
# Initial Groundwater Management Plan for the Waccamaw Capacity Use Area

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Technical Document Number: 0801-17

**Bureau of Water**
**August 2017**

S.C. Department of Health and Environmental Control

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# Contents

# Executive Summary

South Carolina's Groundwater Use and Reporting Act (Chapter 5, Section 49-5-60) gives the South Carolina Department of Health and Environmental Control (DHEC) the legal authority and mandate to establish and implement a local groundwater management program in designated Capacity Use Areas. Effective groundwater management ensures that the groundwater resources of the State are put to beneficial use to the fullest extent which they are capable, conserves and protects the resource, prevents waste, and establishes conditions which are conducive to the development and long-term viability of the water resources. As aquifers and the relative social and economic requirements of the State vary by area and region, groundwater management should be locally and/or regionally assessed, balancing all needs and interests. In this regard, DHEC coordinates with local stakeholders to achieve the stated goals of the plan leading to sustainable development of the groundwater resources. Sustainable development is the key guiding principle, where South Carolina's groundwater resources are managed so that development meets the needs of the present without compromising the ability of future generations to meet their needs.

# Introduction

On June 22, 1979, the South Carolina Department of Health and Environmental Control Board, as established in Section 49-5-60, Capacity Use Designation, declared the whole of Georgetown County and Horry County as the ***Waccamaw Capacity UseArea***(Waccamaw Area), Figure 1.The Waccamaw Area was the first of the four currently declared Capacity Use Areas in South Carolina. Within the Waccamaw Area, no person shall withdraw, obtain, or otherwise utilize groundwater at or in excess of three (3) million gallons per month for any purpose unless said person shall first obtain a Groundwater Withdrawal Permit from DHEC. A groundwater withdrawer is defined as any person withdrawing groundwater at or in excess of three (3) million gallons during any one month from a *single well* or *multiple wells* within a one-mile radius of any existing or proposed well.

The Waccamaw Area plan will guide the initial groundwater management strategy and provide direction for future groundwater management goals by evaluating, as data become available, the hydrologic, environmental, social, and economic impacts of groundwater withdrawals at various rates on the long-term sustainable levels for the aquifers of the Waccamaw Area. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their needs and requirements. Therefore, the three general goals of the Waccamaw Area Groundwater Management Plan are:

1. Ensure sustainable development of the groundwater resource by management of groundwater withdrawals;
2. The protection of groundwater quality from salt-water intrusion; and,
3. Monitoring of groundwater quality and quantity to evaluate conditions.

To accomplish the above goals, the Waccamaw Area Groundwater Management Plan addresses the following aspects of water use in the Georgetown and Horry County region:

- Groundwater sources currently utilized;
- Current water demand by type and amount used;
- Current aquifer storage and recovery and water reuse;
- Population and growth projections;
- Water demand projections;
- Projected opportunities for aquifer storage and recovery, as well as water reuse;
- Projected groundwater and surface water options; and,
- Water conservation measures.

Planning is a multi-stage process that includes provisions for updating/amending as conditions change over time. In this first plan, only general goals can be established. As more data are developed about the groundwater resources of the Waccamaw Area, more specific goals and withdrawal limits will be incorporated.

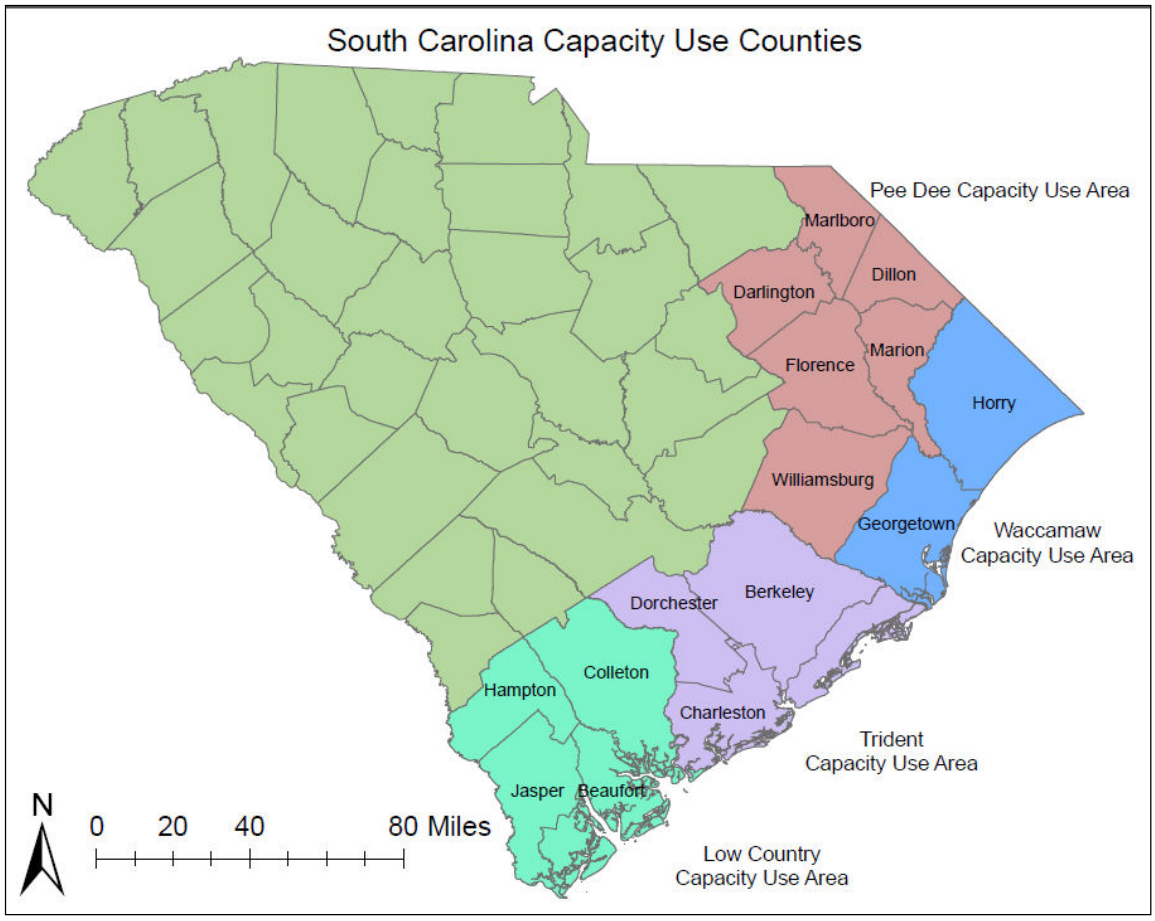


*Figure 1. Capacity Use Areas.*

# Definitions

**"Adverse Effects" –** Undesirable consequences of withdrawing groundwater that may include: changes in water quality, significant reduction in water level of the aquifer, saltwater intrusion, land subsidence, and decreases in stream flow.

**"Beneficial Use"** - The use of that amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made.

"**Best Management Plan**" means a document that supports the design, installation, maintenance, and management of water conveyance systems and/or water withdrawal systems (water supply, commercial, industrial, agricultural, etc.), which promotes water conservation, and protects water quality.

"**Person**" means an individual, firm, partnership, association, public or private institution, municipality or political subdivision, local, state, or federal government agency, department, or instrumentality, public water system, or a private or public corporation organized under the laws of this State or any other state or county.

**‘Sustainable Yield”** - ground-water sustainability as development and use of ground water in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences.

**“Water User”** - A person using groundwater for any purpose.

## Geo-Political Structure

As one of South Carolina’s ten Regional Planning Councils, the WRCOG’s primary objectives include providing planning and technical support to local governments and assisting them in the development of local and regional plans. The WRCOG is governed by a twenty-five-member board, who are appointed by the legislative delegation of each respective county (Georgetown, Horry and Williamsburg Counties). This board, led by an Executive Committee, sets policy and provides direction to the programs of the WRCOG.

Currently, the two-county (Georgetown and Horry Counties) Waccamawarea contains 11 cities and towns and over 360,000 people. This includes a few central cities surrounded by smaller cities, island communities, and rural towns (up to 59 small unincorporated areas). Georgetown and Horry Counties’ governments are conducted through a Council-Administrator form of government. Of these 11 jurisdictions, 5 utilize a Mayor-Council form of government.

The SCDHEC has permit authority for all groundwater withdrawals in the Waccamaw Area. Permits are issued after appropriate review in accordance with Chapter 5, The Groundwater Use and Reporting Act, Groundwater Use and Reporting Regulation, R.61-113, and the goals and management strategy developed in the Waccamaw Area Groundwater Management Plan.

## Regional Description

Comprised of Georgetown and Horry Counties, the Waccamaw area covers 2,290 square miles, of which approximately 342 square miles are surface water. The Waccamaw area stretches about seventy miles through the northern coast of South Carolina, bordered by the Santee River on the south, the North Carolina border to the north, Pee Dee to the west, and the Atlantic Ocean on the east. The region includes over sixty miles of uninterrupted Atlantic coastline, also known as the Grand Strand. Both counties are located in the Coastal Plain physiographic region, Figure 2.

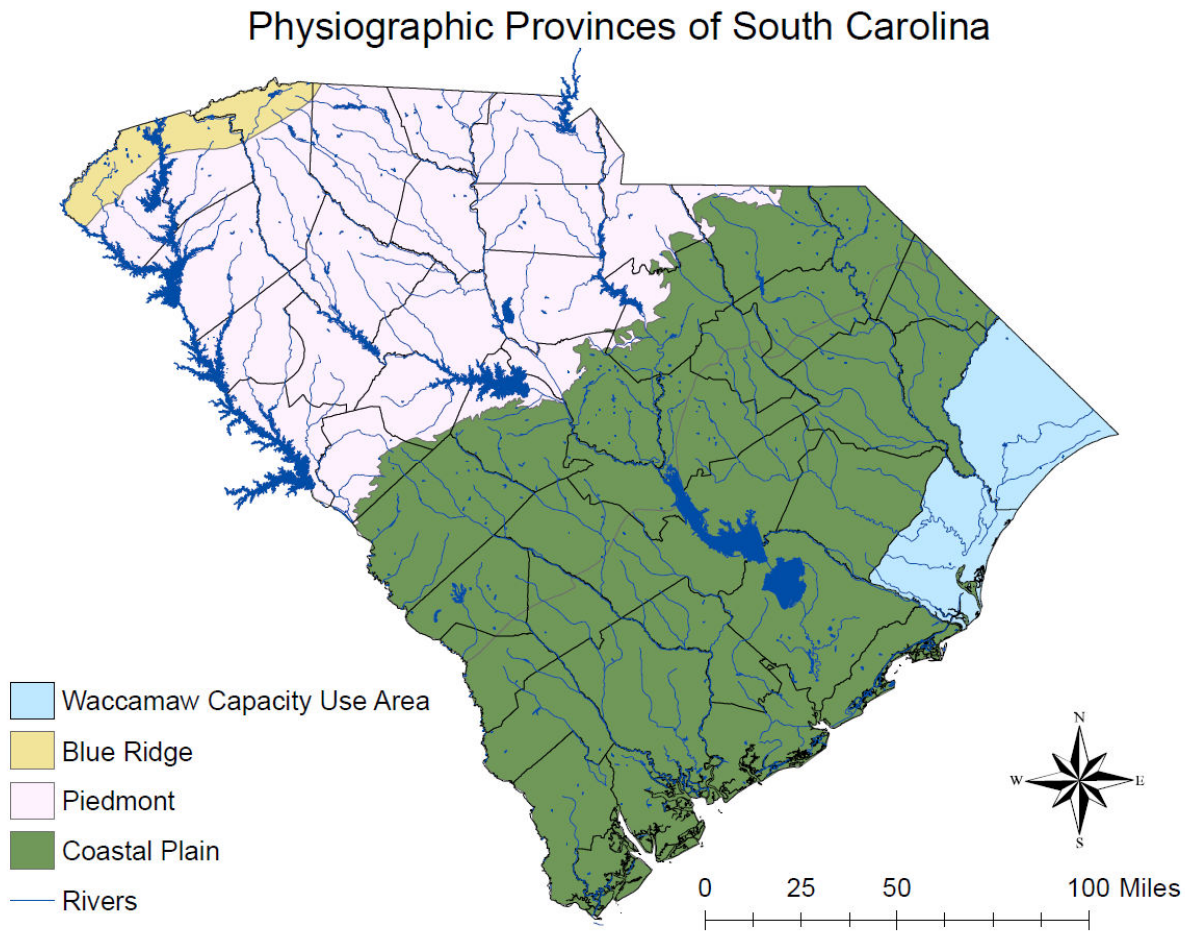


*Figure 2. Physiographic Provinces of South Carolina.*

There are several major water bodies in the area in addition to the Atlantic Ocean including the Intracoastal Waterway, numerous rivers such as the Waccamaw, Pee Dee, and part of the Santee Rivers and a network of streams, wetlands, and marshes, Figure 3. The topography of the region is very level with only slight undulations in the landscape. Elevations range from mean sea level to slightly over one hundred feet. Soil types vary from well-drained sandy loams to muck lands. Generally, alluvial deposits border the larger streams, organic deposits underlie the swamps, and various types of loams cover the better-drained areas.

