GROUNDWATER USE AND THE NEED FOR A STATE-WIDE GROUNDWATER LEVEL MONITORING NETWORK IN SOUTH CAROLINA

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Abstract. Increased demand on South Carolina groundwater resources due to population growth, industrial development and recent drought-induced conditions have emphasized the need for more and better data describing groundwater conditions of the South Carolina Coastal Plain region. The South Carolina Department of Health and Environmental Control (DHEC) Water Use and Reporting Program currently requires reporting on the distribution of use for surface water and groundwater resources across the State. Integrating information from both a groundwater level monitoring network and the Water Use and Reporting Program is critical to making water management decisions and resolving water conflicts.

To meet data requirements, DHEC initiated a groundwater level monitoring network in the Coastal Plain of South Carolina in 2008. The network has been developed in coordination with the U.S. Geological Survey, South Carolina Water Science Center (USGS) and the South Carolina Department of Natural Resources (DNR), both of whom have existing groundwater level monitoring networks in the Coastal Plain of South Carolina. DHEC has focused on identifying gaps within the existing USGS and DNR networks to target for additional monitoring. The DHEC network includes monitoring locations screened within the major drinking water aquifers (Tertiary Sand, Floridan, Black Creek and Middendorf aquifers) of the Coastal Plain. Forty-one (41) dedicated automatic data recording devices (ADRs) have been deployed by DHEC bringing the overall number of groundwater level monitoring locations managed by the three agencies to ninety-one (91) within the South Carolina Coastal Plain. Future efforts will include expanding the network to the entire State.

The goal of the three agencies’ cooperative effort is to develop and maintain a state-wide groundwater level monitoring network that provides scientifically defensible information for use in planning, managing and developing South Carolina’s groundwater resources in a responsible and sustainable manner for all current and future users.

INTRODUCTION

The intent of this paper is to:

- Demonstrate the need for an expanded groundwater level monitoring network
- Describe the current DHEC groundwater level monitoring network
- Identify the methods used to design the network
- Describe the intended and potential uses for the data collected through monitoring the network
- Present the anticipated future activities and cooperative efforts between the three agencies.

BACKGROUND

Both the USGS and DNR have been monitoring groundwater levels in a few select locations in major drinking water aquifers across the state beginning in the 1950's and 1960's. Early data are primarily occasional field measurements of water levels. In the 1990's deployment of instruments to record daily and hourly water levels was initiated by the USGS and DNR. DHEC also maintained a limited network of dedicated ADR's in Beaufort and Jasper Counties since 1997. This limited network has been focused on the increased dependence in these two counties on the Floridan aquifer for water supply, a cone of depression that has developed in the aquifer in the Savannah-Hilton Head area, and saltwater intrusion issue in the Hilton Head Area. In the past, there was no formal coordination between the three agencies in developing and maintaining the networks or in sharing of the data.

In 1969, the State Legislature passed the Groundwater Use and Reporting Act that required the establishment of a state-wide groundwater management program. This program included the requirement to establish Capacity Use Area designations in areas where excessive groundwater withdrawal presents potential adverse effects to the natural resource or poses a threat to the
public health, safety or economic welfare, or where conditions pose a significant threat to the long-term integrity of a groundwater source, including saltwater intrusion. To date, four areas of the state have been designated as Capacity Use Areas: Pee Dee (Darlington, Dillon, Florence, Marion, Marlboro, and Williamsburg Counties), Waccamaw (Georgetown, Horry Counties), Trident (Berkeley, Charleston, and Dorchester Counties), and Low Country (Beaufort, Colleton, Hampton, and Jasper Counties).

The current Capacity Use Areas have been designated as such at the request of local entities concerned about declining groundwater levels and increasing demands on the groundwater resource. For example, in 2003 DHEC designated the Pee Dee Capacity Use Area. Water levels in Middendorf aquifer near Florence had declined approximately 195 feet from 110 feet above sea level to 85 feet below sea level.

It is anticipated that additional areas of the Coastal Plain will become Capacity Use Areas in the future. Counties relying primarily on groundwater will face increasing pressures on their water resources as population increases and they experience economic growth. Figure 1 provides a comparison of groundwater use to population changes in Horry County (Population Division, U. S. Census Bureau, 2009). In general, as population has increased so has water use (both surface water and groundwater). This pattern is expected to continue in the future with special areas of concern in the Coastal counties and in the larger metropolitan areas of the Midlands (Florence, Lexington and Richland Counties).

In addition to population growth, cyclical drought conditions also have an impact on groundwater use. Recent significant droughts occurred in 1998-2002 and 2007-2008. Water levels in the State's reservoirs, rivers and streams dropped to historical lows. When water levels are low in surface water bodies, people turn to groundwater. There is also an increased demand on groundwater for irrigation. If there is no rain, the farmers use more groundwater to irrigate their crops. Figure 2 is a comparison of water level data (U.S.G.S, South Carolina Water Science Center, 2010) to precipitation data (Southeast Regional Climate Center, University of North Carolina, 2010) for Aiken County and illustrates the effects of the 1998-2002 drought on groundwater levels. Groundwater level monitoring point AIK-0430 (USGS monitoring location) is located in Aiken County.

