. Static water level below top of casing: 16.5 (ft.)       Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617         11. Borehole diameter: 10 (in.)       (in.)         12. Well construction method: Mud Rotary       Mud Rotary         (i.e. auger, rotary, cable, direct push, etc.)       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         FOR WATER SUPPLY WELLS ONLY:       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         13b. Disinfection type: HTH Amount: 1 Cup       Amount: 1 Cup	For multiple wells list all depths if different (example)	nple- 3@200' and 2@100')	constru	uction	to the	followi	ng:				mil	CALCULATION OF A CALCULATION
11. Borehole diameter:       10       (in.)         12. Well construction method:       Mud Rotary         (i.e. auger, rotary, cable, direct push, etc.)       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 we construction to the following:         FOR WATER SUPPLY WELLS ONLY:       13a. Yield (gpm)       1         13b. Disinfection type:       HTH       Amount:       1 Cup	10. Static water level below top of casing	: <u>16.5</u> (ft.)		1	Division	of Wa	ater Resou	rces, I	nformat	ion Pro	cessing	Unit,
11. Borenote diameter:	11 Breakets de 10	<i>n</i> - >	24		location in the second	AND IN COMPANY	own	inci, R	diningu, I		-101	
12. Well construction method:       MUCH KOTAFY         (i.e. auger, rotary, cable, direct push, etc.)       Construction to the following:         FOR WATER SUPPLY WELLS ONLY:       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         13a. Yield (gpm)       1         13b. Disinfection type:       HTH         Amount:       1 CUp	11. Borchole diameter:	(In.)	240. E	ove.	also sul	bmit a	CODY of th	n addi	tion to so m within	ending the address of	ne form	ompletion of we
FOR WATER SUPPLY WELLS ONLY:       Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636         13a. Yield (gpm)       1       Method of test:       bail         13b. Disinfection type:       HTH       Amount:       1 CUp	12. Well construction method: Mud F (i.e. auger, rotary, cable, direct push. etc.)	kotary	constru	uction	to the	followi	ng:			. ov udj	,	supretion of we
13a. Yield (gpm)       1       Method of test:       bail       24c. For Water Supply & Injection Wells:         13b. Disinfection type:       HTH       Amount:       1 CUp			D	ivisio	n of Wa	ater R	esources, U	Inderg	round I	njection	Contr	ol Program,
13a. Yield (gpm)       1       Method of test:       Dall       24c. For Water Supply & Injection Wells:         13b. Disinfection type:       HTH       Amount:       1 CUp       24c. For Water Supply & Injection Wells:         13b. Disinfection type:       HTH       Amount:       1 CUp       24c. For Water Supply & Injection Wells:	FOR WATER SUPPLY WELLS ONLY				1036	Mail S	service Cer	ner, R	aleigh, l	NC 2769	9-1636	
13b. Disinfection type: HTH Amount: 1 CUP well construction to the county health department of the county where constructed.	13a. Yield (gpm) 1	Method of test: bail	Also s	or Wa	t one c	opy of	Injection	Wells: within	n 30 day	ys of con	npletio	n of
	13b. Disinfection type: HTH	Amount: 1 CUP	well c	onstru ucted.	iction t	o the c	county heal	th dep	artment	of the o	county	where

Form GW-1

North Carolina Department of Environment and Natural Resources - Division of Water Resources