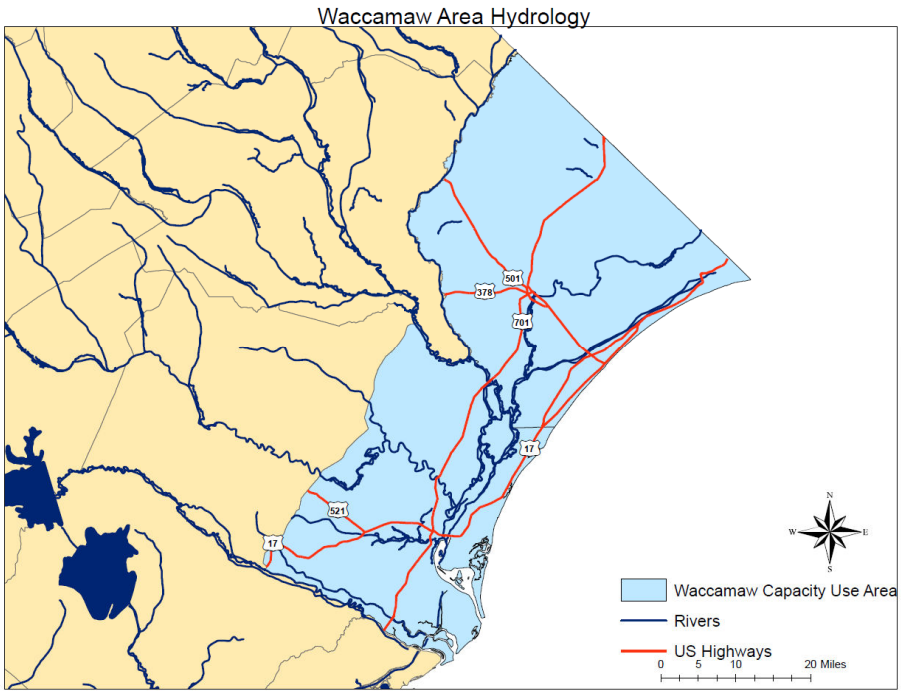


*Figure 3. Hydrology of the area.*

The Waccamaw Area enjoys a relatively mild and moderate climate characteristic of its southeast US coastal location. Compared to overall State averages, winter temperatures are generally warmer and summers tend to be cooler and less humid. The average annual temperature is 64.58°F, with an average daily maximum of 75.63°F and a minimum of 53.5°F. Approximately thirty-five percent of the fifty-four inches of average annual precipitation occurs during the summer months (Figure 4, 5). Thunderstorms are most frequent during the summer and create relatively short durations of concentrated runoff.

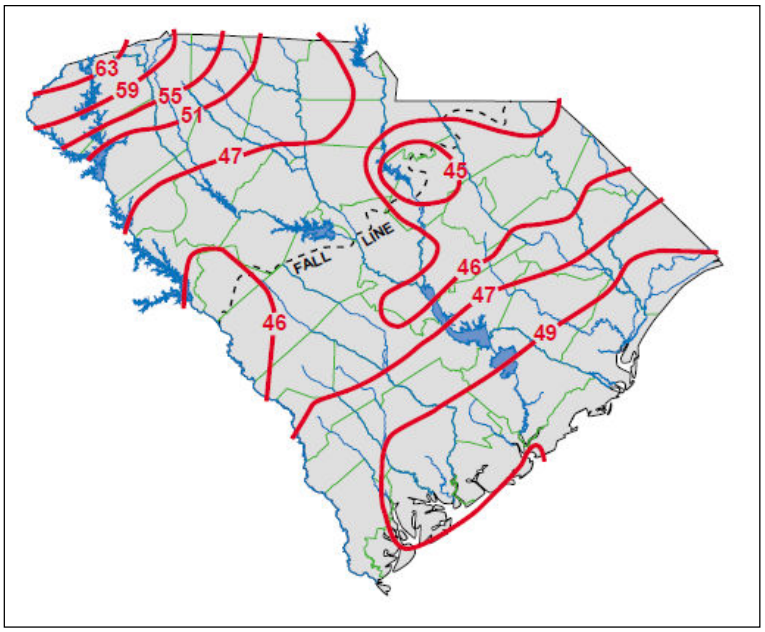


*Figure 4. Average annual precipitation, in inches for the period 1948-1990. Source: South Carolina Department of Natural Resources (SCDNR)-Hydrology/Geology Map 2, R.N. Cherry, A.W. Badr, and Andrew Wachob, 2001.*

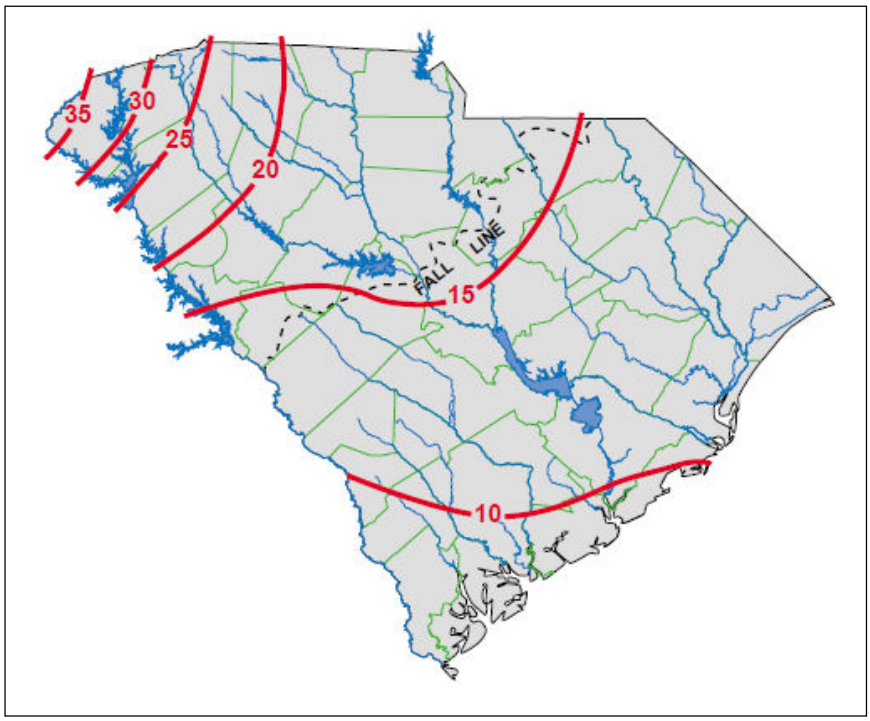


*Figure 5. Average annual water yield (precipitation less evapotranspiration), in inches, 1948-1990. Source: SCDNR-Hydrology/Geology Map 2, R.N. Cherry, A.W. Badr, and Andrew Wachob, 2001.*

## Groundwater Supplies

The oldest (and deepest) aquifers or water-bearing units underlying the Waccamaw Area are of Late Cretaceous age and comprise sediments that have been subdivided into four (4) aquifer systems (oldest to youngest): the Gramling, Charleston, McQueen Branch, Crouch Branch, and Gordon, Figure 6. These units are generally continental shelf to inner marine shelf and deltaic deposits and range from fine to medium grained sand, silts and clays. Water bearing zones typically are beds of sands of varying thickness and extent separated by silty, clayey beds or lenses.

- The Gramling Aquifer is not well defined and no known outcrop has been identified in South Carolina. It is thought to mainly consist of sand and gravel beds separated by thick layers of silt and clay.
- The Charleston/McQueen Branch Aquifer occurs throughout the Coastal Plain, from the Fall Line to the coast. The McQueen Branch crops out (catchment area) adjacent to the Fall Line from Chesterfield County to Edgefield County. In the Waccamaw Area the aquifer is generally composed of thin- to thick-bedded sands and clays deposited in marginal marine and/or lower delta plain environments. In the Waccamaw area, the McQueen Branch-Charleston aquifer is approximately 400 feet thick.
- The Crouch Branch Aquifer occurs throughout the Lower Coastal Plain and crops out in the eastern portion of the Coastal Plain from Lexington County to Dillon County. The aquifer is generally composed of thin- to thick-bedded sands and clays deposited in marginal marine and/or

lower delta plain environments. In the Waccamaw area, the Crouch Branch is approximately 450 feet thick.

Units overlying the Late Cretaceous formations include the Tertiary age Gordon, Floridan, and Surficial Formations, Figure 6. These units range from marginal marine to outer shelf deposits and their lithologies consist predominantly of sand, silt, and clay, with the upper part being mainly pure to impure limestone.

- The Gordon Aquifer extends from its catchment area in the middle of the Lower Coastal Plains southwest. In the Waccamaw area, the Gordon is approximately 50 feet thick.
- The Floridan Aquifer occurs throughout the southern portion of the coastal plain. In the Waccamaw area, the Floridan Aquifer is not very well represented, only in the southernmost part of Georgetown County.
- The Tertiary units are overlain by a sequence of sand, silt, clay, and shells of Pleistocene age that are generally not more than fifty feet thick.

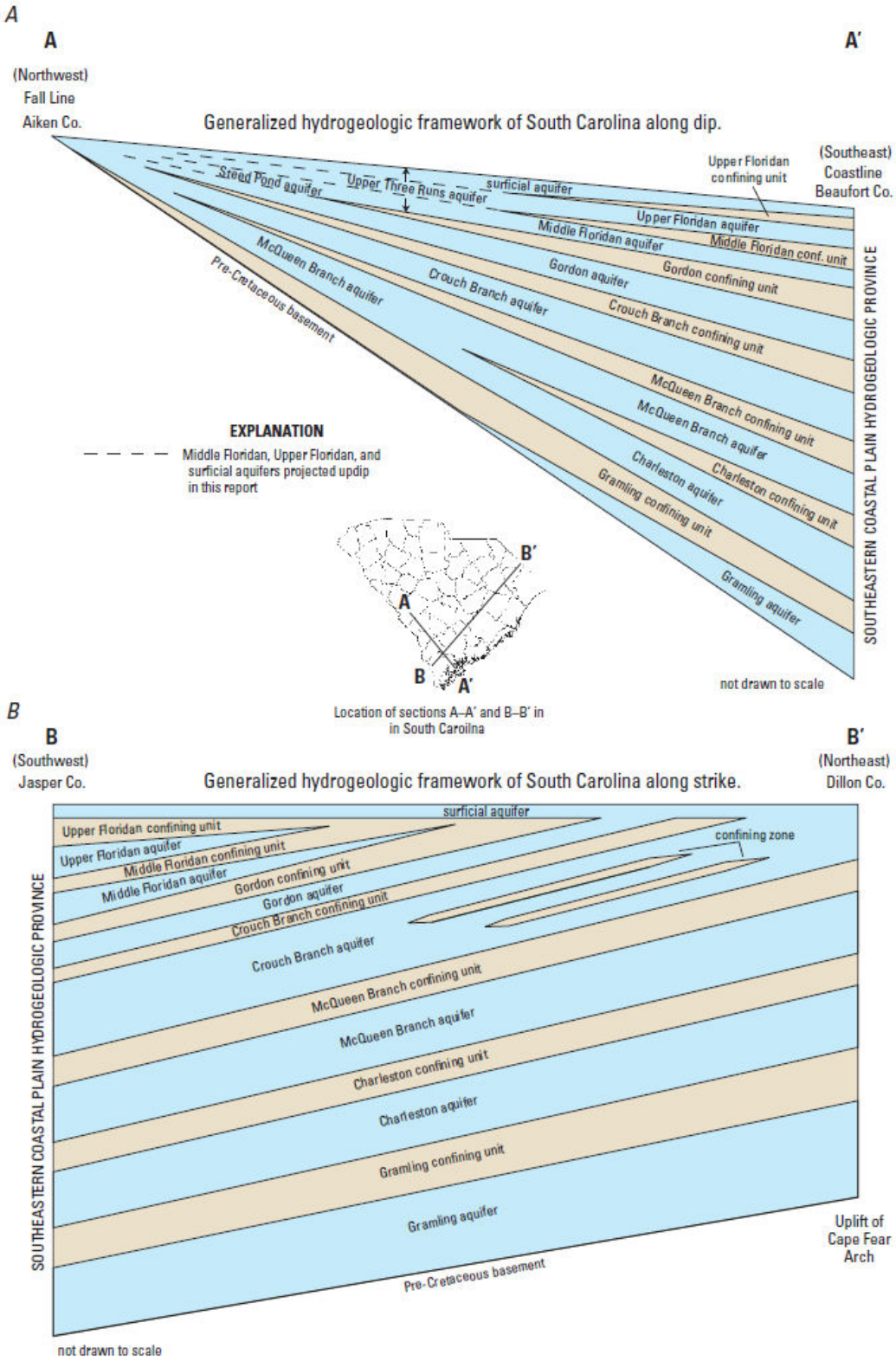


*Figure 6. Generalized hydrogeologic framework, J. Gellici and J. Lautier, 2010 Hydrogeologic Framework of the Atlantic Coastal Plain, North and South Carolina: U.S. Geological Survey Professional Paper 1773, 113p.*

Groundwater recharge occurs with infiltration of precipitation in catchment (recharge) areas. Figure 7 depicts the general recharge or catchment areas for the aquifers of the Waccamaw Area. The majority of recharge of aquifers in the Waccamaw area occurs mainly north of the region proper.

