Initial Groundwater Management Plan for the Pee Dee Capacity Use Area

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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 February 12, 2004, the South Carolina Department of Health and Environmental Control Board, as established in Section 49-5-60, Capacity Use Designation, declared the whole of Darlington County, Dillon County, Florence County, Marion County, Marlboro County, and Williamsburg County as the ***Pee Dee Capacity Use Area*** (Pee Dee Area), Figure 1. The Pee Dee Area was the fourth of the four currently declared Capacity Use Areas in South Carolina. Within the Pee Dee 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 plan for the Pee Dee 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 Pee Dee 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 Pee Dee 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 Pee Dee Area Groundwater Management Plan addresses the following aspects of water use in the Pee Dee 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 Pee Dee Area, more specific goals and withdrawal limits will be incorporated.

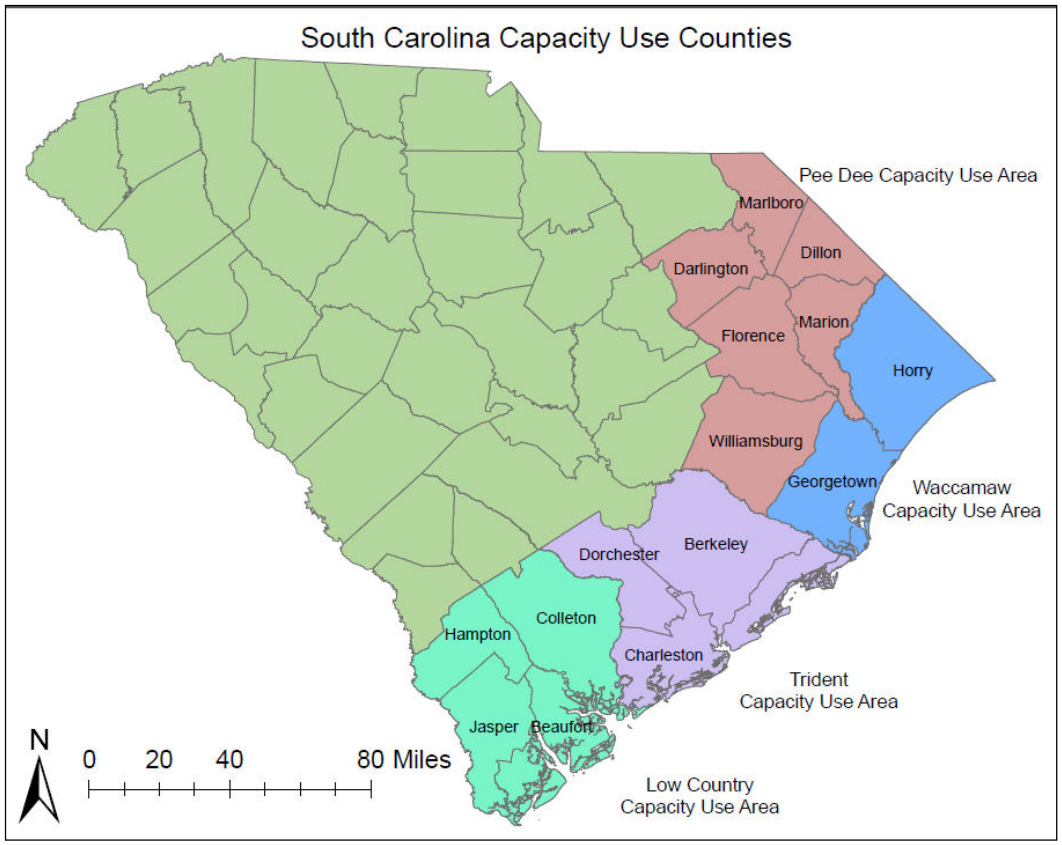

Figure 1. Capacity Use Areas.

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

This area is a part of two out of ten of South Carolina's Regional Planning Councils. The WRCOG and PDRCOG primary objectives include providing planning and technical support to local governments and assisting them in the development of local and regional plans. The two COG are governed by a twenty-six-member board and a twenty-nine-member board, all of who are appointed by local governments within the six and 3 county regions. These boards, led by an Executive Committee, set policy and provide direction to the programs of the two COGs.

Currently, the six-county Pee Dee area contains forty-eight cities and towns and over three-hundred thousand people. This includes a few central cities surrounded by smaller cities, area incorporations, and rural towns. Williamsburg County's government is conducted through a Supervisor-Council form of government, while Darlington, Dillon, Florence, Marion, and Marlboro Counties use Council-Administrator forms of government. The majority of the municipalities in the region utilize a Mayor-Council form of government.

The SCDHEC has permit authority for all groundwater withdrawals in the Pee Dee 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 Pee Dee Area Groundwater Management Plan.

Regional Description

Comprised of Darlington, Dillon, Florence, Marion, Marlboro, and Williamsburg Counties, the Pee Dee Capacity Use Area covers 3,694 square miles, of which approximately 24.6 square miles are surface water. The Pee Dee area stretches over seventy miles through northeastern to central South Carolina, bordered by North Carolina on the north, the Santee River on the south, and the Waccamaw Capacity Use Area on the east. The region is partially split by interstate 95 and contains much of the Pee Dee River Basin, draining into the Waccamaw Capacity Use Area. All six counties are located in the Coastal Plain physiographic region, Figure 2.

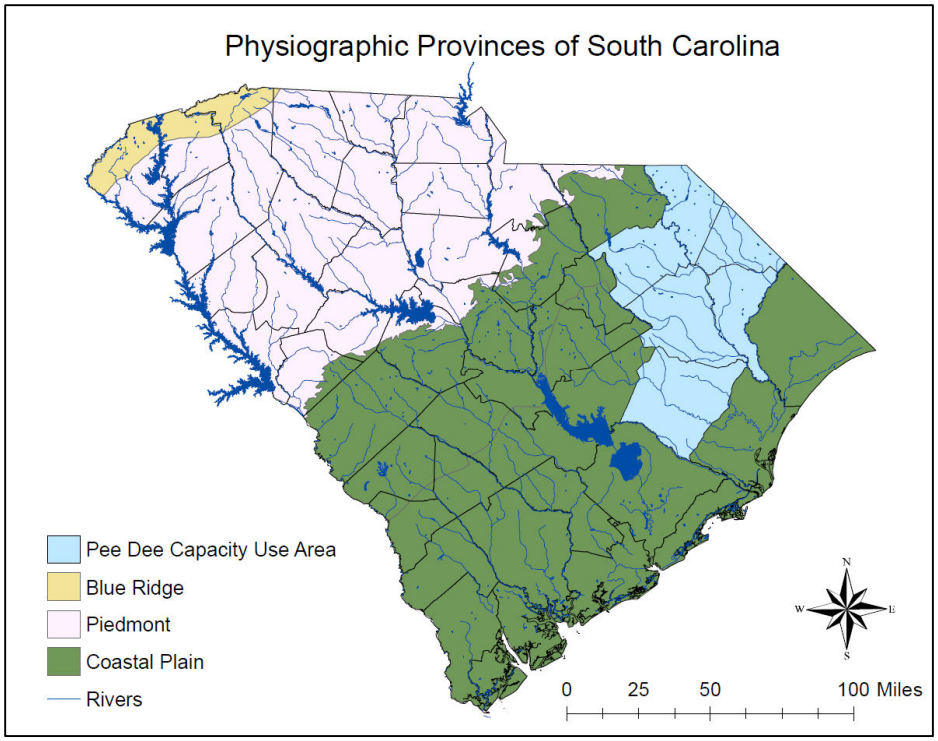

Figure 2. Physiographic Provinces of South Carolina.

There are several major water bodies in the area including the Great Pee Dee River and Little Pee Dee River, the Lynches River, Black Creek, 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 four hundred sixty feet.

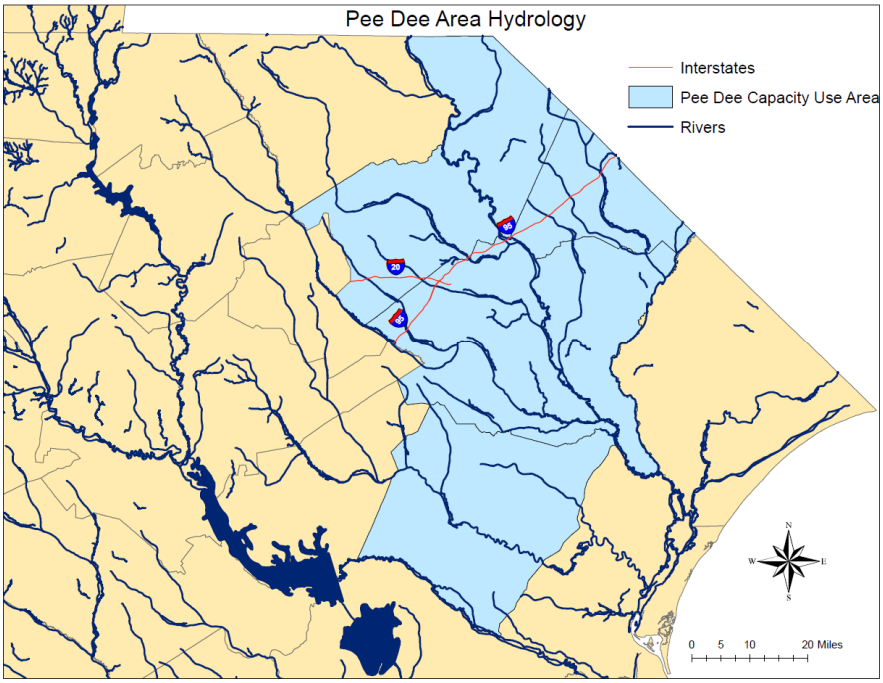

Figure 3. Hydrology of the area.