Revised August 2013

WELL CONSTRUCTION RECORD This form can be used for single or multiple wells			For Internal Use ONLY:											
1. Well Contractor Information:							_							
Jonathan Kamionka			14. WATER ZONES											
Well Contractor Name		19	ft.	29	ft.	DESCRIPT	ION		Sands	_				
3465-A		10	ft.		ft.									
NC Well Contractor Certification Number		15. 01	TER	CASI	NG (for	r multi-cased	wells) (	RLINE	R (if app	licable)	A WALLAND			
Bill's Well Drilling Co		FROM	0	TO	0	DIAMETE	R	THICK	NESS	MATE	CRIAL			
Bill's Weil Dhilling Co.		16 IN	NER	CASIN	IC OR	TURING (get	otherm	al closed	-loop)					
Company Name		FROM	TER	TO	U UIL	DIAMETE	R	THICK	NESS	MATE	RIAL			
2. Well Construction Permit #: List all applicable well permits (i.e. County, Stat	te, Variance, Injection, etc.)	+3	ft.	19	ft.	4.5	in.	SD	R17		PVC			
3. Well Use (check well use):		29	IL.	30	II.	4		sci	n80		PVC			
Water Supply Well:	the state	FROM	REE	то		DIAMETER	SLOT	SIZE	THICK	NESS	MATERIAL			
□Agricultural	DMunicipal/Public	19	ft.	29	ft.	4 <sup>in.</sup>	.0	)20			SS			
Geothermal (Heating/Cooling Supply)	□Residential Water Supply (single)		ft.		ft.	in.								
□Industrial/Commercial	□Residential Water Supply (shared)	18. GI	ROUT	TO		MATERIA	1.	EMPI	ACEMEN	TMETE	IOD & AMOUNT			
□Irrigation		0	ft.	19	ft.	bentoni	e	DOUT	ed		and the rest of the little			
Non-Water Supply Well:			ft.	10	ft.			1000.						
Monitoring	Recovery		ft.		ft			-						
Injection well:	Groundwater Remediation	19 54	ND/G	RAVE	I. PAC	'K (if annlica	ble)	40-3		- 17 1.5	CONTRACTOR OF T			
Aquifer Storage and Recovery	DSalinity Barrier	FROM		TO		MATERIA	L		EMPLACEMENT METHOD					
Aquifer Test	Stormwater Drainage	19	ff.	30	ft	#3	grave	1	poured					
Finerimental Technology			ft.		ft				_					
Geothermal (Closed Loon)		20. DI	arri	NG LO	OG (att	ach additiona	additional sheets if necessary) DESCRIPTION (color, hardpess, soil/eack tone, grain size				main size etc.)			
Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)		ft.	1.0	ft	·	See Attached				Francisco Corrig			
5 9 17		1	ft.	1	ft									
4. Date Well(s) Completed: 5-0-17	Well ID#		ft.	-	ft									
5a. Well Location:	EE 30PZ	-	ft.	-	ft									
NC-DENR	Presidio		ft	-	fr					_				
Facility/Owner Name	Facility ID# (if applicable)		6				_		-					
105 Presidio Dr, Wilmingto	on, NC 28412	-	11. ft	-	11 ft	·		1						
Physical Address, City, and Zip		21. RI	EMAR	KS	-		11/2 24	ANG N		- 19 - 1 <b>7</b>	- and the second second			
New Hanover			JIT 22 BA											
County	Parcel Identification No. (PIN)	-												
5b. Latitude and Longitude in degrees/	minutes/seconds or decimal degrees:	22 60	rtific	ation										
(if well field, one lat/long is sufficient)	_	44. CC	1	anon.		1		/						
N	W		l	N	1	En	1	_		5-8-	-17			
• · · · · · · · · · · · · · · · · · · ·	1	Sigurtu	re of (	Certifie	d Well	Contractor				Date				
6. Is (are) the well(s): Permanent	or DTemporary	By sign	ing th	is form	, I her	eby certify that	t the w	ell(s) wa	s (were) c	onstruc	ted in accordance			
7. Is this a repair to an existing well:	□Yes or ☑No	copy of	this n	ecord h	as been	or ISA NCAC provided to the	he well	owner.	l Construc	tion Ma	maaras ana inal a			
If this is a repair, fill out known well construction	on information and explain the nature of the	23 Site diagram or additional well details												
repair under +21 remarks section or on the back	k oj mis jorm.	You n	nay u	se the	back (	of this page	to prov	vide add	litional v	vell site	e details or well			
8. Number of wells constructed:	s ONLY with the same construction, you can	constru	uction	n detai	ls. Yo	u may also a	ttach a	ddition	al pages i	fneces	sary.			
submit one form.		SUBN	IITT.	AL IN	STU	TIONS								
9. Total well depth below land surface: 30 (ft.) For multiple wells list all depths if different (example- 3@200' and 2@100')			24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:											
10. Static water level below top of casin If water level is above casing, use "+"	g: <u>3.8</u> (ft.)	Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617												
11. Borehole diameter: 10	(in.)	24b. <u>I</u>	or In	iectio	n We	lls ONLY:	In add	ition to	sending	the for	m to the address			
12. Well construction method: Mud	Rotary	24a above, also submit a copy of this form within 30 days of completion of we construction to the following:												
FOR WATER SUPPLY WELLS ONL	Y:	Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636												
13a. Yield (gpm) 10	Method of test: pump	24c. F	or W	ater S	upply	& Injection	Wells	1. 20.			an of			
	Also submit one conv of this form within 20 dows of completion of													