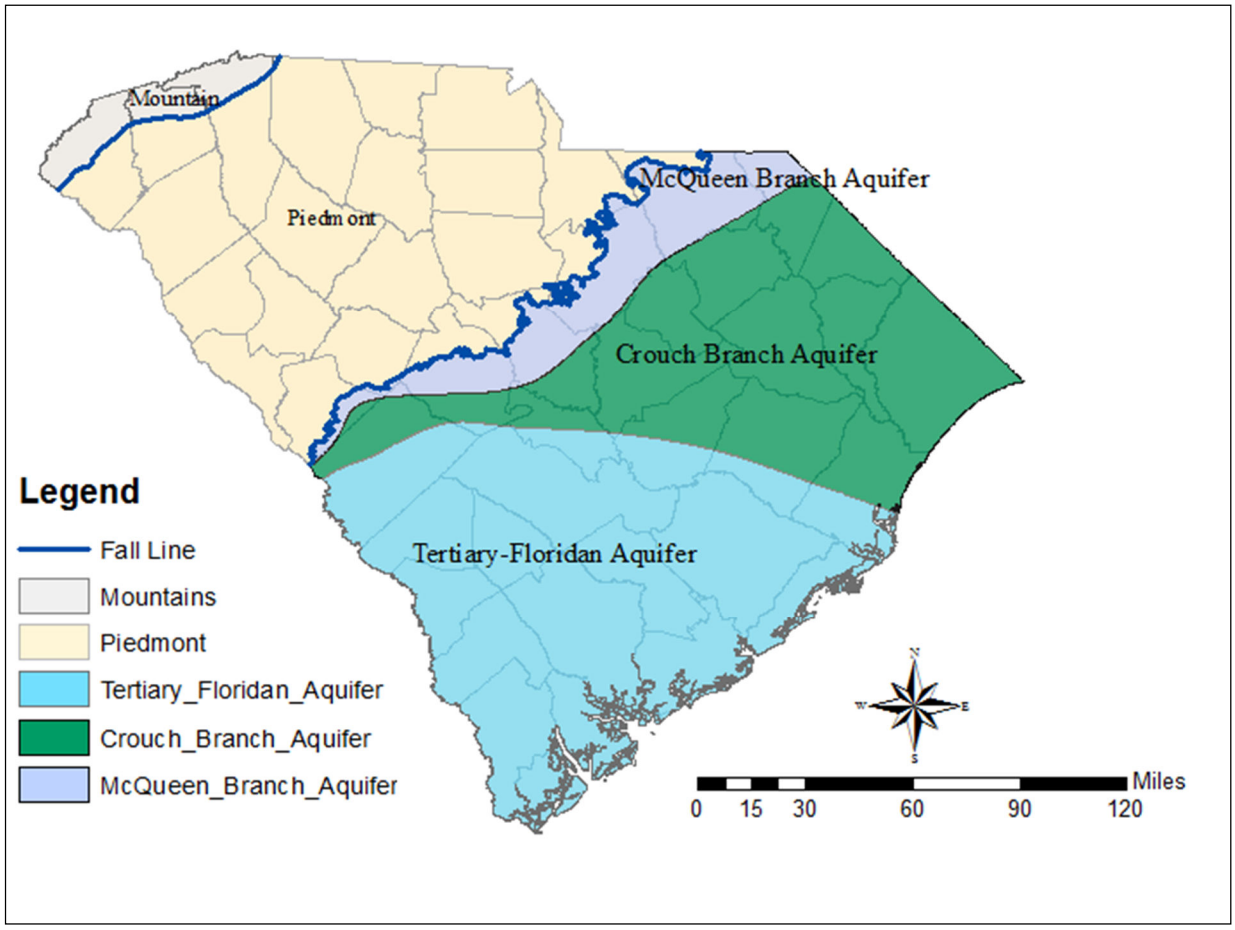


*Figure 7. Generalized aquifer recharge areas.*

# Groundwater Level Trends

***Crouch Branch Aquifer***

Groundwater levels in the Crouch Branch Aquifer have declined substantially from pre-development levels in the Waccamaw area. Most of this decline can be attributed to concentrated public water supply usage. By 2000, the water level had dropped to 125 feet below mean sea level. Even with surface water being utilized for public water supply, the sharp influx of people over a short period of timehas caused severe depressions in the region. Figure 8 shows the 2004 water levels in the Crouch Branch Aquifer (formerly known as the Black Creek). Figure 9 shows the 2015 potentiometric map for the Crouch Branch Aquifer produced by SCDNR. In 2015, the cone of depression centered in near the City of Georgetown is more well-defined as is the smaller area of concern in Horry County.

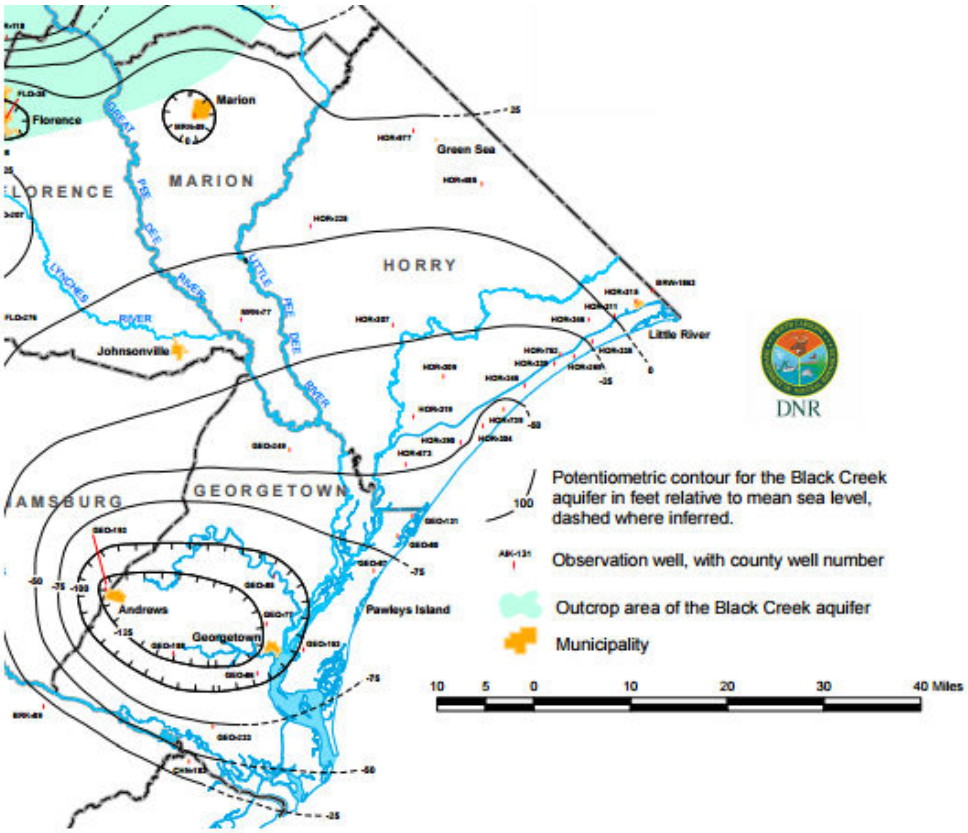


*Figure 8. Water level map for the Black Creek Aquifer (Crouch Branch), 2004. Source: Hockensmith, 2008, SCDNR Water Resources Report 47.*

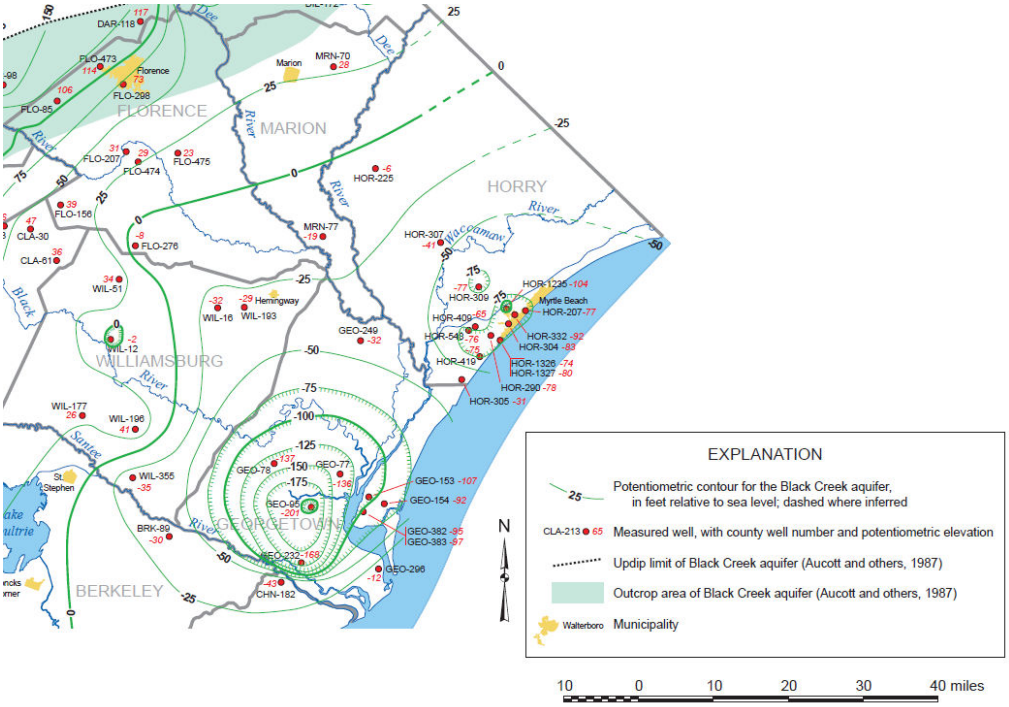


*Figure 9. Water level map of the Crouch Branch Aquifer, 2015. Source: Wachob and Czwartacki, 2015, SCDNR Water Resources Report 59.*