![Graph of groundwater use and population](image-url)

**Figure 1.** Comparison of groundwater use data and population data for Horry County from 2000-2009 (U.S. Census, March 19, 2009).
AIK-0430 is 605 feet deep and completed in the Middendorf Formation. Water levels at this location never fully recovered from the 1998-2002 drought. Given the vulnerability of our groundwater resources to overuse and drought, the need to have scientifically defensible data to support management of the resource for current and future uses is clear.

**CURRENT DHEC NETWORK**

DHEC's groundwater level monitoring network is currently focused in the Coastal Plain. It consists of 41 locations (wells) equipped with ADR devices. Figure 3 shows the DHEC water level monitoring locations. There are 16 locations within the Middendorf aquifer, one screened in both the Black Creek and Middendorf aquifers, 9 within the Black Creek aquifer, 12 within the Floridan limestone aquifer, and three in the Tertiary Sand aquifer. This network is separate from the Salt-Water Intrusion Study network concentrated in the Beaufort/Hilton Head area.

ADR's are deployed within the well, generally 15 to 20 feet below the water surface. DHEC is using Schlumberger Mini and Micro divers (pressure transducers that measure submergence depth). Direct read (data) cables are used to hang the ADR's within the wells. Barometric data is also collected in order to correct the ADR data for barometric effects (changes). Schlumberger Barodivers, in addition to NOAA weather monitoring stations, are used for this purpose. One Barodiver or NOAA weather monitoring station is used to provide barometric data for ADRs within a 40-mile radius. Manual tape-down water levels are collected each time data is downloaded. The direct read cables allow for ease of data download. A laptop or PDA is connected to the direct read cable at the wellhead. The use of direct read cables eliminates the need to remove the ADR from the well in order to download the data. Data is downloaded twice a year and maintained in an Access database.

**NETWORK DESIGN**

Locations for the DHEC monitoring points were selected by evaluating data from the existing USGS/DNR network and water use data from DHEC's Water Use program. Once areas of concern were identified, offline or emergency back-up water supply wells were targeted.
for ADR deployment. DHEC’s current budget does not include monies for the drilling of monitoring wells for the network. So DHEC is constrained to use of existing public water supply wells or other wells that are not routinely pumped. In some instances water supply systems have observation wells available for use.

DATA EVALUATION AND USE

Corrected data is evaluated to determine short-term (seasonal) and long-term trends. Water use data and precipitation data are used in the evaluation. Based on this evaluation, areas of concern for additional monitoring are identified. The Water Use Program also uses the groundwater level data as part of their permit decision-making process.

The public can access the groundwater level data for USGS and DNR monitoring locations via the Internet. The USGS website is located at http://groundwaterwatch.usgs.gov/StateMapsNet.asp?ncd=rtn&sc=45. The DNR web address is http://www.dnr.sc.gov/water/hydro/groundwater/gw_main.html. DHEC groundwater level data is not yet available on-line. However, upon request, the data can be supplied in either an Excel spreadsheet format or in an Access database table. All data is shared between the three agencies.

FUTURE ACTIVITIES

The three agencies will continue to cooperate in developing and maintaining the Coastal Plain groundwater level monitoring network. It is anticipated that additional locations within the Coastal Plain and expansion of the network to fully cover the Piedmont will be undertaken as funding is available. Of specific concern are the recharge zones for the Black Creek and Middendorf aquifers in the Upper Coastal Plain. Other priority areas include locations near the town of Andrews and Georgetown and the area of Mt. Pleasant and Charleston. A significant cone of depression exists in the Black Creek aquifer near Andrews and Georgetown. A cone of depression has also developed in the Middendorf aquifer in the vicinity of Mt. Pleasant and Charleston. More monitoring locations are needed to understand the causes and predict future impacts. Additionally, DHEC is in the process of developing access to the DHEC groundwater level network via the Internet to make the data readily available to the public and other entities.

ONGOING CHALLENGES

As mention previously, DHEC is currently constrained to utilizing only existing wells for monitoring points. This limitation restricts DHEC’s ability to extract the best information from the network by limiting the location of the network of wells. A funding source or other means needs to be identified to provide for well installations in optimal locations. In addition, the current budget situations for DHEC, DNR and the USGS present significant challenges to maintaining and expanding the network over the long-term. Depending on near-term budgets it may prove difficult for one or more of the participating agencies to continue with these activities.

LITERATURE CITED


The Southeast Regional Climate Center, University of North Carolina, 2010, Precipitation Data: http://www.sercc.com/cgi-bin/sercc/cliMAIN.pl?sc0074