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.

13b. Disinfection type: HTH

North Carolina Department of Environment and Natural Resources - Division of Water Resources

Amount: 1 CUP

Revised August 2013

WELL CONSTRUCTION RI This form can be used for single or multiple wells	For Inte	ernal U	Ise ONL	Y:									
1. Well Contractor Information:													
Jonathan Kamionka			14. WATER ZONES										
Well Contractor Name		155	ft.	165	ft.		L	imest	one & sa	nds			
3465-A		-	ft.		ft.								
NC Well Contractor Certification Number		15. O	UTER	CASIN	G (for	multi-cased	vells) (	OR LINE	ER (if applic	able)	TAT		
Bill's Well Drilling Co.		O	ft.	55	ft.	10	in.	SC	h40	PVC			
Company Name		16. IN	INER	CASIN	GOR	TUBING (geo	therm	nal closed-loop)					
2. Well Construction Permit #:		FROM	ft.	TO	ft.	DIAMETER 4 5	in.	THICKNESS		MATER			
List all applicable well permits (i.e. County, State	, Variance, Injection, etc.)	105	ft.	100	ft.	4.5	in.	30			PVC		
3. Well Use (check well use):		17.50	CREE	N N		4		SCI	100 1	=0	PVC		
Water Supply Well:	14 3	FROM	1	TO		DIAMETER	SLOT	T SIZE	THICKNE	SS	MATERIAL		
	□Municipal/Public	155	n. 0	165	n. 2	4 in	.0	)20			SS		
Geothermal (Heating/Cooling Supply)	□Residential Water Supply (single)	19 0	R. DOLT		н.			1000000					
□Industrial/Commercial	□Residential Water Supply (shared)	FROM	1	TO		MATERIA	L	EMPI	ACEMENT	METHO	DD & AMOUNT		
Dirrigation Non-Water Supply Well:		0	ft.	135	ft.	bentonit	е	pum	ped				
Z Monitoring	□Recovery	135	ft.	145	ft.	bentonit	е	pour	red		N		
Injection Well:			ft.		ft.								
□Aquifer Recharge	□Groundwater Remediation	19. S/	AND/G	RAVE	L PAC	K (if applical	ole)	1	EMPLACES	MENT	METHOD		
□Aquifer Storage and Recovery	□Salinity Barrier	145	ft.	170	ft.	#3 0	rave	1	Ditt Live Di	DOUL	ed		
□Aquifer Test	□Stormwater Drainage		ft.		ft.					1			
DExperimental Technology	□Subsidence Control	20. D	RILLI	NG LO	G (atta	ich additiona	sheets	s if neces	isary)				
Geothermal (Closed Loop)		FROM	1	TO	ft	DESCRIPT	DESCRIPTION (color, hardness, soil/rock type, grain size, etc						
LiGeothermal (Heating/Cooling Return)	UOther (explain under #21 Remarks)	1 <u> </u>	ft.		6		See Attached						
4. Date Well(s) Completed: 5-12-17	_Well ID# EE 30P3		ft.		ft.								
5a. Well Location:	Dessidia		ft.		ft.								
NC-DENR	Presidio	)			ft.								
acility/Owner Name Facility ID# (if applicable)			ft.		ft.								
105 Presidio Dr, Wilmingto	n, NC 28412		ft.		ft.								
Physical Address, City, and Zip		21. R	EMAR	RKS			1.2	4,8,			Notice scenes		
New Hanover													
<b>5b. Latitude and Longitude in degrees/m</b> (if well field, one lat/long is sufficient)	Parcel Identification No. (PIN) inutes/seconds or decimal degrees:	22. Ce	ertific	ation:	11	/_		_		5-12	.17		
N	w	Sienzi	The of C	ertified	Well	Contractor			- 1	Date			
6. Is (are) the well(s): ØPermanent or 7 Is this a repair to an existing well.	By sign with 15	ting th SA NC	is form, 4C 02C	I here .0100 c	by certify that or 15A NCAC	the we 02C .0	ell(s) wa 200 Wel	s (were) con l Constructio	istructe on Stan	d in accordance dards and that a			
If this is a repair, fill out known well construction repair under #21 remarks section or on the back	information and explain the nature of the of this form.	<ul><li>23. Site diagram or additional well details: You may use the back of this page to provide additional well site details or well</li></ul>											
8. Number of wells constructed: For multiple injection or non-water supply wells a submit one form.	ONLY with the same construction, you can	construction details. You may also attach additional pages if necessary.           SUBMITTAL INSTUCTIONS											
9. Total well depth below land surface: <u>170</u> (ft.) For multiple wells list all depths if different (example- 3@200' and 2@100')			24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:										
10. Static water level below top of casing: 22 (ft.)			Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617										
11. Borehole diameter: 10	(in.)	24b. ]	For In	iectio	Well	Is ONLY:	n addi	ition to	sending th	e form	to the address in		
12. Well construction method: Mud F (i.e. auger, rotary, cable, direct push, etc.)	Rotary	24a above, also submit a copy of this form within 30 days of completion of well construction to the following:											
FOR WATER SUPPLY WELLS ONLY		່		163	i Mail	Service Ce	nter, F	Raleigh	NC 27695	9-1636	or a rogram,		
13a. Vield (gpm) 20+ Method of test: pump				ater Su	opy	& Injection	Wells	in 30 d	avs of com	pletio	n of		
13b. Disinfection type: HTH	well c	ucted.	uction	to the	county hea	lth de	partmer	nt of the co	ounty	where			