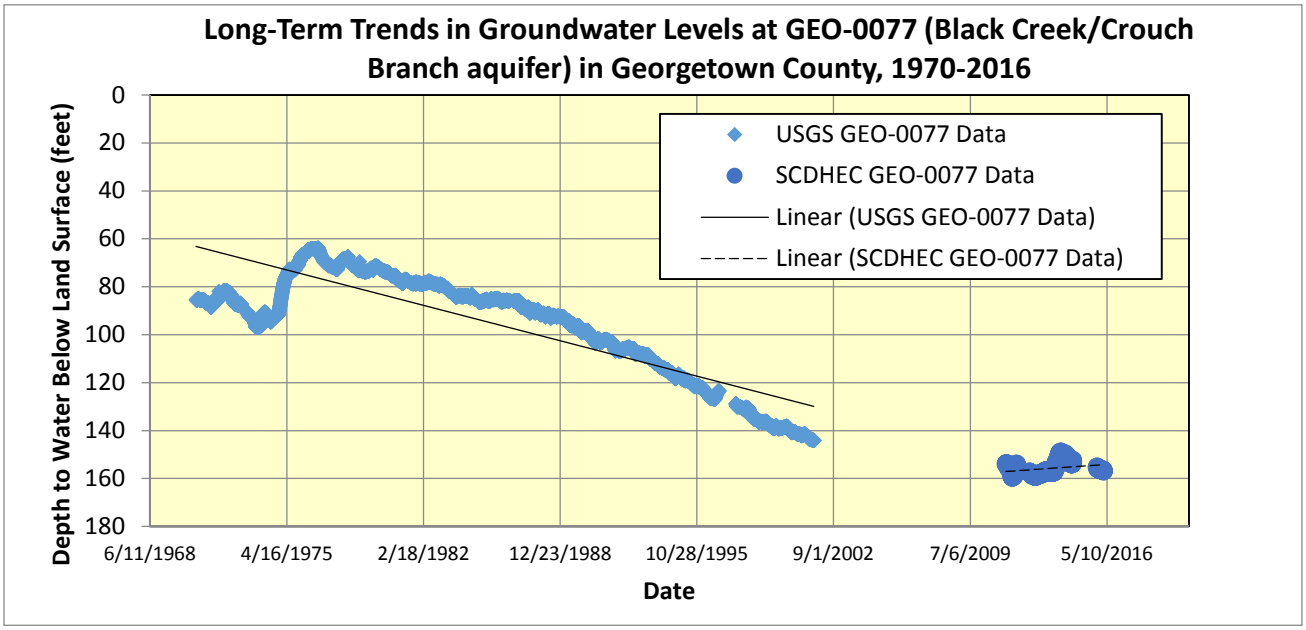


*Figure 10: Long-Term Trends in Groundwater Levels at GEO-0077 in Georgetown County, 1970-2016*

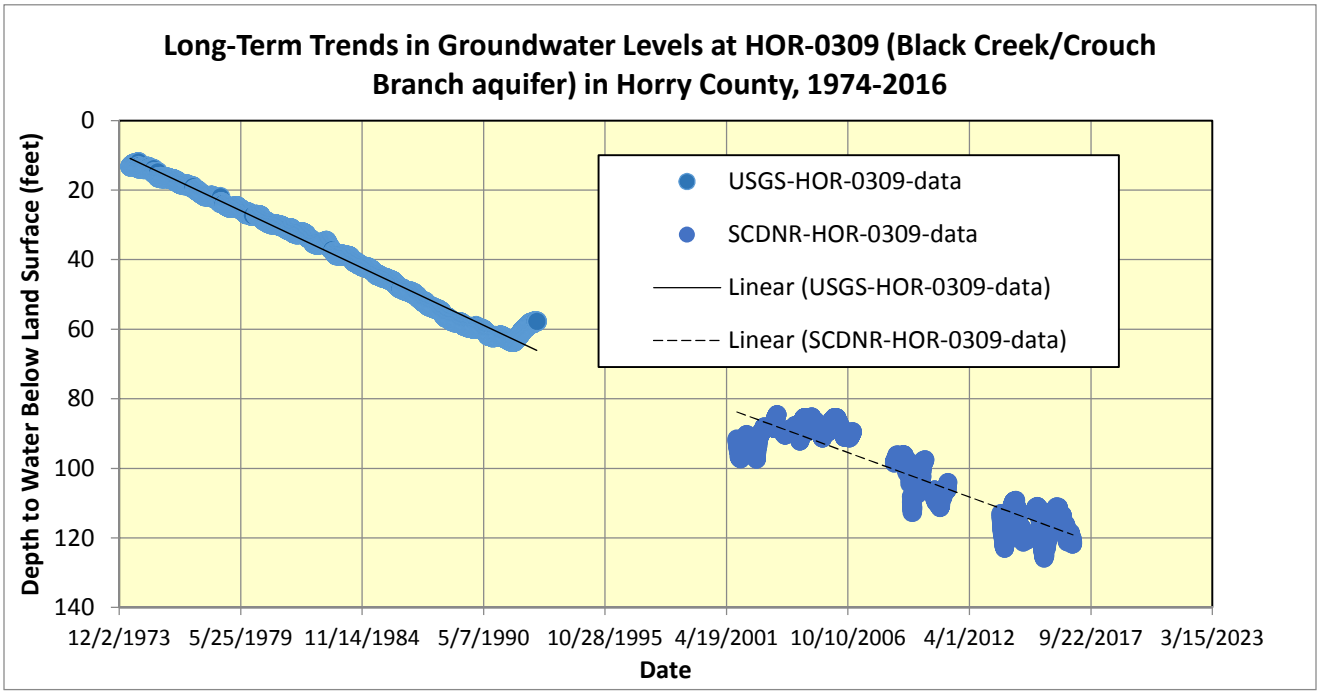


*Figure 11: Long-Term Trends in Groundwater Levels at HOR-0309 in Horry County, 1974-2016*

Continuous water level data for the Crouch Branch Aquifer is available from two wells, GEO-0077 (Georgetown) and HOR-0309 (Horry County). The United States Geological Survey (USGS) collected water level data from GEO-0077 between 1970 and 2001. SCDHEC began collecting water level data from this well in 2011. The USGS collected water level data from HOR-0309 between 1974 and 1992 with SCDNR continuing monitoring at this location in 2001. Data from these two wells (Figure 10 and Figure 11, respectively) was used to evaluate long-term trends in groundwater levels in the Crouch Branch Aquifer in the Waccamaw area.

Between 1970 and 2001, the groundwater levels in the Crouch Branch Aquifer at the GEO-077 well have declined at an approximate rate of 1.9 feet per year, with a total decline at this well of approximately 100 feet.Subsequent monitoring data appears to indicate that this decline has leveled off. However, this data set is too limited to make a definitive determination that groundwater levels in the Crouch Branch (Black Creek) Aquifer have stabilized in Georgetown County. Additional monitoring at this location is needed as are additional new monitoring locations to evaluate the status of the cone of depression observed in the Georgetown area.

Between 1974 and 1992, the groundwater levels in the Crouch Branch Aquifer at the HOR-0309 well (Horry County) have declined at a rate of about 2.5 feet per year. Between 2001 and 2016, the rate of decline in groundwater levels was approximately 1.9 feet per year at the HOR-0309 well, which suggests that the rate of decline in this aquifer in the Horry County area is slowing. This is most likely due to changes in water use (an increased reliance on surface water) by groundwater withdrawers in the region.

The population of the region increased and is projected to reach 436,800 by 2030 (Source: South Carolina Revenue and Fiscal Affairs Office, *http://abstract.sc.gov/chapter14/pop5.html*), demands on the groundwater resource are certain to increase in the future.

### *McQueen Branch/Charleston Aquifer*

The Middendorf/McQueen Branch Aquifer potentiometric maps produced by SCDNR appear to show a water level increase in the Myrtle Beach area of approximately 50 feet between 2004 (Figure 12) and 2014 (Figure 13). In the Georgetown County, there appears to be a 75 foot increase in water levels between 2004 and 2014 potentiometric maps. However, data from only two monitoring locations in Horry County and no wells in Georgetown County were used in producing the 2004 potentiometric map. For the 2014 potentiometric map, only one well in Horry County and no wells in Georgetown County were used. This introduces some uncertainty in what conclusions can be drawn regarding groundwater conditions in the McQueen Branch/Charleston aquifer in the Waccamaw area based on the two potentiometric maps. Note that the potentiometric maps were produced based on water level measurements collected by the USGS, SCDNR and SCDHEC during November/December of 2004 and 2014 respectively.

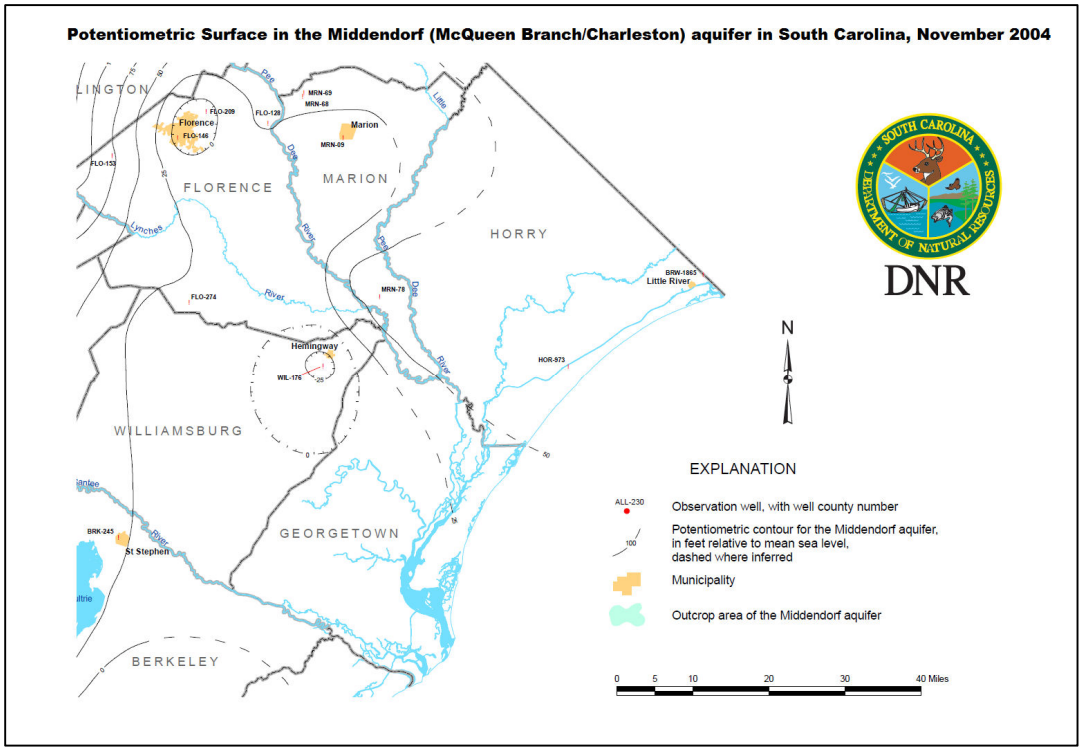


*Figure 12: Water level map for the Middendorf/McQueen Branch/Charleston Aquifer, 2004. Source: Hockensmith, 2008, SCDNR Water Resources Report 46.*

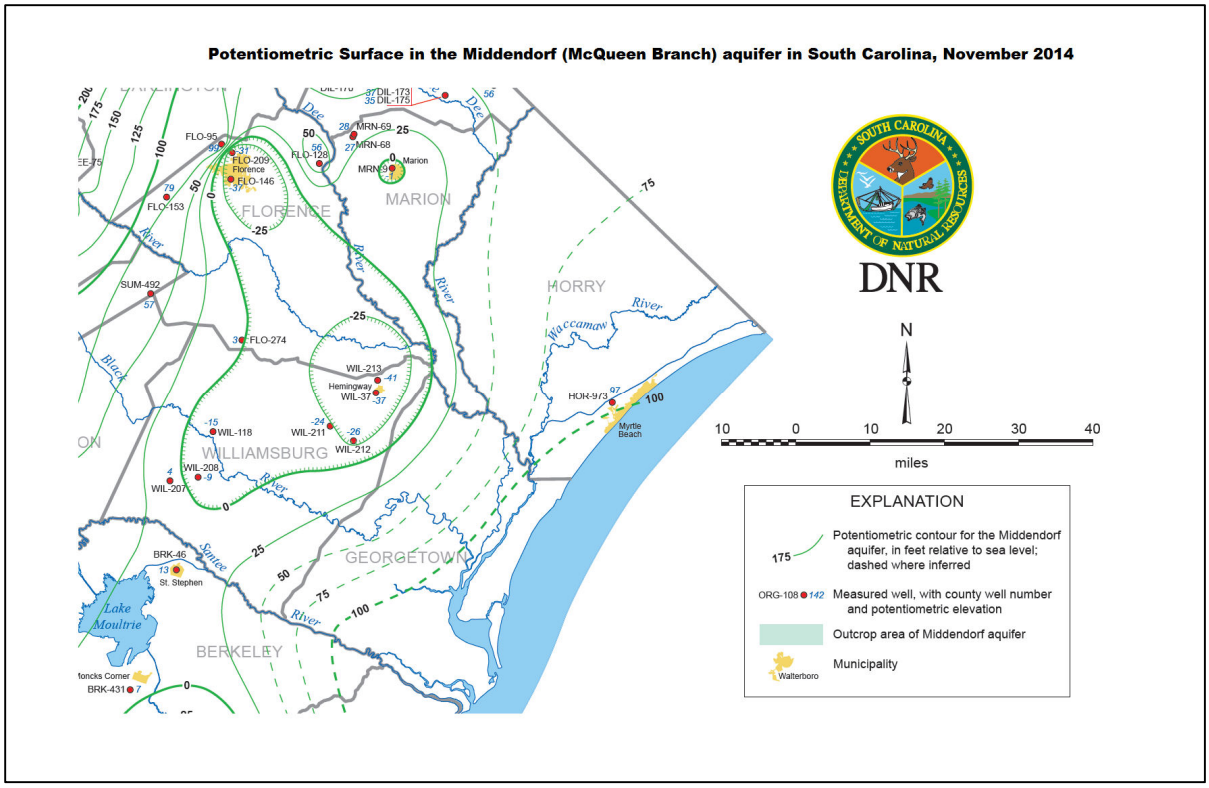


*Figure 13: Water level map for the Middendorf/McQueen Branch/Charleston Aquifer, 2014. Source: Wachob, 2015, SCDNR Water Resources Report 58.*

However, long-term water level data collected at well HOR-0973 is available for evaluation. SCDNR collects manual water level measurements from this well periodically. Based on HOR-0973 well groundwater level data (Figure 14), there has been an overall decline (approximately 12 feet) in the groundwater level since 1998, averaging about 0.5 feet per year. Between 2010 and 2016 the rate of decline appears to have increased as groundwater levels declined by 6 feet or approximately 1 foot a year. If one looks at the reported water use in Figure 15, between 2007 and 2016, there was an increase in reported groundwater use from the McQueen Branch/Charleston aquifer system. This most likely accounts for the increase in the rate of decline noted in water level data presented in Figure 14.