The Pee Dee 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 63.2°F, with an average daily maximum of 73.5°F and a minimum of 54.5°F. Approximately thirty-two percent of the forty-six 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.

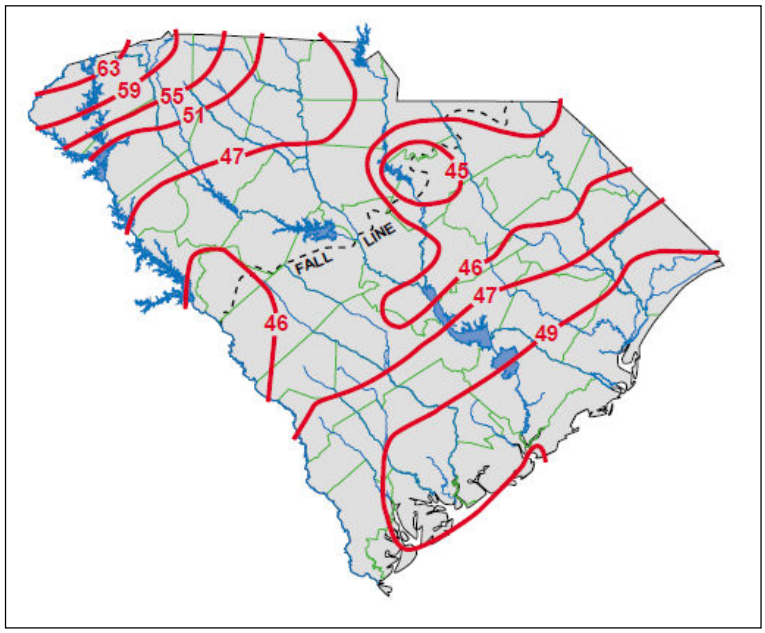

Figure 4. Average annual precipitation, in inches for the period 1948-1990. Source: South Carolina Department of Natural Resources (SCDNR)-Hydrology/Geology Map 2, R.N. Cherry, A.W. Badr, and Andrew Wachob, 2001.

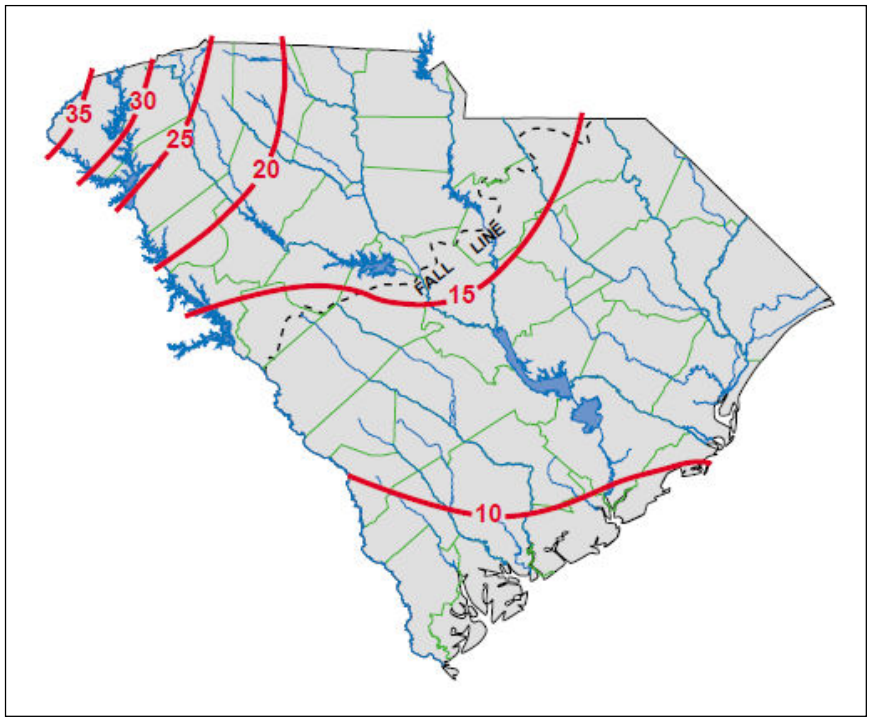

Figure 5. Average annual water yield (precipitation less evapotranspiration), in inches, 1948-1990. Source: SCDNR-Hydrology/Geology Map 2, R.N. Cherry, A.W. Badr, and Andrew Wachob, 2001.

Groundwater Supplies

The oldest (and deepest) aquifers or water-bearing units underlying the Pee Dee 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 Pee Dee Area the aquifer is generally composed of thin- to thick-bedded sands with some gravel and laminated. In the Pee Dee area, the McQueen Branch-Charleston aquifer is approximately 300 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 Pee Dee area, the Crouch Branch is approximately 100 to 400 feet thick.

Units overlying the Late Cretaceous formations include the Tertiary age Gordon 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 Pee Dee area, the Gordon is very thin if even present.
- 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.

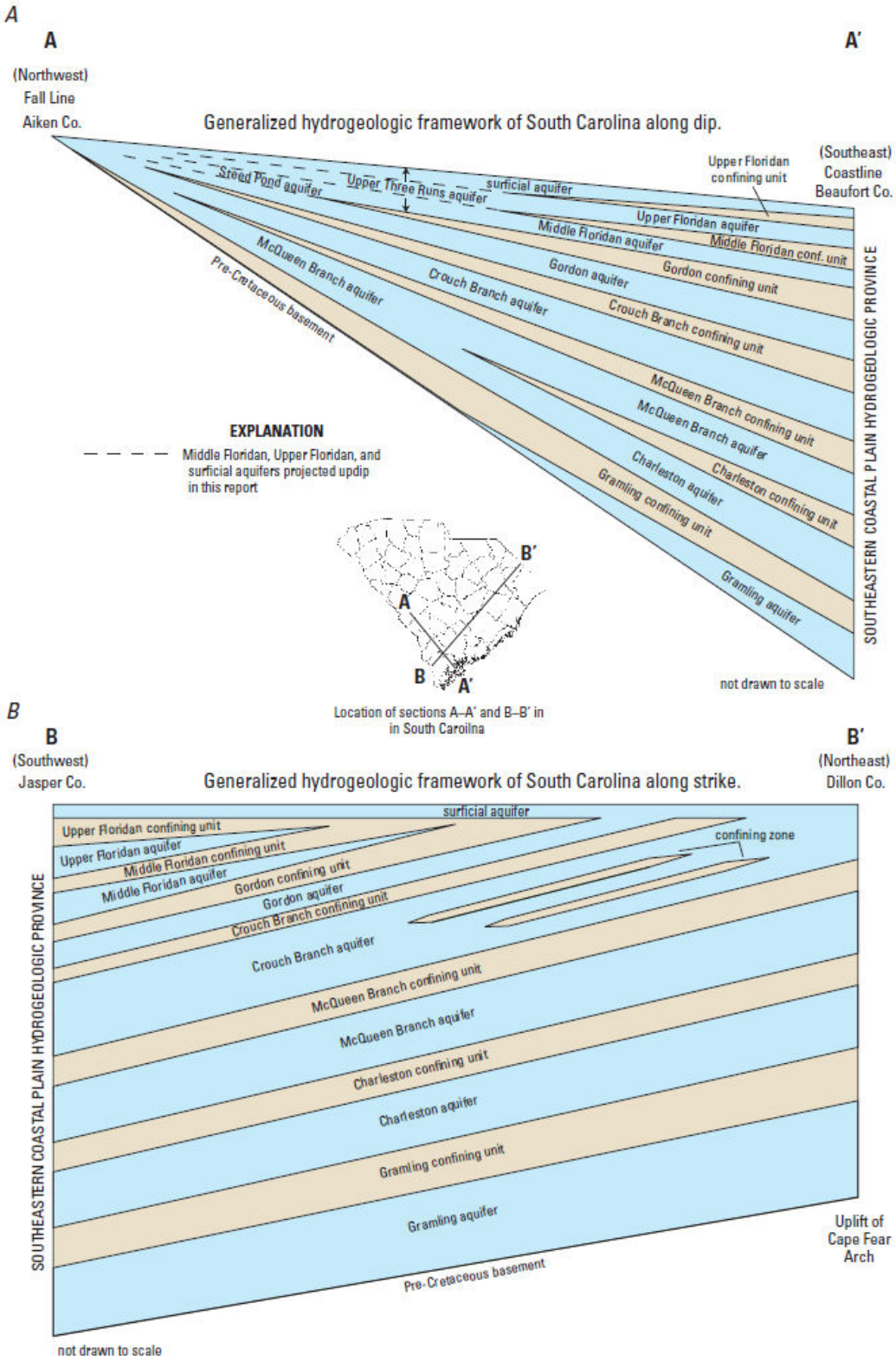

Figure 6. Generalized hydrogeologic framework, J. Gellici and J. Lautier, 2010 Hydrogeologic Framework of the Atlantic Coastal Plain, North and South Carolina: U.S. Geological Survey Professional Paper 1773, 113p.