Form GW-1

North Carolina Department of Environment and Natural Resources - Division of Water Resources

Revised August 2013

#### 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	То	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 R	For In	ternal U	Jse ON	LY:								
1. Well Contractor Information:												
Jonathan Kamionka		14. WATER ZONES FROM TO DESCRIPTION										
Well Contractor Name		27	ft.	37	ft	. DESCRIPT	ION		Sands			
3465-A			ft.		ft							
NC Well Contractor Certification Number		15. (	DUTER	CASI	NG (fo	r multi-cased	wells) (	OR LINI	ER (if appli	icable)		
Bill's Well Drilling Co		FRO	M ft.	TO	ft	DIAMETE	R in.	THICK	NESS	MATER	IAL	
Company Name		16. I	NNER	CASI	NG OR	TUBING (geo	otherm	al closed	-loop)	NC States		
2 Well Construction Reputit #		FRO	M	то	£4	DIAMETE	R	THICK	NESS	MATER	JAL	
List all applicable well permits (i.e. County, State	e, Variance, Injection, etc.)	+4	11. 	27	n	• 4.5		SD	R17		PVC	
3. Well Use (check well use):		37 17. s	II.	41 N	п	·  4		SC	h80		PVC	
Water Supply Well:	1 2017	FRO	M ft.	T0 27	ft.	DIAMETER 1 in.	SLOT	T SIZE	THICKN	ESS	MATERIAL	
	□Municipal/Public	21	ft.	57	ft.	4 in.		020			- 33	
Geothermal (Heating/Cooling Supply)	□Residential Water Supply (single)	18 (	ROUT	•	0.000.000							
	□Residential Water Supply (shared)	FRO	M	ТО		MATERIA	L	EMP	LACEMENT METHOD & AMOU			
Non-Water Supply Well:		0	ft.	20	ft	- bentonit	e	pour	ed			
☑Monitoring	□Recovery		ft.		ft							
Injection Well:			ft.		ft	•						
□Aquifer Recharge	□Groundwater Remediation	19. S	AND/C	RAVI	EL PA	CK (if applical	ble)	Sec. Sec.	EMPLACE	MENT	IFTUOD	
□Aquifer Storage and Recovery	□Salinity Barrier	20	ft.	41	ft	- #3 (	rave	1	ENTLACI	nour	ed	
□Aquifer Test	□Stormwater Drainage		ft.		ft		#3 yraver			poured		
□Experimental Technology	□Subsidence Control	20. 1	RILLI	ING L	OG (at	ttach additional sheets if necessary)				and the second		
Geothermal (Closed Loop)		FRO	M	TO	64	DESCRIPTION (color, hardness, soil/rock type, grain size					rain size, etc.)	
□Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)	」	n.			•		See	Attache	ed		
4. Date Well(s) Completed: 5-15-17	Well ID#_EE 30M1	-	ft. ft.	-	ft							
5a. Well Location:			ft.		ft							
NC-DENR	Myrtle Grove		ft.	-	ft							
Facility/Owner Name	Facility ID# (if applicable)		ft.	-	ft							
250 Shannon Dr, Wilmingt	on, NC 28409	-	ft.		ft							
Physical Address, City, and Zip		21. F	EMAR	RS					C. C. C. C. C. C.		and the state of the	
New Hanover												
County	Parcel Identification No. (PIN)											
<b>5b. Latitude and Longitude in degrees/m</b> (if well field, one lat/long is sufficient)	inutes/seconds or decimal degrees:	22. C	ertific	ation		. /	/					
NT			/		1	11	2			5-15-	17	
IN	w	Signat	uror	ertifie	Well	Contractor				Date		
6. Is (are) the well(s): ☑Permanent or	□ Temporary	By sig with I	ming th 5A NC	is form 4C 02C	, I her 2.0100	eby certify that or 15A NCAC	the we	ell(s) wa 200 Wel	s (were) co l Construct	nstructed ion Stand	d in accordance lards and that a	