Despite the noted declines, water levels in this aquifer are still above mean sea level, and also approximately 500 feet above the top of the aquifer itself. While declines in the aquifer are documented by data from HOR-0973, overall conditions in the Middendorf/McQueen Branch/Charleston Aquifer in the Waccamaw Capacity Use Area don't show the same evidence of stress from long-term use that exist in the Crouch Branch aquifer.

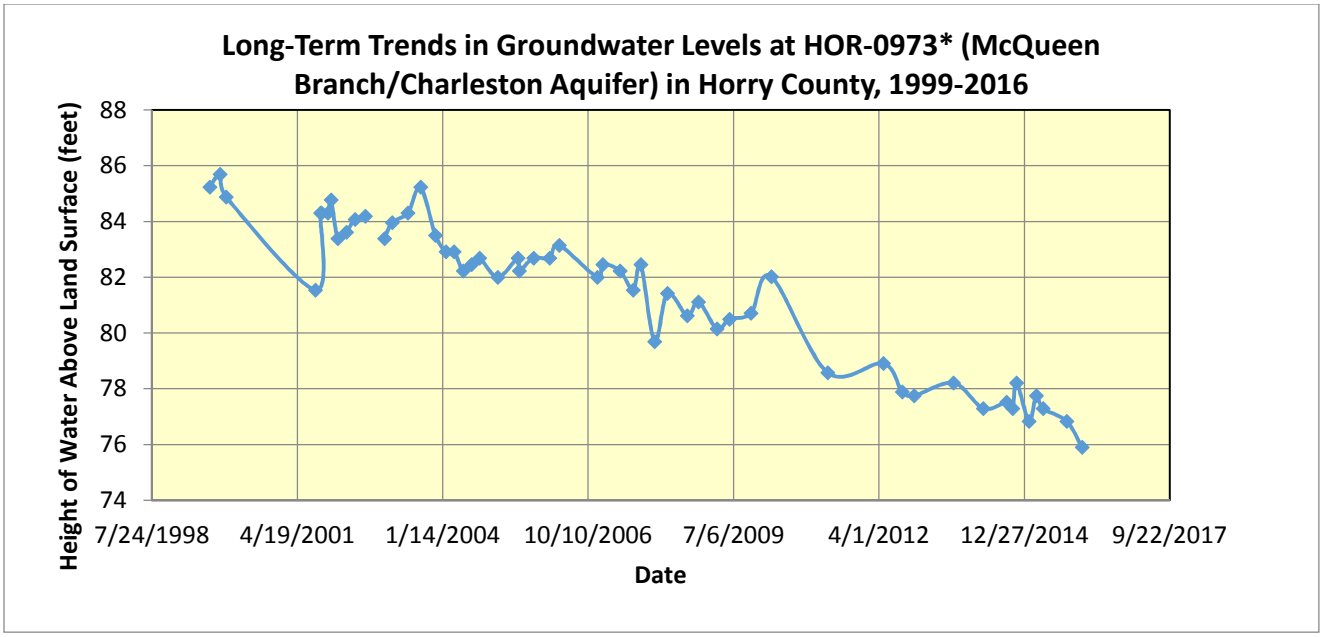


*Figure 14: Long-Term Trends in Groundwater Levels at HOR-0973 in Horry County, 1999-2016*

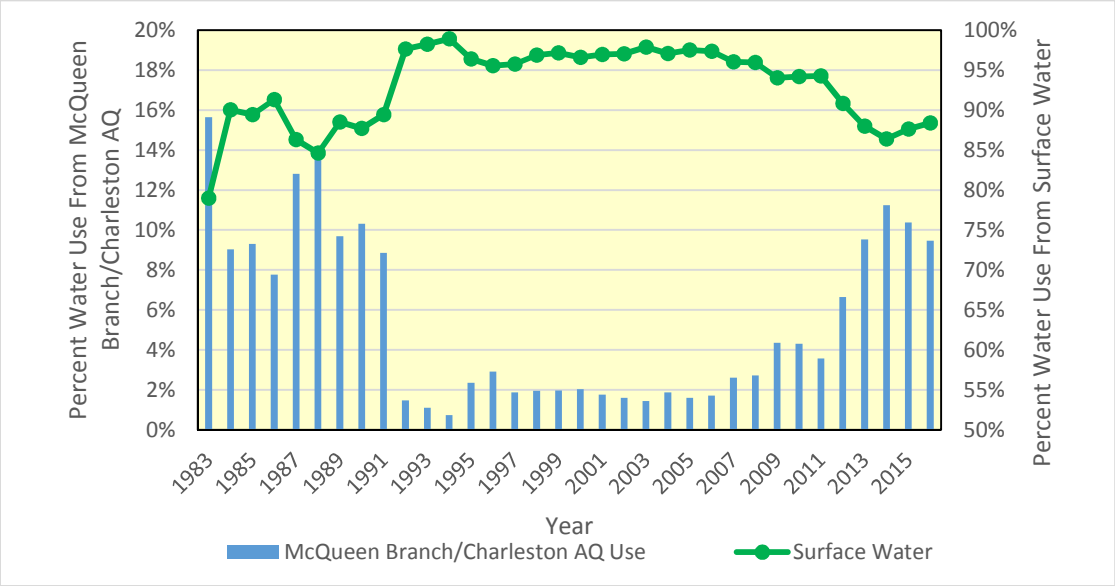


*Figure 15. A comparison of reported surface water use to groundwater use from the McQueen Branch/Charleston aquifer system in Horry County.*

# Current Groundwater Demand

For purposes of water use reporting, DHEC defines the following groundwater withdrawal categories:

- Aquaculture (AQ)– Water used for raising, farming and/or harvesting of organisms that live in water, such as fish, shrimp and other shellfish and vegetal matter (seaweed),
- Golf course irrigation (GC)- Water applied to maintain golf course turf, including tee boxes, fairways, putting greens, associated practice areas and periphery aesthetic landscaping,

- Industrial process (IN)- Water used for commercial and industrial purposes, including fabrication, processing, washing, in-plant conveyance and cooling,
- Agricultural and aesthetic irrigation (IR)- Water that is used for agricultural and landscaping purposes including turf farming and livestock management.
- Mining process (MI)- Water used in mine operations, including mining, processing, washing and cooling,
- Water supply (WS)- Water withdrawn by public and private water suppliers and conveyed to users or groups of users. Water suppliers provide water for a variety of uses including domestic, commercial, industrial and public water use.

Currently in the Waccamaw Area there are 50**permitted** groundwater withdrawers distributed as follows: 11 public water supply facilities, 24 golf course facilities, 8 industries, and 11 agricultural irrigation facilities (Table 1). These 50 facilities have 211 wells, Figure 16.

*Table 1. Permitted Groundwater Withdrawers by County.*

| Category | Georgetown County | Horry County | Totals |
|---|---|---|---|
| **Golf Courses** | 2 | 22 | **24** |
| **Industry** | 4 | 3 | **7** |
| **Agricultural Irrigation** | 1 | 7 | **8** |
| **Public Water Supply** | 5 | 6 | **11** |
| **Totals** | **12** | **38** | **50** |

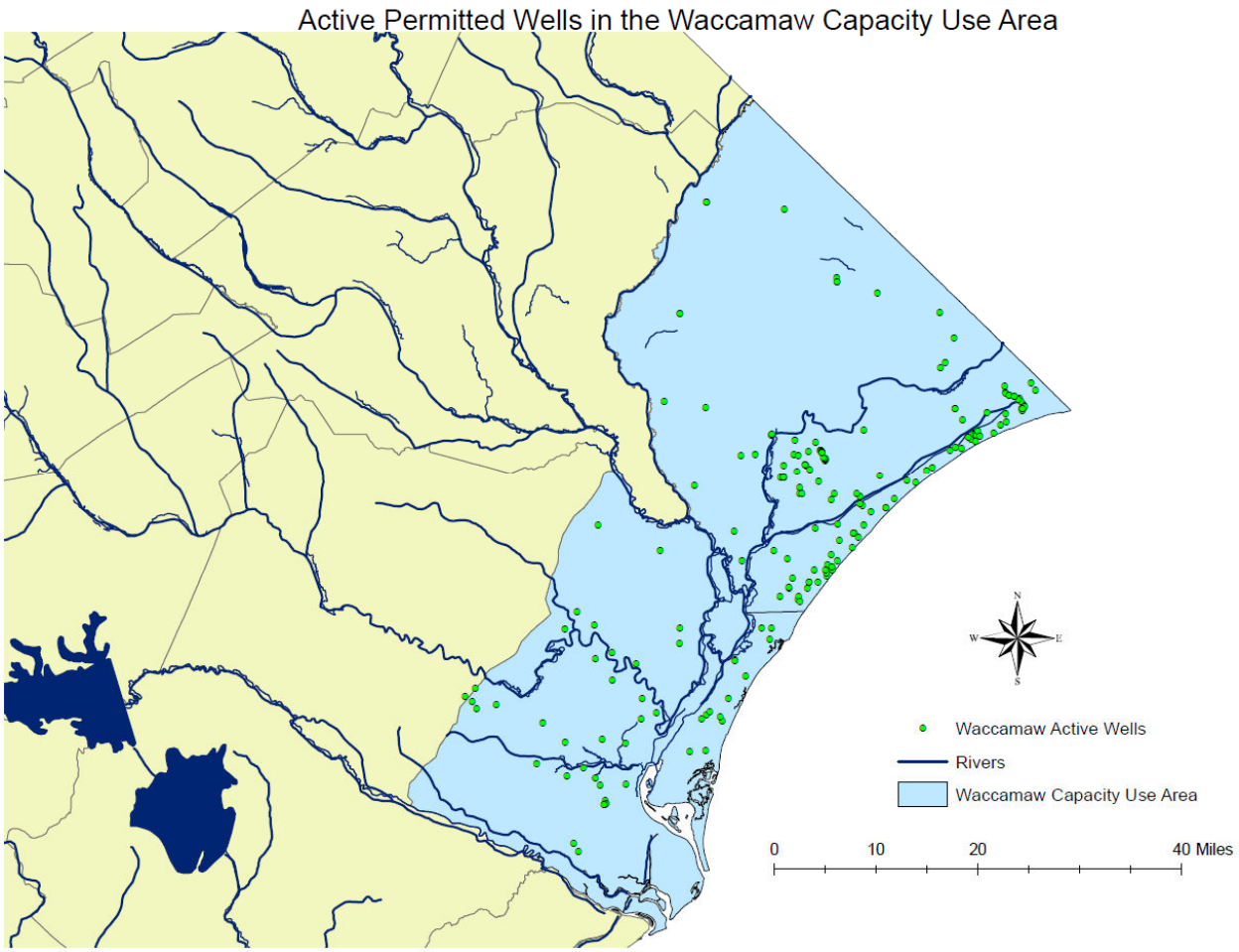


*Figure 16. Locations of permitted groundwater withdrawals.*

During the period 2010 through 2015, total reported groundwater withdrawals for the Waccamaw Area averaged 4,008.44 million gallons per year or approximately 10.98 million gallons per day (MGD). Withdrawals for water supplyaveraged 3,032.88 million gallons per year, or approximately 8.31 MGD. Agricultural irrigation averaged 178.02 million gallons per year, or approximately 0.49 MGD, golf courses used an average of 629.55 million gallons per year, approximately 1.72 MGD. The remaining categories averaged 167.99 million gallons per year, or approximately 0.46 MGD. For reporting year 2015, withdrawers in Georgetown County reported total withdrawals of 1,399,600,000gallons (approximately 1.40 billion gallons) andHorry County reported withdrawals of 2,690,090,000 gallons (approximately 2.69 billion gallons). Reported usage by category for 2015 is listed in Table 2 and shown in Figure 16.