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 Pee Dee Area. Although limited recharge of the Tertiary Sand/Limestone Aquifer occurs in the region, the majority of recharge of aquifers in the Pee Dee area occurs mainly west-northwest of the region proper.

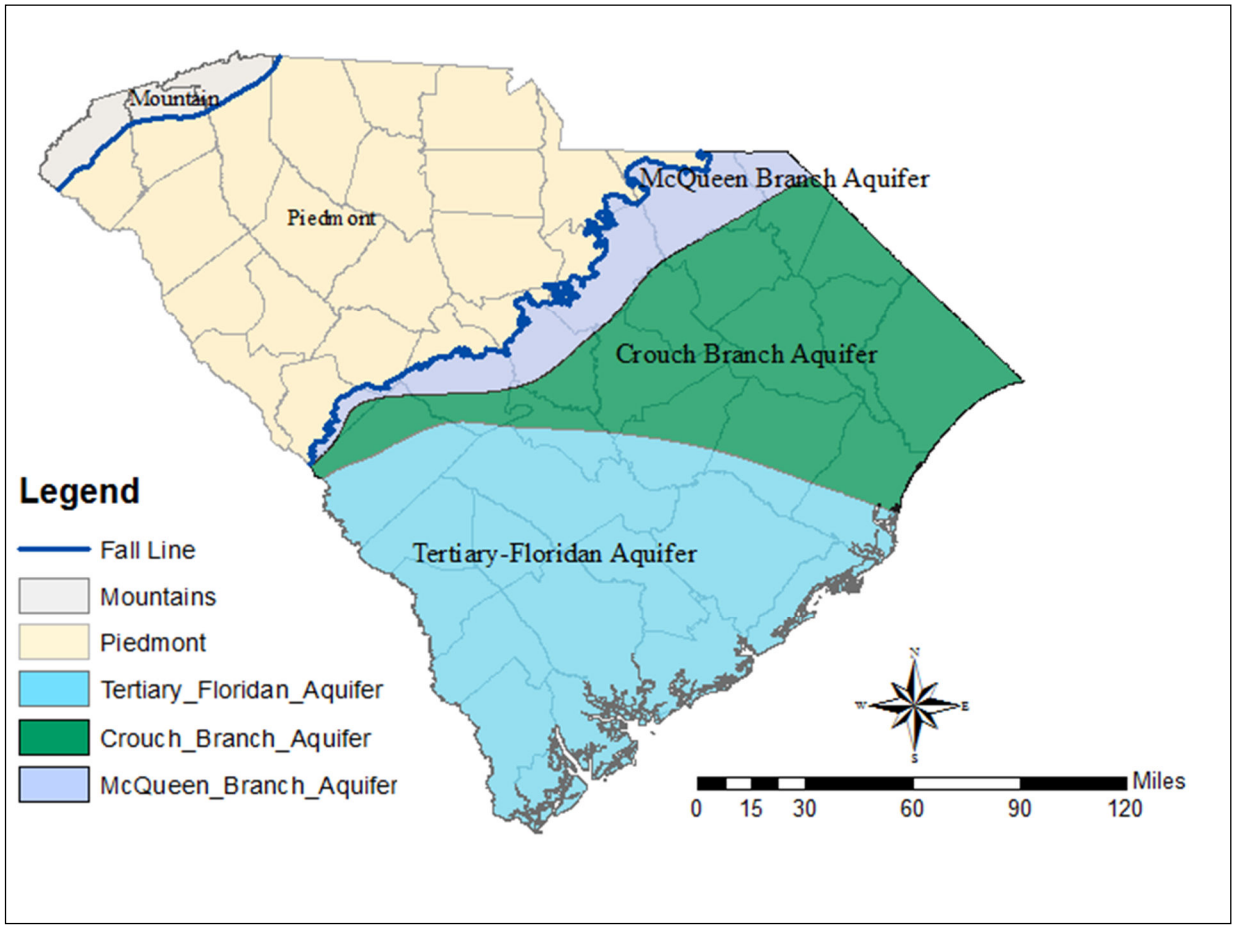

Figure 7. Generalized aquifer recharge areas.

Groundwater Level Trends

Groundwater levels in the Charleston/McQueen Branch aquifer have declined substantially from pre-development (1879) levels in the Pee Dee area, especially around the Florence area. Much of this decline can be attributed to concentrated public supply and industrial usage. In 2000, the water level in the McQueen Branch was around 60 feet below mean sea level, and has declined to about 77 feet below sea level in 2106. Even with the increased use of surface water when a cone of depression in the Florence County region was identified, groundwater levels continued to decline. Interpretation of published hydrographs indicates that groundwater decline in the Charleston/McQueen Branch Aquifer in Darlington County was around 1.2 feet per year in the early 2000s. However, the FLO-0128 SCDNR well (in the now named McQueen Branch Aquifer) has shown decent rebound since November of 2011, rising almost 10 feet as of December 2016 (from 44.15 feet below land surface to 35.09 feet below land surface). Figure 8 shows the 2004 water levels in the McQueen Branch aquifer (formerly known as the Middendorf). Figure 9 shows a more recent map of the McQueen Branch aquifer, and there has not been

any real rebound due to increased use of groundwater for public water supply. Due to increasing population in the region, (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.

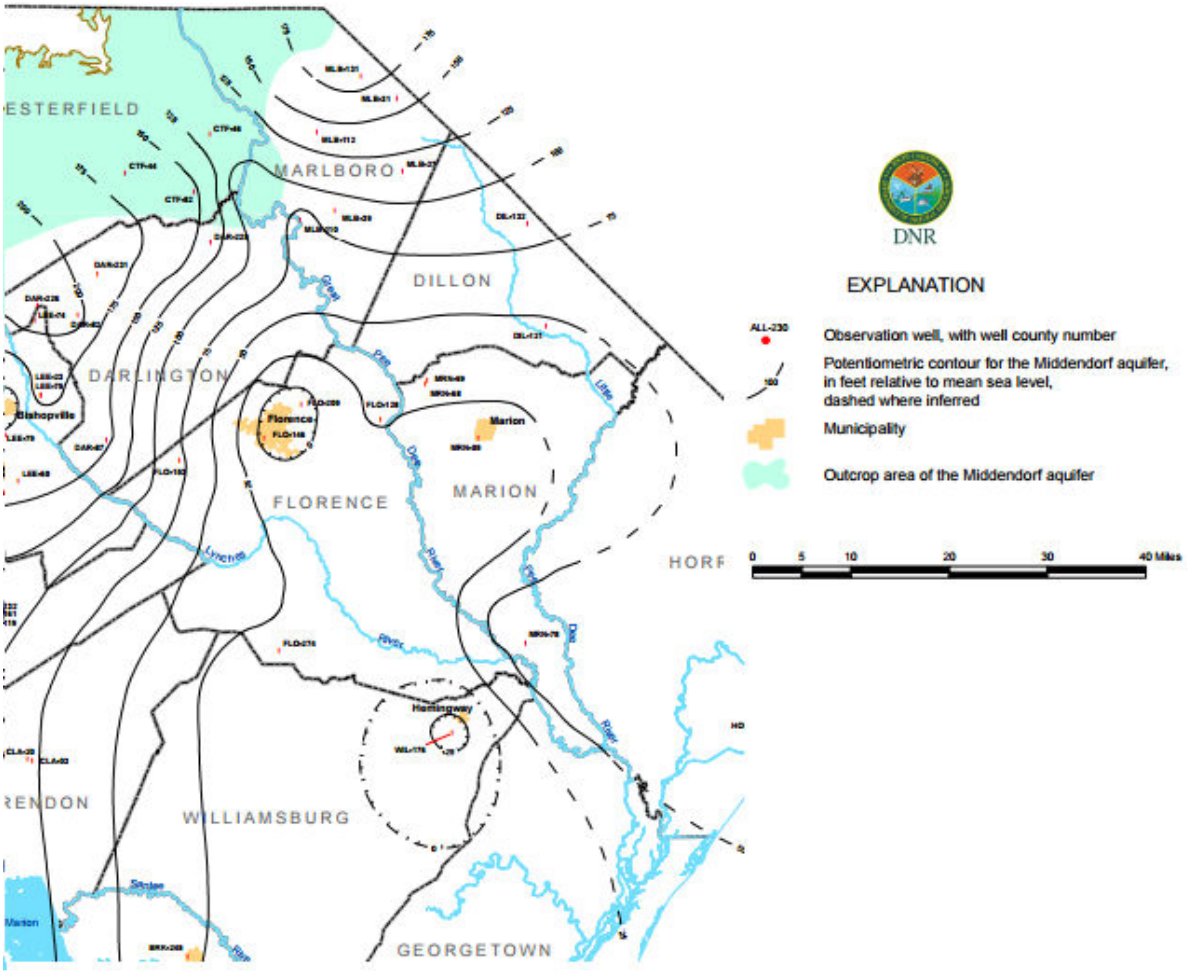

Figure 8. Water level map for the McQueen Branch/Charleston Aquifer (Middendorf), 2004. Source: Hockensmith, 2008, SCDNR Water Resources Report 46.