7. Is this a repair to an existing well: If this is a repair, fill out known well construction repair under #21 remarks section or on the back	□Yes or ☑No n information and explain the nature of the of this form	copy of this record has been provided to the well owner.										
8. Number of wells constructed: 1		You const	may us ruction	se the detai	back of the back o	of this page to u may also at	o prov tach a	ide ado dditiona	litional we	ell site ( necessa	details or well ary.	
For multiple injection or non-water supply wells	ONLY with the same construction, you can	SUR	мітт	AL IN	STU	TIONS						
9. Total well depth below land surface:	41 (ft.)	24a. For All Wells: Submit this form within 30 days of completion of well										
10. Static water level below top of casing: 8 (ft.)			]	Divisi	on of V	Water Resou	rces, l	Inform	ation Pro	cessing	Unit,	
If water level is above casing, use "+"			0100 S 1999	101	/ 19181	a Service Cel	ater, F	caleigh	INC 2769	9-1017		
11. Borehole diameter: 10 (in.)			24b. For Injection Wells ONLY: In addition to sending the form to the address 24a above, also submit a copy of this form within 30 days of completion of w									
(i.e. auger, rotary, cable, direct push, etc.)				n of V	Vater	Resources, U	Jnderg	ground	Injection	Contro	ol Program,	
FOR WATER SUPPLY WELLS ONLY:				163	o Mai	Service Cei	nter, F	caleigh	NC 2769	9-1636		
13a. Yield (gpm) <u>10</u> M	Method of test: pump	24c. ]	For W	ater S	upply	& Injection	Wells:	n 20 J	aus of	nnlatia	of	
13b. Disinfection type: HTH Amount: 1 cup				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 RI This form can be used for single or multiple wells	For Inte	ernal U	lse ONL	Y:										
1. Well Contractor Information:														
Jonathan Kamionka			14. WATER ZONES											
Well Contractor Name		250	ft.	270	ft.	Discial		Sar	nd & Clav	ау				
3465-A			ft.		ft.									
NC Well Contractor Certification Number		15.0	UTER	CASIN	G (for	multi-cased	wells) O	R LINE	CR (if applie	cable)				
Bill's Well Drilling Co.		FROM	ft.	T0 75	ft.	10	R in.	THICK	NESS 040	MATE				
Company Name		16. IN	NER	CASING	GOR	TUBING (geo	otherma	aal closed-loop)			1.00			
2 Well Construction Permit #•		FROM	l ft	TO	ft	DIAMETE	R in.	THICKNESS		MATERIAL				
List all applicable well permits (i.e. County, State	, Variance, Injection, etc.)	+4	64 64	250	fr.	4.5	in	SD	R17		PVC			
3. Well Use (check well use):		270 17. SC	CREE	1275 N		4		SCI			PVC			
Water Supply Well:		250	ft.	270	ft.	1 in.	SLOI	120	THICKNE	55	SS			
Geothermal (Heating/Cooling Supply)	Municipal/Public     Pasidential Water Supply (single)	200	ft.	210	ft.	in.		20						
Industrial/Commercial	Residential Water Supply (single)     Residential Water Supply (shared)	18. G	ROUT		1415 2	Contract Contract			Sel The holdes	List Con	Support of the second second			
	Encesidential water Suppry (shared)	FROM	[ 	TO		MATERIA	L	EMPI	ACEMENT	METH	OD & AMOUNT			
Non-Water Supply Well:			n. 6	230		bentonit	e	pum	ped					
☑Monitoring	□Recovery	230	ft.	240	tt.	bentonit	e	pour	ed					
Injection Well:			ft.		ft.									
Aquiter Recharge		19. SA FROM	IND/G	TO TO	L PAC	K (if applical MATERIA	ble) L		METHOD					
Aquifer Storage and Recovery	DSalinity Barrier	240	ft.	275	ft.	#3 g	gravel		poured					