*Table 2. Reported Use (Million Gallons) By County and Category For 2015.*

| Category | Georgetown | Horry | Totals By Category | Percent |
|---|---|---|---|---|
| **Golf Courses** | 45.05 | 384.09 | **429.14** | 10.49% |
| **Industry** | 78.04 | 2.59 | **80.62** | 1.97% |
| **Agricultural Irrigation** | 9.0 | 209.26 | **218.26** | 5.34% |
| **Public Water Supply** | 1267.51 | 2094.15 | **3,361.66** | 82.20% |
| **Totals For Counties** | **1,399.60** | **2,690.09** | **4,089.69** | 100.00% |
| **Percent** | 34.22% | 65.78% | 100.00% | |

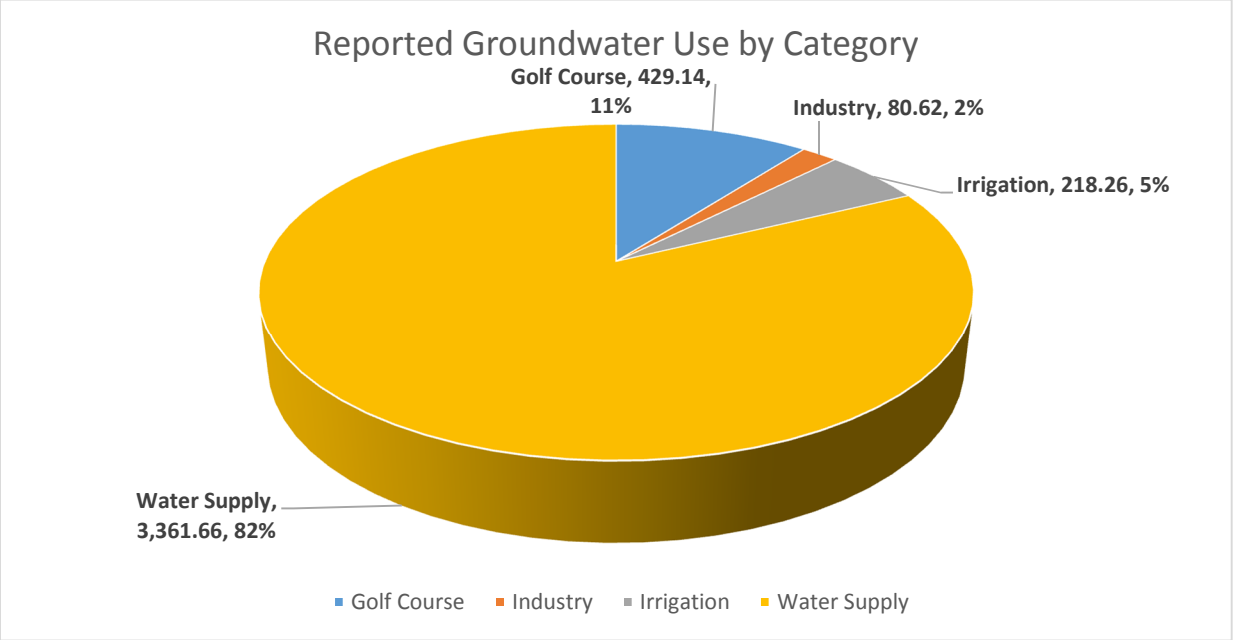


*Figure 17. Reported groundwater use by category, 2015.*

For the Waccamaw Area in 2015, reported groundwater withdrawals from the Surficial aquifer totaled 82.19 million gallons, from the Crouch Branch Aquifer a total of 1,567.89 million gallons, from the Charleston aquifer withdrawals totaled 1,093.17 million gallons, and from the McQueen Branch 1,346.44 million gallons. Groundwater withdrawals by aquifer/county are presented in Table 3 and Figures 17, 18, and 19. In 2015Horry County used 65.43% of the region's groundwater while Georgetown County accounted for 35.57% of the use.

*Table 3. Reported Groundwater Use (Million Gallons) By Aquifer and County, 2015.*

| Aquifer | Georgetown County | Horry County | Totals | Percent |
|---|---|---|---|---|
| **Surficial** | 17.82 | 64.38 | **82.19** | 2.01% |
| **Crouch Branch** | 1,141.78 | 426.11 | **1,567.89** | 38.34% |
| **Charleston** | - | 1,093.17 | **1,093.17** | 26.73% |
| **McQueen Branch** | 240.00 | 1,106.44 | **1,346.44** | 32.92% |
| **Totals** | **1,399.60** | **2,690.10** | **4,089.69** | **100%** |
| **Percent** | 34.22% | 65.78% | | |

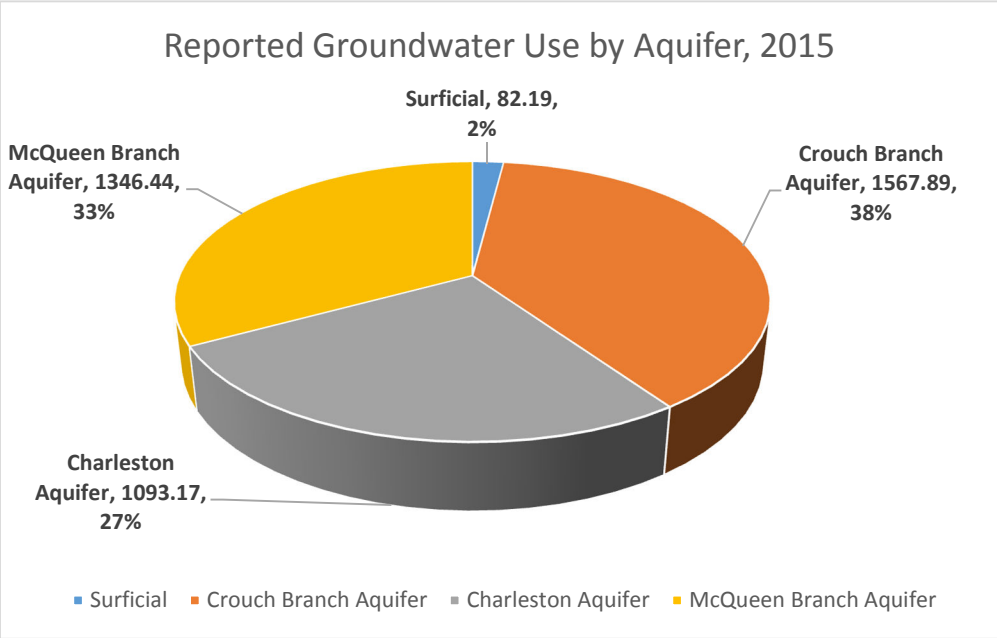


*Figure 18. Reported groundwater by aquifer, 2015.*

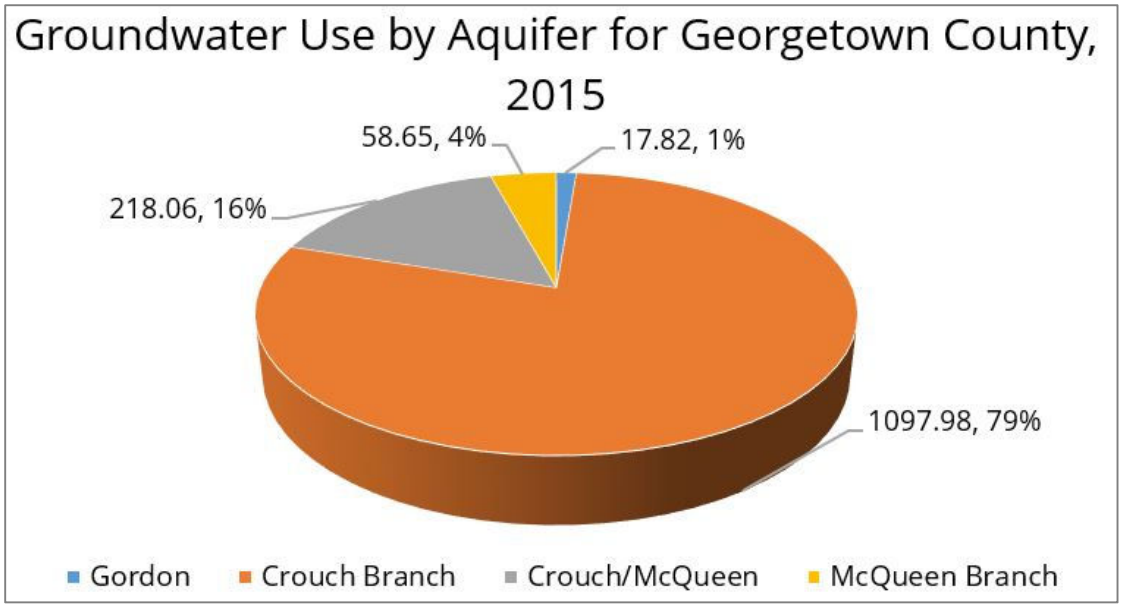


*Figure 19. Reported groundwater use by aquifer for Georgetown County, 2015.*

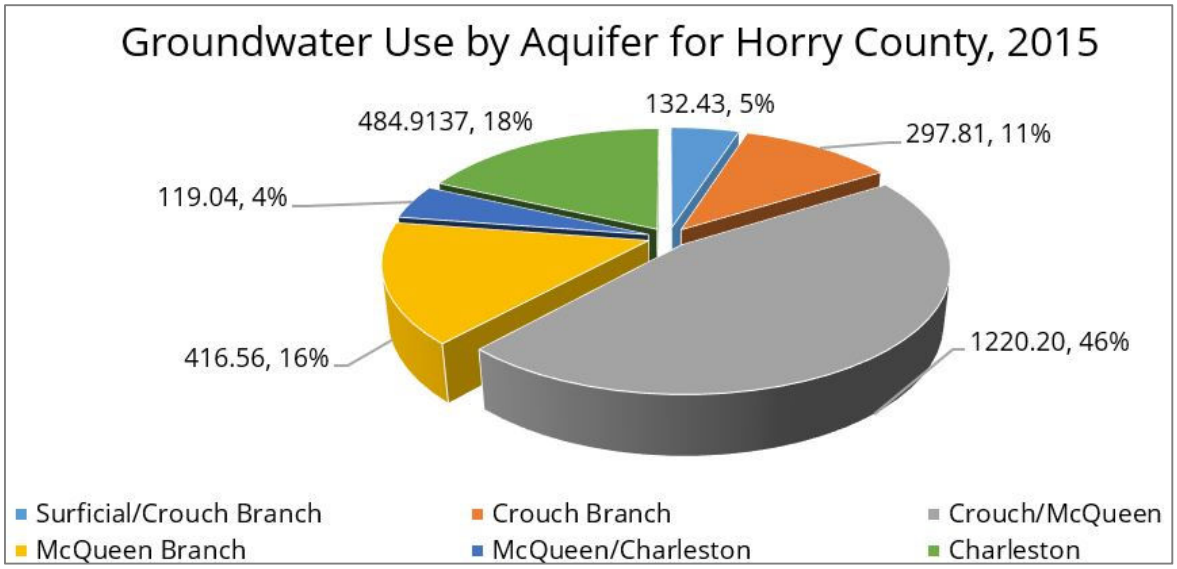


*Figure 20. Reported groundwater use by aquifer for Horry County, 2015.*

## Groundwater Demand Trends

To provide an historical perspective on reported groundwater use in the Waccamaw Capacity Use Area, Figures 20 and 21 show reported use by category of use. Since 2004, the reported permitted use of groundwater forindustry and golf courses has declined. Industrial use has declined from about 275 million gallons in 2004 to 102 million gallons in 2015. Reported groundwater use for Golf Courses declined from 590 million gallons in 2004 to 429 million gallons in 2015. Public water supply increased from 1,861 million gallons to 3,361 million gallons in 2015. Reported use for irrigation has increased slightly from about 179 million gallons in 2004 to 218 million gallons in 2015.