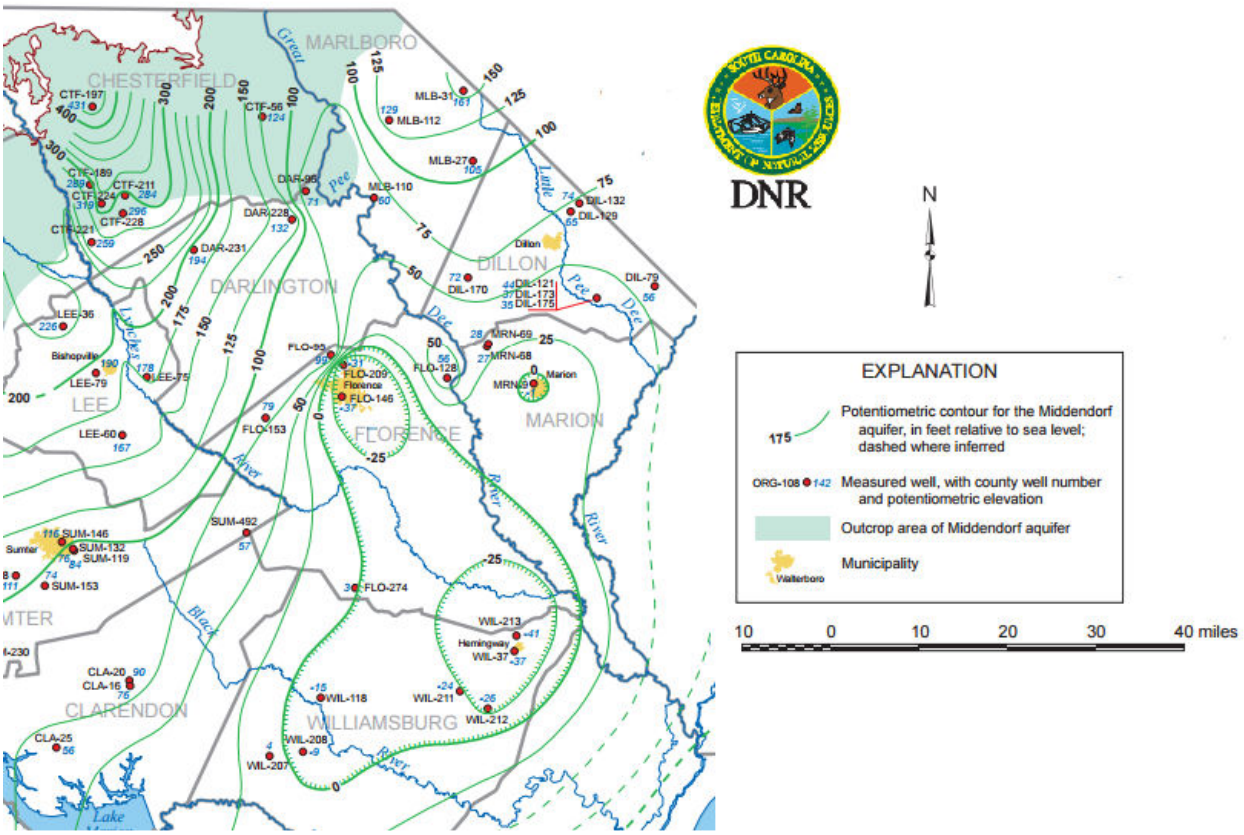

Figure 9. Water level map of the McQueen Branch Aquifer, 2014. Source: Wachob, 2015, SCDNR Water Resources Report 58.

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 Pee Dee Area there are 104 **permitted** groundwater withdrawers distributed as follows: 31 public water supply facilities, 3 golf course facilities, 13 industries, 56 agricultural irrigation facilities, and 1 nuclear power facility (Table 1). These 104 facilities have 326 wells, Figure 10.

Table 1. Permitted Groundwater Withdrawers by County.

Number of Facilities By Type and By County							
Use	Darlington	Dillon	Florence	Marion	Marlboro	Williamsburg	**Total**
Golf Courses	1		1	1			**3**
Industry	4		5		2	2	**13**
Agricultural Irrigation	19	10	6	5	13	3	**56**
Nuclear Power	1						**1**
Public Water Supply	4	4	7	4	5	7	**31**
Total	**29**	**14**	**19**	**10**	**20**	**12**	**104**

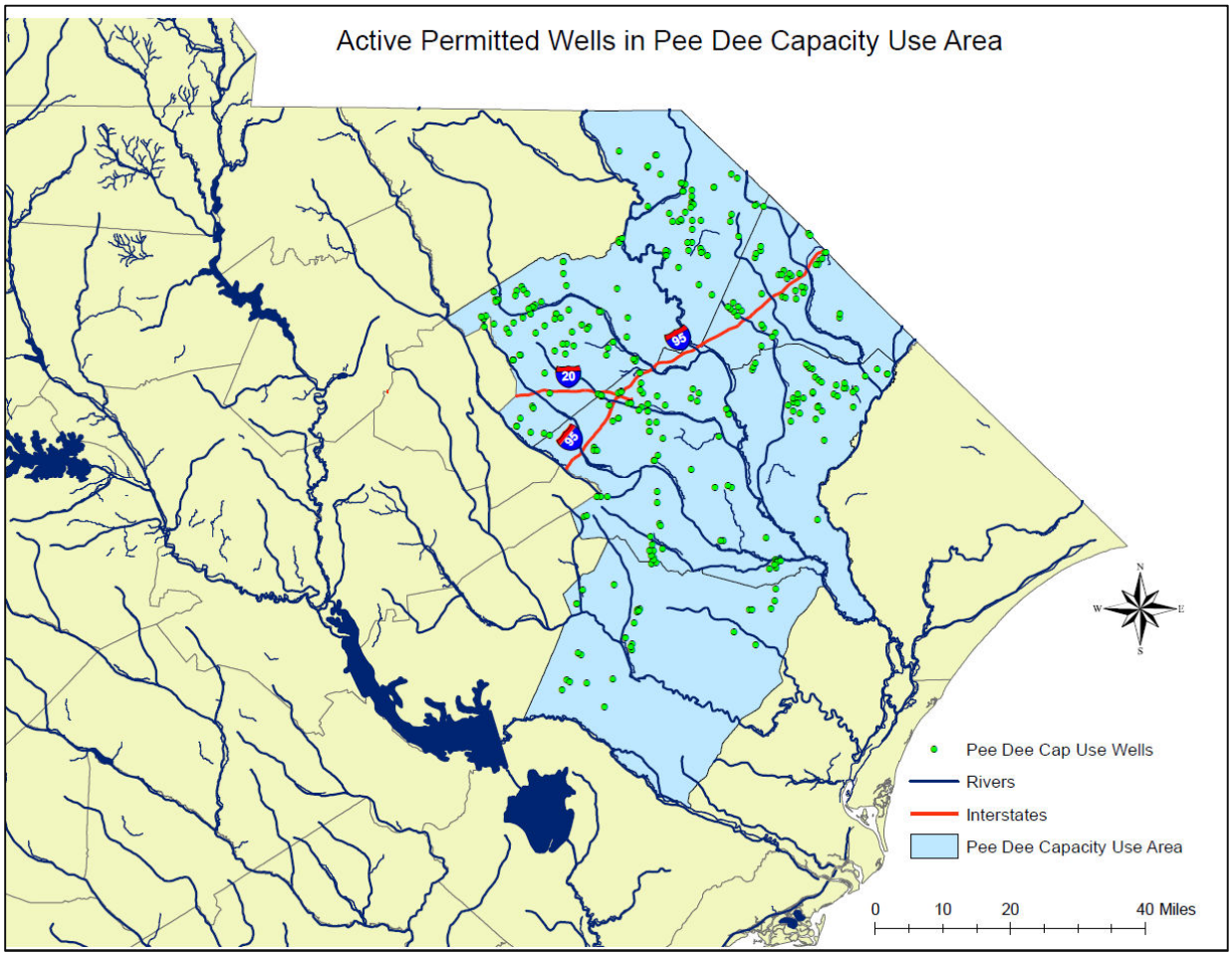

Figure 10. Locations of permitted groundwater withdrawals.