	Distormwater Drainage		ft.		ft.									
Geothermal (Closed Loop)		20. DI	RILLI	NG LO	G (atta	ch additiona	l sheets	if neces	ecessary)					
Geothermal (Heating/Cooling Return)	Other (explain under #21 Remarks)	FROM	ft.	10	ft.	DESCRIPT	DESCRIPTION (color, hardness, soil/rock type, grain siz							
4. Date Well(s) Completed: 5-19-17	Well ID# EE 30M2		ft.		ft.									
5a. Well Location:			n.		It.									
NC-DENR	Myrtle Grove		ft.		ft.	1								
Facility/Owner Name	Facility ID# (if applicable)		ft.		ft.									
250 Shannon Dr, Wilmingto	on, NC 28409		ft. ft.		ft. ft.									
Physical Address, City, and Zip New Hanover		21. RI	EMAR	KS				1000						
County	Parcel Identification No. (PIN)	<i>2</i>												
<b>5b. Latitude and Longitude in degrees/m</b> (if well field, one lat/long is sufficient)	inutes/seconds or decimal degrees:	22. Ce	rtific	ation:	/									
N	XX/	1.	~	1	/	2_				5-19	-17			
N	w	Ignatu	re of C	Certified	Well C	ontractor				Date				
6. Is (are) the well(s): ☑Permanent or	□Temporary	By sign with 15.	ing thi A NCA	s form, IC 02C .	I herel 0100 o	by certify that or 15A NCAC	the we 02C .02	ll(s) was 200 Well	i (were) con Constructio	istructe on Stan	ed in accordance dards and that a			
<i>If this is a repair, fill out known well construction</i>	JYes or ⊻No information and explain the nature of the	copy of	this re	cord has	i been j	provided to th	e well o	wner.						
repair under #21 remarks section or on the back of	of this form.	23. Sit	e diag	gram of	r addi	tional well	details	: ida add	itional wa	11 cito	dataila or wall			
8. Number of wells constructed: 1 For multiple injection or non-water supply wells (	ONLY with the same construction, you can	construction details. You may also attach additional pages if necessary.												
suomit one jorm.	275	SUBM		L INS	100	TIONS								
9. Total well depth below land surface: 27.5 (ft.) For multiple wells list all depths if different (example- 3@200' and 2@100')			24a. <u>For All Wells</u> : Submit this form within 30 days of completion of well construction to the following:											
10. Static water level below top of casing: <u>10</u> (ft.) If water level is above casing, use "+"				Division 1617	ı of W Mail	ater Resou Service Cei	rces, I nter, R	nforma aleigh,	ition Proc NC 27699	essing 9-1617	Unit,			
11. Borehole diameter: 10 (in.)			or In	jection also sul	Well omit a	s ONLY: I	n addit his for	tion to m with	sending th in 30 day	e form s of c	to the address in to the address in ompletion of well			
12. Well construction method: Mud Rotary (i.e. auger, rotary, cable, direct push, etc.)			iction	to the f	ollow	ing:	Inde		Inication	Cert	al Program			
FOR WATER SUPPLY WELLS ONLY:			1 1 1 5 1 0	1636	Mail	Service Cei	nter, R	aleigh,	NC 27699	9-1636	or r rogram,			
13a. Yield (gpm) 1 M	Iethod of test: bail	24c. Fe Also s	or Wa ubmit	ter Su one c	opy o	& Injection	Wells: withir	n 30 da	ays of com	pletio	n of			
13b. Disinfection type: HIH Amount: 2 CUP				well construction to the county health department of the county where constructed.										