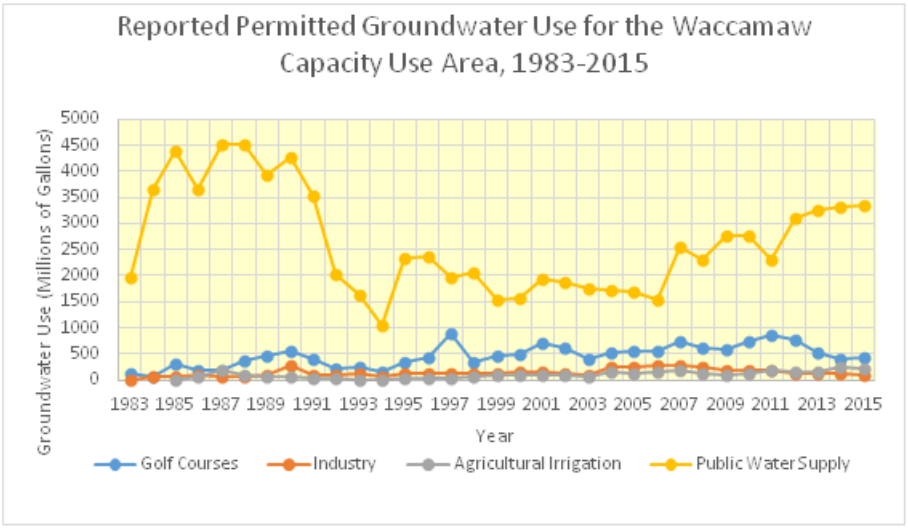


*Figure 21. Reported Permitted Groundwater Use for the Waccamaw Capacity Use Area, 1983-2015.*

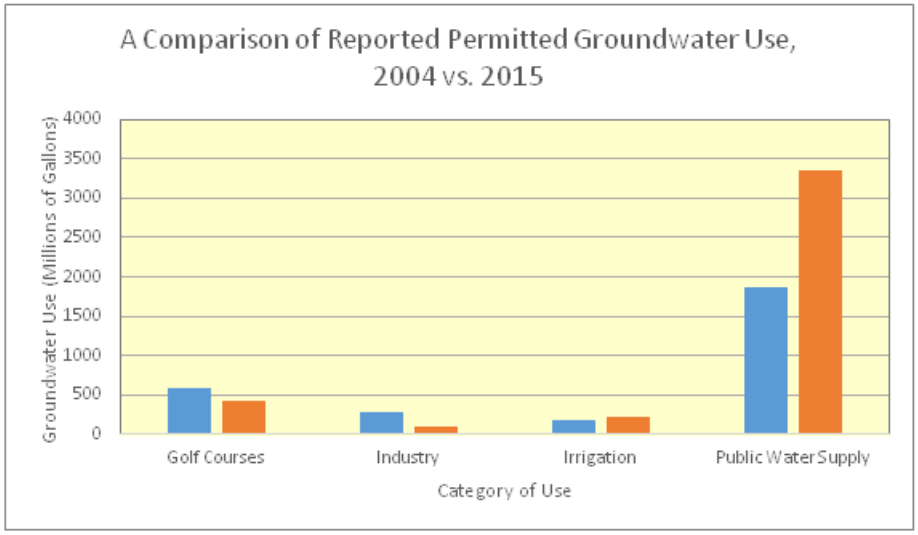


*Figure 22. A comparison of reported permitted groundwater use, 2004 vs. 2015.*

## Population, Growth, and Water Use Projections

As with coastal communities around the nation, the population in the Waccamaw area has increased dramatically, rising over 30 percent the last 30 years. The two county region has increased by approximately 129% over the past 30 years (1980-143,880 to 20110-329,449). At the time of the 2010 Census, almost 330,000 people were living in the region. Since the 2000 Census, Horry County experienced the largest percent increase in population, followed by Georgetown County, as shown in Table 4.

*Table 4. County Population Change 2000-2010.*

| County | April 1, 2000 Census | April 1, 2010 Census | Change in Population | Percent Change |
|---|---|---|---|---|
| **Georgetown** | 55,797 | 60,158 | 4,361 | 7.8% |
| **Horry** | 196,629 | 269,291 | 72,662 | 36.9% |

*Source: http://abstract.sc.gov/chapter14/pop5.html, SC Statistical Abstract, Table 5, Status of Population Projections Based on the 2010 Census Data, South Carolina Revenue and Fiscal Affairs Office).*

Table 5 depicts population projections for the two counties and the region as a whole from 2000 to 2030 presented in the *South Carolina Statistical Abstract, 2010,* as prepared by the South Carolina Revenue and Fiscal Affairs Office. The region is expected to grow by more than 184,374 people between 2000 and 2030, an increase of 73 percent. Horry County has the highest population (294,600 in 2015) and is projected to continue to have a higher population than Georgetown County.

*Table 5. County Projected Population Change, 2000-2030.*

***Source: http://abstract.sc.gov/chapter14/pop5.html, SC Statistical Abstract, Table 5, Status of Population Projections Based on the 2010 Census Data, South Carolina Revenue and Fiscal Affairs Office*).**

| Population Counts and Projections 2000-2030 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **County** | **April 1, 2000 Census** | **April 1, 2010 Census** | **July 1, 2015 Projection** | **July 1, 2020 Projection** | **July 1, 2025 Projection** | **July 1, 2030 Projection** | **Projected Change** | **Projected Percent Change** |
| **Georgetown** | 55,797 | 60,158 | 61,300 | 62,500 | 63,800 | 65,100 | 9,303 | 17% |
| **Horry** | 196,629 | 269,291 | 294,600 | 319,900 | 345,800 | 371,700 | 175,071 | 89% |
| **Waccamaw Area** | **252,426** | **329,449** | **355,900** | **382,400** | **409,600** | **436,800** | **184,374** | **73%** |

| Georgetown County | | | Horry County | | |
|---|---|---|---|---|---|
| **Facility Permit** | **Permit Limit*** | **Reported Use*** | **Facility Permit** | **Permit Limit*** | **Reported Use*** |
| **22GC006** | 70 | 0 | **26GC001** | 50 | 2.85 |
| **22GC011** | 50 | 45.05 | **26GC003** | 65 | 54.52 |
| **22IN001** | 145 | 70.95 | **26GC009** | 55 | 10.79 |
| **22IN002** | 5 | 0 | **26GC010** | 60 | 27.94 |
| **22IN008** | 60 | 7.09 | **26GC013** | 90.34 | 32.70 |
| **22IR038** | 25.2 | 9 | **26GC020** | 25 | 11.51 |
| **22WS001** | 1024 | 613.02 | **26GC021** | 72 | 37.20 |
| **22WS002** | 195.95 | 157.11 | **26GC025** | 25 | 15.73 |
| **22WS003** | 258 | 149.97 | **26GC028** | 70 | 18.60 |
| **22WS004** | 300 | 285.64 | **26GC029** | 30 | 0 |
| **22WS007** | 76.698 | 61.78 | **26GC034** | 54.73 | 13.02 |
| **Total** | **2,209.848** | **1,399.60** | **26GC036** | 46.033 | 19.32 |
| ***Limits and use reported in million gallons** | | | **26GC041** | 24.84 | 0.06 |
| **¥ No longer permitted due to not meeting permitting threshold** | | | **26GC043** | 25 | 2.66 |
| | | | **26GC044** | 99 | 53.60 |
| | | | **26GC046** | 36 | 5.42 |
| | | | **26GC051** | 36 | 6.73 |
| | | | **26GC054** | 70 | 22.20 |
| | | | **26GC055** | 36 | 4.81 |
| | | | **26GC056** | 40 | 17.82 |
| | | | **26GC058** | 54.5 | 26.63 |
| | | | **26GC060** | 36 | 0 |
| | | | **26IN002** | 40.02 | 0 |
| | | | **26IN006** | 18.88 | 2.45 |
| | | | **26IN007** | 98.4 | 0.137 |
| | | | **26IR019** | 36 | 1.54 |
| | | | **26IR020** | 100 | 96.69 |
| | | | **26IR025** | 50 | 53 |
| | | | **26IR026** | 36 | 1.31 |
| | | | **26IR027** | 42.4 | 32.58 |
| | | | **26IR028** | 130 | 24.14 |
| | | | **26WS001** | 453.6 | 199.79 |
| | | | **26WS002** | 500 | 364.74 |
| | | | **26WS003** | 17 | 5.91 |
| | | | **26WS005** | 128 | 89.28 |
| | | | **26WS009** | 4661.241 | 1399.61 |
| | | | **Total** | **7,471.98** | **2,690.10** |

*Table 6. Permit limits versus reported use in 2015 (million gallons).*

Permitted withdrawal limits in the Waccamaw Area total 9,681.83 million gallons per year. Total reported usage for 2015 in the Waccamaw Area was 4,089.69 million gallons (Table 6).

Potential future groundwater demands are estimated for water supply, based on population projections, and all other categories (total) based on an estimated nominal growth of 2.43% per year.

**Water Supply:**

For 2015 in the Waccamaw Area, total groundwater withdrawal for water supply is approximately 3,361,660,000 gallons. Combined with reported surface water supply (18,116,346,000 gallons), the per capita use of water in the Waccamaw Area is approximately 25.88million gallons per day. Utilizing this value (25.88MGD), projected population, and assuming groundwater will represent approximately 16% of the total water supply demand, groundwater demand is projected through 2030 (Table 7).

*Table 7. Projected groundwater demand-water supply (million gallons) in Waccamaw Area.*

| 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|
| 3,361.66 MGY | 3,770.66 MGY | 4,229.43 MGY | 4,744.01 MGY |
| 9.21MGD | 10.33MGD | 11.59MGD | 13.00MGD |

**Other**:

Groundwater demand for all other categories through 2030 is calculated based on an estimated nominal and steady growth of 2.4% per year (Table 8).

*Table 8. Projected groundwater demand-other (million gallons) in Waccamaw Area.*

| 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|
| 728.03 MGY | 816.61 MGY | 915.96 MGY | 1,027.40 MGY |
| 1.99 MGD | 2.24 MGD | 2.51 MGD | 2.81 MGD |

**Total Projected Water Demand:**

Total potential groundwater demand for the Waccamaw Area is estimated from the calculations for Water Supply (Table 7) and Other category (Table 8) (see Table 9).

*Table 9. Total projected groundwater demand-Waccamaw Area (million gallons).*

| | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| **Water Supply** | 3361.66 | 3,770.66 | 4,229.43 | 4,744.01 |
| **Other** | 728.03 | 816.61 | 915.96 | 1,027.40 |
| **Total MGY** | 4,089.69 | 4,587.27 | 5,145.39 | 5,771.41 |
| **Total MGD** | 11.20 | 12.57 | 14.10 | 15.81 |

# Groundwater Management Strategy

The ultimate goal of the Groundwater Management Plan is to outline a process to conserve and protect the groundwater resource while establishing conditions that are conducive to the continued development and long-term viability of the aquifers of the Waccamaw Area. In short, the goal is to develop and implement a sustainable development strategy. Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their needs. Ultimately, good scientific data must be available that allow the sustainable yields from each aquifer system in the Waccamaw Area to be determined, and permits for withdrawals issued accordingly. However, these data do not fully exist at this date. This plan, therefore, must focus on obtaining this critical data and the issuance of permits for reasonable water withdrawals in the interim. The key strategies to achieve these goals are outlined below.

Strategy #1: Identify areas where a leveling and/or reduction in pumping is appropriate.

Prior to each permit renewal cycle, SCDHEC will consider the best available information on the geologic and hydrogeologic characteristics of the aquifer(s) and groundwater withdrawals of the area to protect against or abate unreasonable, or potentially unreasonable, adverse effects on the aquifer(s) and water users of the Waccamaw Area. Measures that the SCDHEC may require applicants, permit holders and groundwater withdrawers to take may include, but not be limited to, the following:

- Reduction of groundwater withdrawal in areas of concentrated pumping;
- Withdrawals from other available freshwater aquifers than those currently used;
- Selective curtailment or reduction of groundwater withdrawals where it is found to be in the public interest or general welfare or to protect the water resource;
- Conjunctive use of aquifers, or waters of less desirable quality, where water quality of a specific character is not essential;
- Construction and use of observation or monitor wells;
- Abandonment of wells that have penetrated zones of undesirable water quality where such wells are found to cause contamination of freshwater aquifers;
- Prohibiting the hydraulic connection of aquifers that could result in deterioration of water quality in a freshwater aquifer(s);
- Abandonment of wells, which will be filled with cement grout, plugged, and sealed. Undesirable water quality is defined as not meeting the standards for Class GB Waters as listed in *Water Classifications & Standards*, R.61-68.H.9;
- Implement reasonable and practical methods to conserve and protect the water resources and to avoid or minimize adverse effects of the quantity and quality of water available to persons whose water supply has been materially reduced or impaired as a result of groundwater withdrawals;
- Such other necessary and appropriate control or abatement techniques as are technically feasible.