During the period 2010 through 2015, total reported groundwater withdrawals for the Pee Dee Area averaged 16,224.9 million gallons per year or approximately 44.45 million gallons per day (mgd). For Darlington County, average withdrawals were: 34.38 million gallons for golf courses, 432.71 million gallons for agricultural irrigation, 366.11 million gallons for nuclear power, 1,369.79 million gallons for industrial use, and 2,348.9 million gallons for public water supply. For Dillon County, average withdrawals were: 183.35 million gallons for agricultural irrigation and 1,572.5 million gallons for public water supply. For Florence County, average withdrawals were: 67.14 million gallons for golf courses, 1,083.79 million gallons for industrial use, 239.75 million gallons for agricultural irrigation, and 4,421.62 million gallons for public water supply. For Marion County, average withdrawals were: 13.06 million gallons for golf courses, 164.06 million gallons for agricultural irrigation, and 1,170.72 million gallons for public water supply. For Marlboro, average withdrawals were: 93.47 million gallons for industrial use, 234.45 million gallons for agricultural irrigation, and 1,118.35 million gallons for public water supply. For Williamsburg County, average withdrawals were: 363.82 million gallons for industrial use, 56.91 million gallons for agricultural use, and 888.76 million gallons for public water supply. For reporting year 2015, withdrawers in Darlington County reported total withdrawals of 5,362,850,000 gallons (approximately 5.36 billion gallons), Dillon County 1,946,709,000 gallons (approximately 1.95 billion gallons), Florence County 5,944,742,050 gallons (approximately 5.94 billion gallons), Marion County 1,600,921,000 gallons (approximately 1.6 billion gallons), Marlboro County 1,692,343,500 gallons (approximately 1.69 billion gallons), and Williamsburg 1,518,261,000 gallons (approximately 1.52 billion gallons). Reported usage by category for 2015 is listed in Table 2 (in millions of gallons a year) and shown in Figure 11.

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

Category	Darlington	Dillon	Florence	Marion	Marlboro	Williamsburg	Total	Percentage
Golf Courses	0.84		64.55	14.15			**79.54**	**0.44%**
Industry	1,709.0		1,464.68		68.87	369.91	**3,612.46**	**20.00%**
Agricultural Irrigation	947.42	326.47	278.31	343.19	440.96	151.50	**2,487.86**	**13.77%**
Nuclear Power	367.49						**367.49**	**2.03%**
Public Water Supply	2,338.09	1,620.24	4,137.20	1,243.58	1,182.51	996.86	**11,518.48**	**63.79%**
Totals for Counties	**5,362.85**	**1,946.71**	**5,944.74**	**1,600.92**	**1,692.34**	**1,518.26**	**18,065.83**	
Percentage	**29.69%**	**10.78%**	**32.91%**	**8.86%**	**9.37%**	**8.40%**		

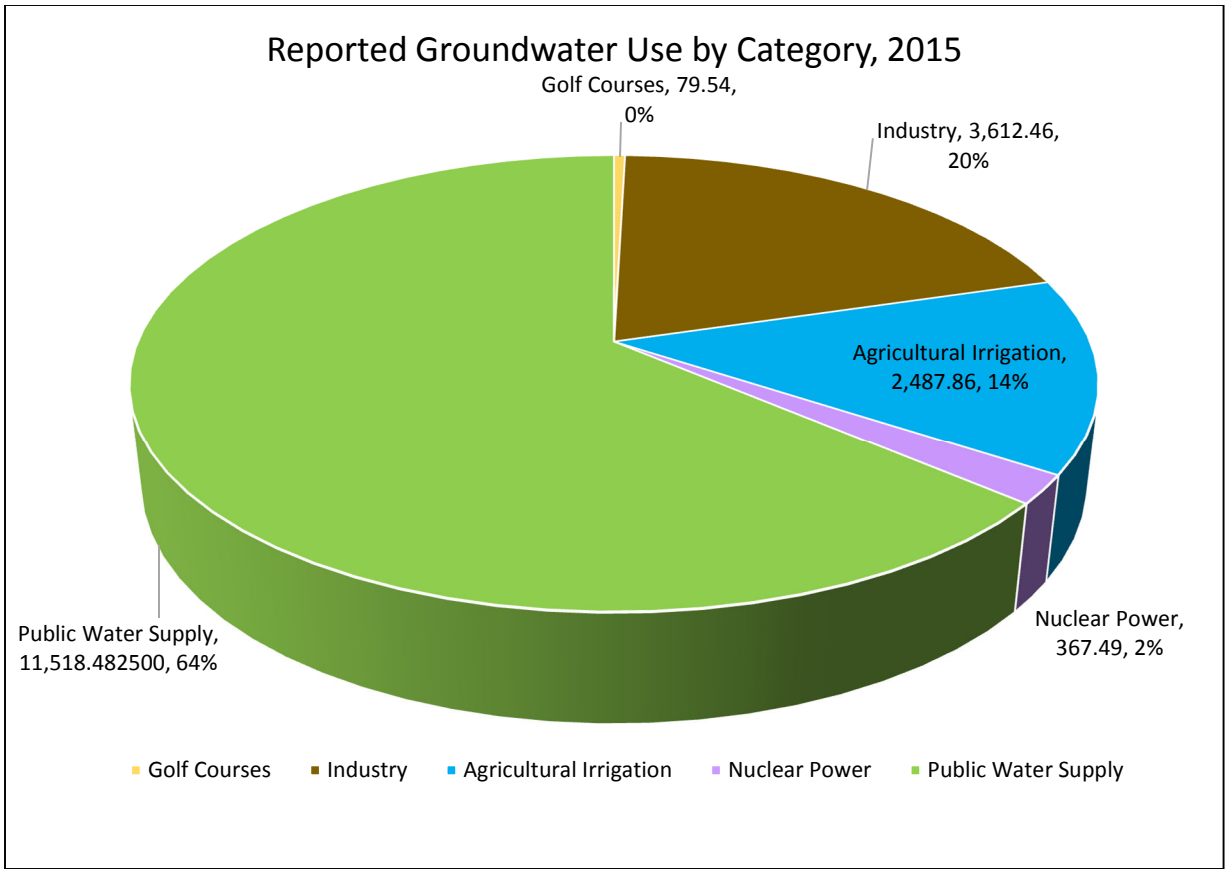

Figure 11. Reported groundwater use by category, 2015.

For the Pee Dee Area in 2015, reported groundwater withdrawals from the Surficial Aquifer were 0.84 million gallons, from the Crouch Branch Aquifer were 3,735.32 million gallons, from the McQueen Branch Aquifer were 13,852.13 million gallons, from the Charleston Aquifer were 347.98 million gallons, and from the Gramling Aquifer were 129.54 million gallons. Groundwater withdrawals by aquifer/county are presented in Table 3 and Figures 12, 13, 14, 15, 16, 17, and 18. In 2015 Florence County used 32.90% of the region's groundwater while Darlington County accounted for 29.68% of the use. Dillon County used 10.77% of the total reported groundwater use for the Pee Dee area in 2015. Marlboro used 9.37% and Marion and Williamsburg Counties both used under 9% each of the reported groundwater use in the region.

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

Aquifer Name	Darlington	Dillon	Florence	Marion	Marlboro	Williamsburg	**Total**	**Percentage**
Surficial	0.84		0.00				**0.84**	**0.00%**
Crouch Branch Aquifer	59.64		1,560.17	787.78	1,053.39	274.35	**3,735.32**	**20.68%**
McQueen Branch Aquifer	5,302.37	1,946.71	4,384.58	813.14	509.41	895.93	**13,852.13**	**76.68%**
Charleston Aquifer						347.98	**347.98**	**1.93%**
Gramling Aquifer	0.00				129.54		**129.54**	**0.72%**
Total	**5,362.85**	**1,946.71**	**5,944.74**	**1,600.92**	**1,692.34**	**1,518.26**	**18,065.83**	
Percentage	**29.68%**	**10.77%**	**32.90%**	**8.86%**	**9.37%**	**8.40%**		