WELL CONSTRUCTION R	For Int	ernal U	lse ONL	Y:										
1. Well Contractor Information:					_									
Jonathan Kamionka			14. WATER ZONES											
Well Contractor Name		160	ft.	170	ft.	DESCRIT		-	Sands					
3465-A			ft.		ft.									
NC Well Contractor Certification Number		15. 0	UTER	CASIN	G (for	multi-cased v	vells) (	OR LINI	ER (if applica	able)				
Bill's Well Drilling Co.		FROM	1 ft.	T0 75	ft.	DIAMETE:	n in.	THICK	NESS N	ATERIA				
Company Name		16. IN	NER	CASING	NG OR TUBING (geotherma			al closed	VC					
2 Well Construction Permit #:		FROM	1	то	TO DIAMETER T			THICK	THICKNESS MATERIAL					
List all applicable well permits (i.e. County, State	, Variance, Injection, etc.)	+3	n. 6	160	11. 64	4.5	in.	SD	R17	17 PVC				
3. Well Use (check well use):		170 17. Se	CREEI	175 N	n.	4	·	sch80		P	VC			
Water Supply Well:		FROM	ft.	<u>T0</u> 170	ft. A	DIAMETER in.	SLOT	T SIZE	THICKNES	SS M.	SS			
Genthermal (Heating/Cooling Supely)	Municipal/Public  Residential Water Secola (size la)	100	ft.	110	ft.	in.					00			
Industrial/Commercial	Residential Water Supply (single)	18. G	ROUT							Contraction V				
	Encesidential water Suppry (shared)	FROM	1	TO	64	MATERIA	L	EMPI	ACEMENT N	1ETHOD	& AMOUNT			
Non-Water Supply Well:		0	n. 6	150	n. 6	bentonit	e	pum	ped					
☑Monitoring	□Recovery	150	n.	155	II.	bentonit	е	pour	ed					
Injection Well:			it.		ft.									
Aquifer Recharge		I9. SA	AND/G 1	TO	PACE	MATERIA	le) L		EMPLACEN	IENT ME	THOD			
Aquifer Test	Salinity Barrier	155	ft.	175	ft.	#3 gravel				poured	1			
			ft.		ft.									
Geothermal (Closed Loop)		20. D	RILLI	NG LO	G (attao	h additional	sheets	if neces	sary)	tuna guain	n size			
□Geothermal (Heating/Cooling Return)	□Other (explain under #21 Remarks)	1.00.0	ft.	ft. See Attached										
4. Date Well(s) Completed: 5-23-17	4. Date Well(s) Completed: 5-23-17 Well ID# EE 30M3				ft. ft.									
5a. Well Location:			n. 6		n. 6									
NC-DENR	Mvrtle Grove		n.		п.									
Facility/Owner Name	Facility ID# (if applicable)		II.		II.									
250 Shannon Dr. Wilmingto	on, NC 28409		ft.		ft.									
Physical Address, City, and Zip		21. R	II. EMAR	KS	II.		Trailer S			UNIX 175				
New Hanover														
County	Parcel Identification No. (PIN)		Index Control of											
5b. Latitude and Longitude in degrees/m (if well field, one lat/long is sufficient)	inutes/seconds or decimal degrees:	22. Ce	ertifica	ation:	/	/								