As an example, a cone of depression in the McQueen Branch/Charleston aquifer developed in the Charleston/Mt. Pleasant area between the 1980's and early 2000's. Water-levels in the USGS well CHN-0014 (Figure 18.) declined approximately 90 feet in the McQueen Branch/Charleston aquifer. In 2006, public water supply systems reduced their use of groundwater by increasing their reliance on surface water (Figure 19.). Groundwater use for public water supply was reported at 3,248.9 million gallons in 2005; by 2015 the amount reported used had declined to 2,104.7 million gallons. Surface water use for public water supply increased from 32,973.2 million gallons in 2005 to 36,709.6 million gallons. This has resulted in a rebound of groundwater levels in the area of approximately 50 feet.

The reduction in the reliance on groundwater versus surface water for public water supply required the coordination and cooperation of the utilities in the area and is a prime example of users working together to protect and manage the groundwater resource.

Strategy #2: Review of permit applications based on demonstrated reasonable use.

Proposed withdrawals will be evaluated considering reasonableness of use and need, aquifer(s) being utilized, potential adverse effects on adjacent groundwater withdrawers, previous reported water use, anticipated demand for the proposed activities, availability of alternate water sources and reported water use at facilities with similar activities. Applications for groundwater withdrawal will incorporate a "Water Use Plan" or a "Best Management Strategy" detailing actual or proposed water use activities and all conservation techniques for site specific water management including, but not limited, to:

- Provide appropriate documentation that the proposed water use is a beneficial use of the resource and necessary to meet the reasonable needs of the applicant;
- Describe in detail the applications for which the water is being withdrawn and approximate quantities utilized in each application;
- Identify the aquifer(s) currently utilized and the hydrogeologic (groundwater quality, specific capacity/yield, etc.) factors for utilization. Identify if a less utilized aquifer is suitable to the facility's need;
- Identify additional or alternate sources of water, including surface water, effluent, or recycled water, among others, suitable to meet the needs of the applicant and supplement, minimize, or eliminate groundwater sources;
- Identify reasonable and appropriate conservation methods or practices that maximize current water use and reduce current water demand;
- Identify any existing or anticipated adverse effects on other groundwater withdrawers, including public use, and strategies to eliminate or minimize these effects.

As part of the permitting process, stakeholder involvement, comment and recommendations will be incorporated during the public notice of the permit application.

Strategy #3: Establish a comprehensive groundwater monitoring program.

With increased population and a growing industrial base, water demand (from both surface and groundwater) is increasing at an expanding rate. Although water level declines are a normal response to groundwater withdrawals, not stabilizing these declines may cause serious impairment to the aquifers and groundwater quality of the region. SCDHEC will pursue partnerships with local entities, groundwater users and other agencies (both Federal and State) to facilitate the most effective use of resources in designing and maintaining a monitoring network for the Waccamaw Area. Both the SCDNR and SCDHECmaintain several groundwater level monitoring locations in the Waccamaw area. The table below lists the wells currently being used to monitor groundwater levels in the WaccamawCapacity Use Area.

| County | Well Id | Aquifer | Agency |
|---|---|---|---|
| Horry | HOR-0290 | Crouch Branch | SCDNR |
| Horry | HOR-0305 | Crouch Branch | SCDHEC |
| Horry | HOR-0307 | Crouch Branch | SCDHEC |
| Horry | HOR-0309 | Crouch Branch | SCDNR |

| | | | |
|---|---|---|---|
| Horry | HOR-0973 | McQueen Branch | SCDNR |
| Georgetown | GEO-0077 | Crouch Branch | SCDHEC |
| Georgetown | GEO-0381 | Surficial | SCDNR |
| Georgetown | GEO-0382 | McQueen Branch | SCDNR |
| Georgetown | GEO-0383 | Crouch Branch | SCDNR |

Current groundwater level monitoring locations (Figure 22.) include a SCDNR well cluster installed in 2014 in Georgetown County (GEO-0381, GEO-0382, and GEO-0383), one SCDHEC well in Georgetown County (GEO-0077) and several wells in Horry County. Crouch Branch wells include HOR-0290 and HOR-0309. The McQueen Branch water levels in Horry County are monitored by one SCDNR well, HOR-0973. SCDHEC monitors water levels in wells GEO-0077 (Crouch Branch), HOR-0305 (Crouch Branch) and HOR-0307 (Crouch Branch). Data from the new SCDNR well GEO-0383 in Georgetown will supplement the long-term data available from GEO-0077, HOR-0290 and HOR-0309 for the Crouch Branch. GEO-0382 will address the lack of data in the McQueen Branch aquifer in Georgetown County. Additional monitoring locations within the McQueen Branch aquifer in both Georgetown and Horry Counties would clarify conditions in the aquifer in the Waccamaw area.

Expanding the current network will allow more accurate monitoring of groundwater level conditions and facilitate scientifically-based recommendations for strategies to address any stressed conditions identified in the aquifers used in the Waccamaw area.

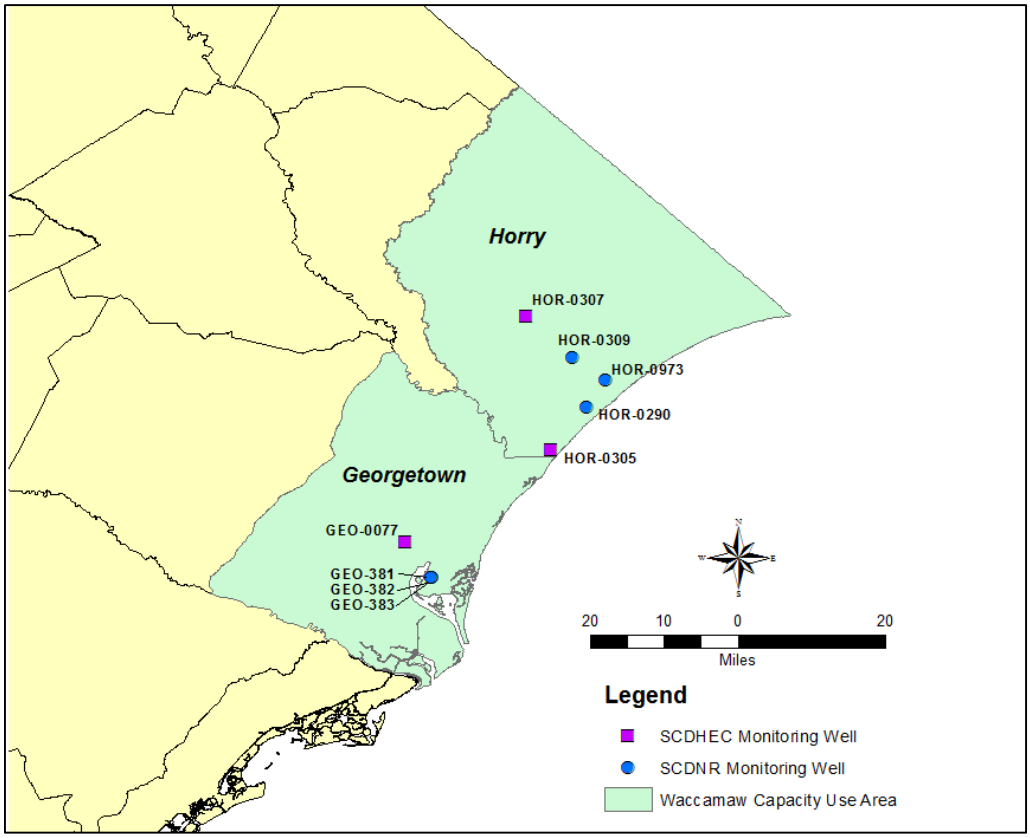


*Figure 23. Locations of monitoring wells.*

The existing groundwater monitoring network with the additional locations is necessary to:

- Provide accurate data on the amount and rate of groundwater level declines;
- Establish the correlation between groundwater pumping and water level changes, both on a local and regional scale;
- Guide management efforts to minimize potential impairment of the aquifers and track progress in reversing water level declines;
- Provide groundwater withdrawers with timely and accurate information to effectively manage withdrawal activities.

Strategy #4: Establish a conservation educational plan for the general public and existing groundwater withdrawers.

Water conservation has increasingly become a cornerstone to the development of water management strategies. An effective, viable water conservation program should incorporate the following:

- Provide public education and outreach programs;
- Determine and enhance water use efficiency;
- Determine water losses and establish corrective actions;
- Prepare for water shortages and provide appropriate responses.

Strategy #5: Regulation and Planning.

The Groundwater Use and Reporting Act provides for regulation of water withdrawals in South Carolina. Groundwater regulation is necessary to protect and provide for the long-term sustainability of the resource. As data are developed on the groundwater resources of the designated Capacity Use Areas, the regulations should will be reviewed to ensure that sufficient and adequate protection of the resource is provided.

SCDNR is responsible for developing and updating the State Water Plan. A groundwater model of the coastal aquifers is currently being developed by the USGS and SCDNR. As the results of the modeling effort and the updates to the State Water Plan become available, they will help inform potential regulatory and policy changes and will be incorporated into this Groundwater Management Plan.

# Groundwater Management Plan Reports

Every 5 years, or length of the permitting cycle, total annual groundwater withdrawals will be compiled and compared to available aquifer potentiometric maps. The report will include the following information:

- Listing of all permitted withdrawers, permitted withdrawal limits, and average groundwater withdrawal;
- Evaluation of withdrawal by category and by aquifer;
- Identification of areas of aquifer stress and all withdrawers utilizing the stressed aquifer(s).

Based on the information developed for the plan report, modifications of groundwater withdrawals in stressed areas will be reviewed and subsequently the Groundwater Management Plan may be amended.

The report will also evaluate, as information is developed, changes in water quality of the aquifers, available storage capacity of the aquifers, project future rates of withdrawal and estimate future groundwater declines from the projected withdrawal rates. Through time, a safe sustainable yield for each aquifer will be developed and subsequent withdrawal limits will be based on this available yield. The Department will host a stakeholder meeting to discuss the draft report. Comments on the draft plan will be taken into consideration as the Department finalizes the report and updates the groundwater management plan based on the report recommendations. The final report and updated groundwater management plan will be shared with the Stakeholders and the permit renewals will be issued consistent with the report and the plan.

Aquifer Recharge/Storage and Recovery

ASR is the re-injection of potable water back into an aquifer for later recovery and use. This process replenishes ground water stored in aquifers for beneficial purposes. Presently, SCDHEC regulation states that only 80% of water injected can be recovered for potable use leaving millions of gallons for replenishing declining water levels. "Potable" refers to water of high quality posing no health risk when consumed.

Some recognized environmental benefits of ASR:

- A significant amount of water can be stored underground reducing the need to construct large and expensive surface reservoirs.
- ASR systems are considered to be more environmentally and aesthetically friendlier than surface reservoirs and offer better protection from tampering and contamination.
- ASR adds millions of gallons that may stabilize or reverse declining water levels in an aquifer that has experienced long-term declines in water levels due to heavy pumping.

The Waccamaw capacity use area has approximately 23 active ASR wells that have been installed since around 2000. This process has proven to be a viable option for storing water for emergencies and reducing capital cost for meeting peak summer tourism demands. To date in Horry County, 3.4 billion gallons of water has been injected and remain in the Black Creek aquifer for replenishing water levels and maintaining a buffer between newly injected water and native groundwater. The Black Creek Aquifer appears to be a suitable aquifer for ASR development. ASR is an important management tool for maintaining declining aquifer water levels and certain items should be considered to continue its success.

- Permitted ASR sites are limited to recover no more than 80% of total injected water.
- ASR sites should have top priority and the process should not be jeopardized by groundwater withdrawal.
- Applications and renewal for use should be evaluated for water use purpose and location to an ASR site.
- With the increasing ASR growth, the Black Creek Aquifer should be considered primary for ASR use in the Waccamaw capacity use area when considering new withdrawal applications.
- Reducing or limiting existing groundwater usage in close proximity of an ASR site to reduce the risk of pulling injected water away from an ASR site.