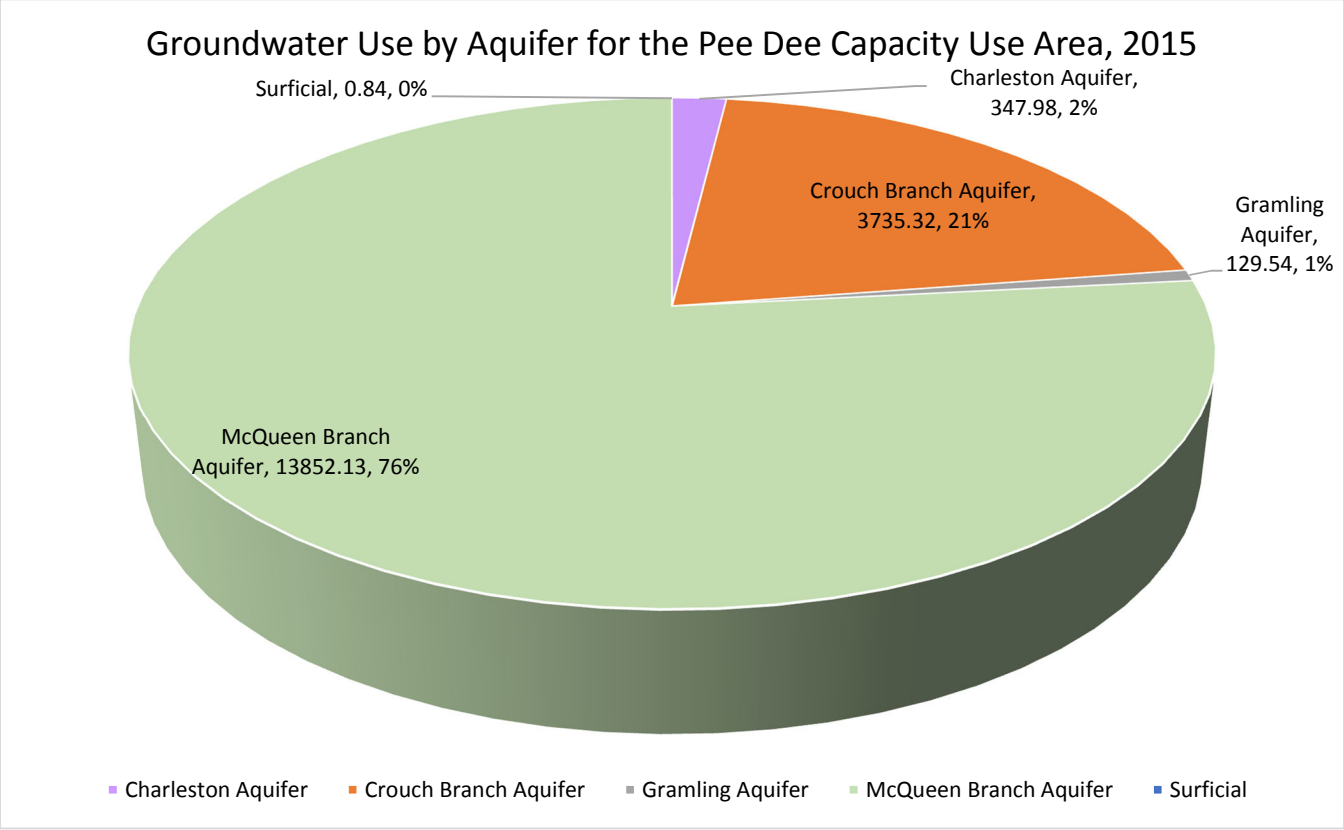

Figure 12. Reported groundwater by aquifer, 2015.

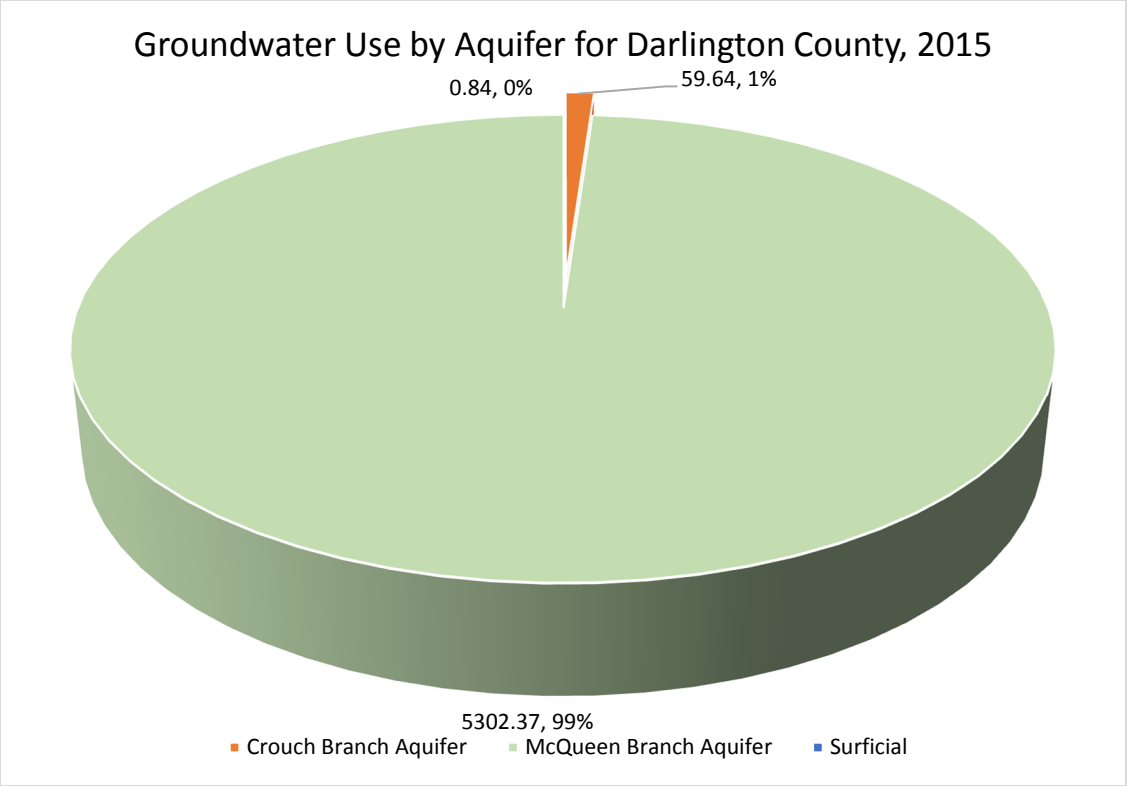

Figure 13. Reported groundwater use by aquifer for Darlington County, 2015.

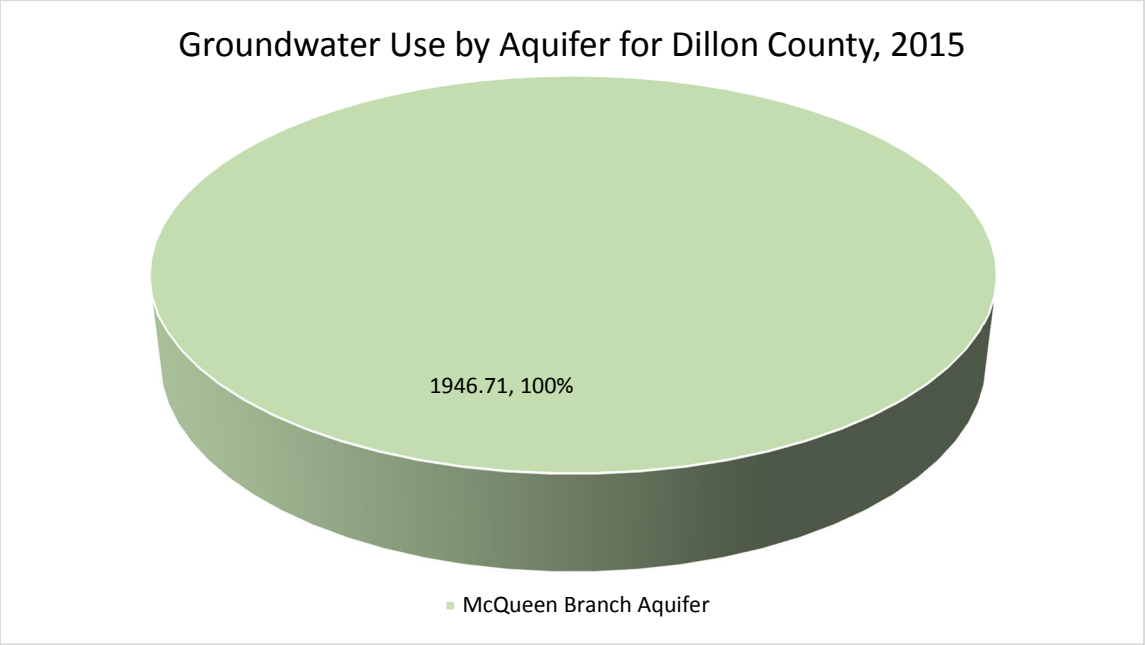

Figure 14. Reported groundwater use by aquifer for Dillon County, 2015.