N	W			/	L	l				5-23-17	7			
		Signatu	ire of C	ertified	Well Co	ontractor			D	ate				
<ul> <li>o. is (arc) the well(s): Derrmanent or</li> <li>7. Is this a repair to an existing well:</li> </ul>	□ Temporary	By sign with 15 copy of	ning thi A NCA Cthis re	s form, IC 02C .	l hereb 0100 oi been n	y certify that · 15A NCAC rovided to th	the we	ell(s) wa. 200 Well	s (were) cons Construction	tructed in 1 Standar	n accordance ds and that a			
If this is a repair, fill out known well construction repair under #21 remarks section or on the back of	information and explain the nature of the	copy of units record has been provided to the well owner.												
1	5 m 5 m	You n	nay us	e the b	ack of	this page t	o prov	ide add	itional well	site det	tails or well			
8. Number of wells constructed: For multiple injection or non-water supply wells of submit one form.	ONLY with the same construction, you can	construction details. You may also attach additional pages if necessary. SUBMITTAL INSTUCTIONS												
9. Total well depth below land surface: <u>175</u> (ft.) For multiple wells list all depths if different (example- 3@200' and 2@100')				24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:										
<b>10. Static water level below top of casing:</b> If water level is above casing, use "+"		I	Divisior 1617	of Wa Mail S	ater Resou Service Cer	rces, I iter, R	lnform: Raleigh,	ation Proce NC 27699-	ssing Uı •1617	nit,				
11. Borehole diameter: <u>10</u>	(in.)	<b>24b.</b> <u>F</u> 24a ab	For In	jection	Wells	ONLY: I	n addi	ition to	sending the	form to	the address in			
12. Well construction method: Mud Rotary (i.e. auger, rotary, cable, direct push, etc.)				construction to the following:										
FOR WATER SUPPLY WELLS ONLY:		1636 Mail Service Center, Raleigh, NC 27699-1636												
13a. Yield (gpm) M	lethod of test: blow	24c. F	or Wa	ter Su	pply &	Injection	Wells:	n 20 4	ave of as-	lation -	f			
13b. Disinfection type: HTH Amount: 1 CUP				iction to	o the o	county heal	th dep	bartmen	t of the co	unty wh	ere			

#### 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	То	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 compromise 10% of the total samples collected.

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

	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