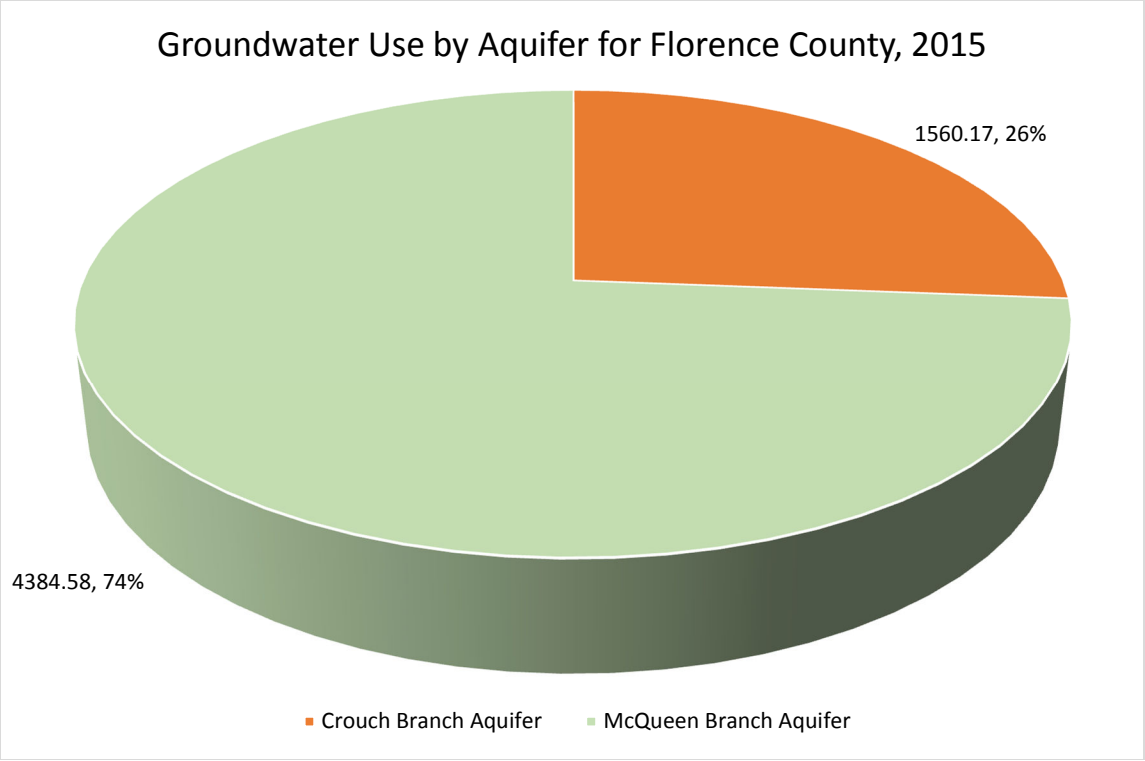

Figure 15. Reported groundwater use by aquifer for Florence County, 2015.

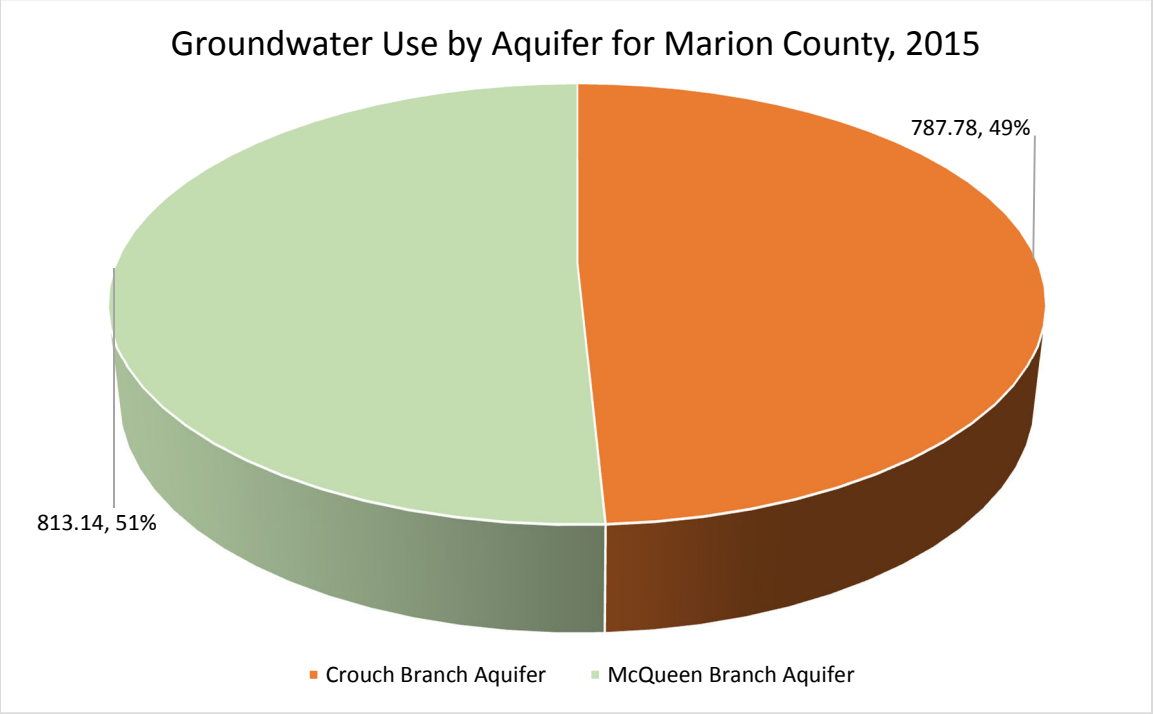

Figure 16. Reported groundwater use by aquifer for Marion County, 2015.

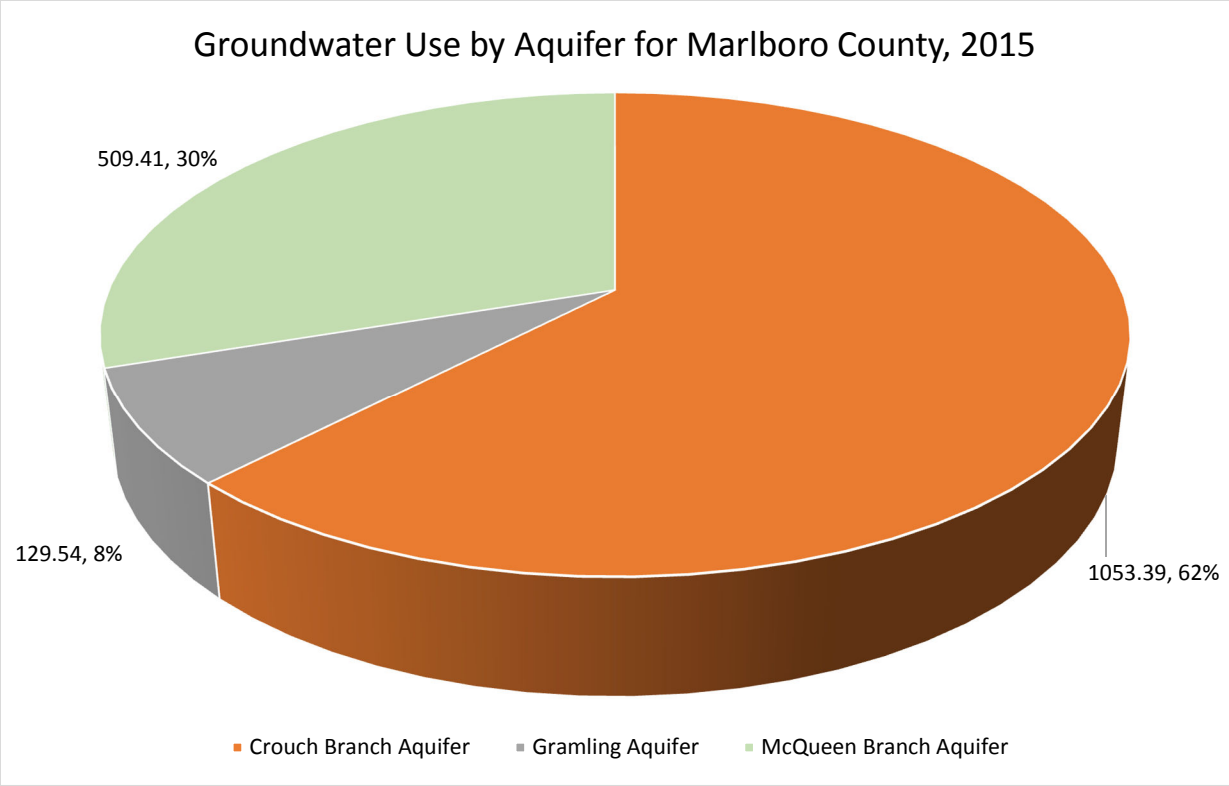

Figure 17. Reported groundwater use by aquifer for Marlboro County, 2015.

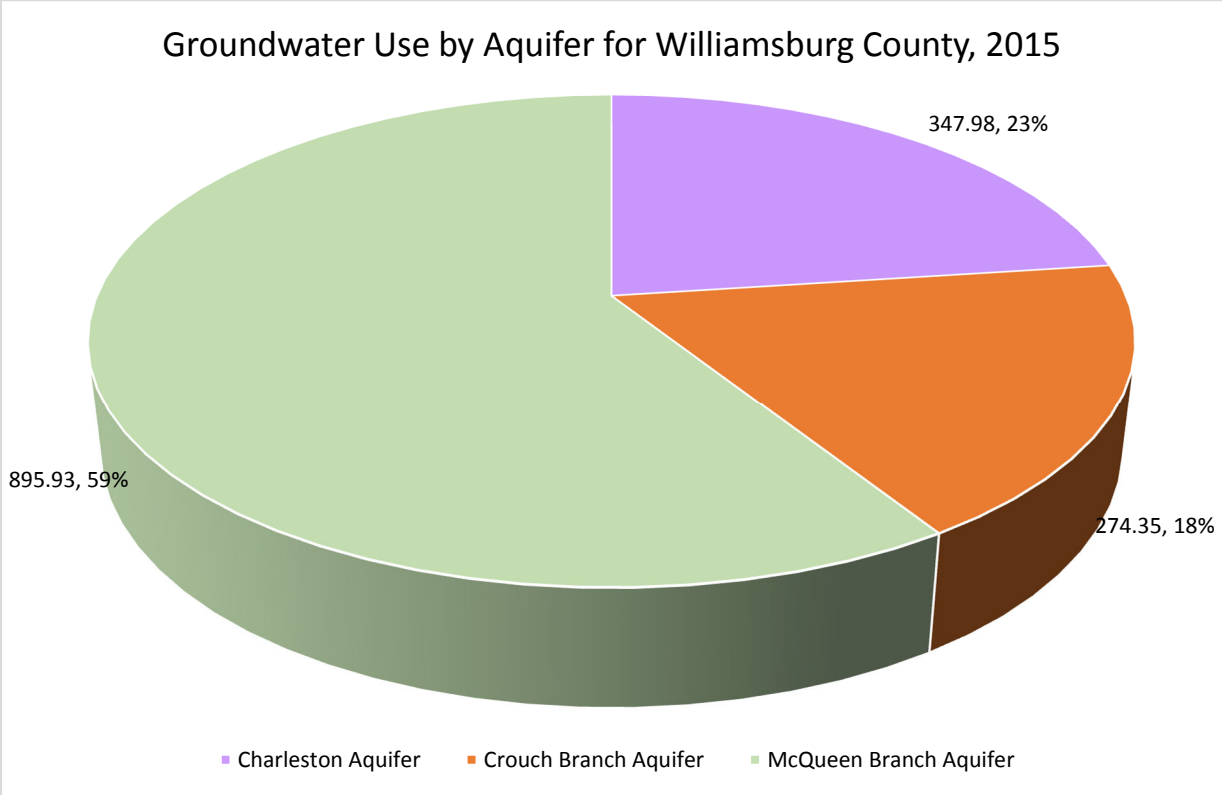

Figure 18. Reported groundwater use by aquifer for Williamsburg County, 2015.

Groundwater Demand Trends

To provide an historical perspective on reported groundwater use in the Pee Dee Capacity Use Area, Figures 19 and 20 show reported use by category of use. Public water supply use increased until about 2003, when it began to level off. Reported use for Irrigation was fairly low but started increasing between 2013 and 2014, going up from 828 million gallons to 1,658 million gallons. Industrial use has fluctuated between 3,192 million gallons in 2004 to 1,853 million gallons in 2010 and back up to 3,612 million gallons in 2015. Reported groundwater use for Golf Courses stayed relatively consistent, hovering around 120 million gallons. Reported Nuclear Power use has also stayed relatively constant, around 378 million gallons.

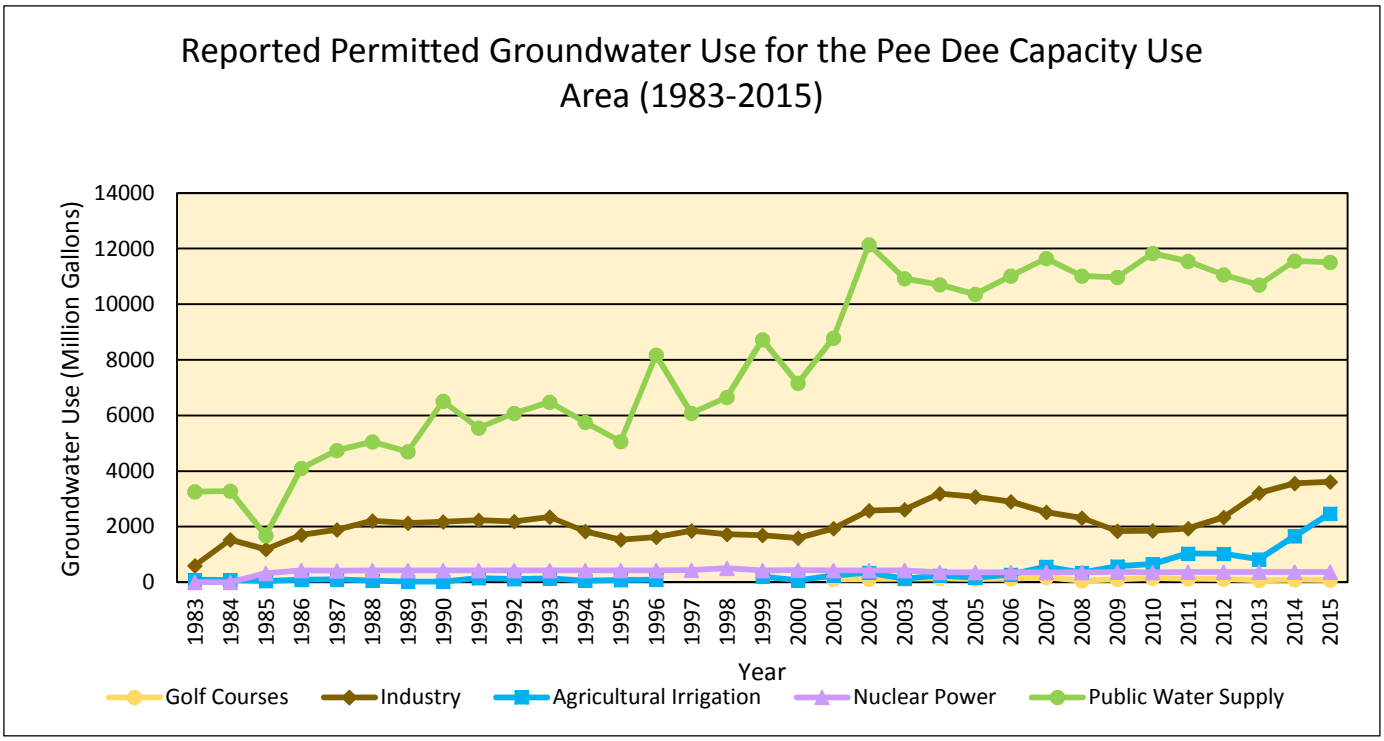

Figure 19. Reported permitted groundwater use for the Pee Dee Capacity Use Area, 1983-2015.

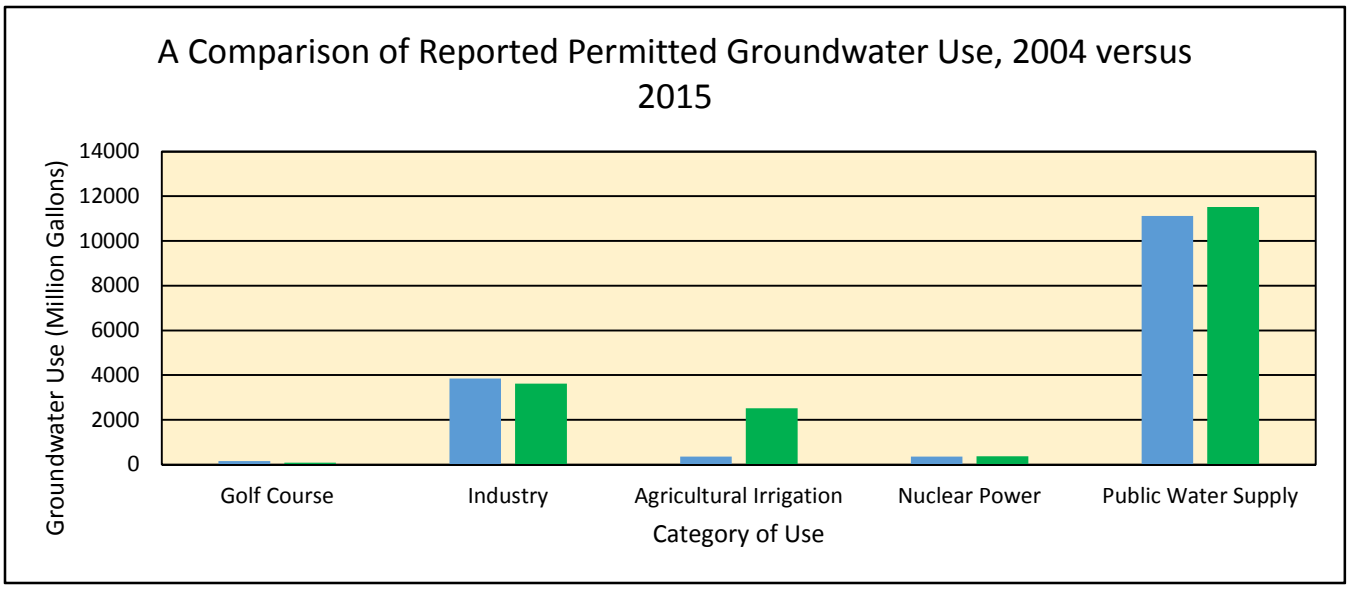

Figure 20. A comparison of reported groundwater use for 2004 to 2015.

Population, Growth, and Water Use Projections

The population in the Pee Dee area has not increased very much, only rising 3 percent the last 10 years. At the time of the 2010 Census, only 334,046 people were living in the region. Since the 2000 Census, Florence County experienced the largest percent increase in population, followed by Dillon and Darlington Counties, 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**
Darlington	67,394	68,681	1,287	**1.9%**
Dillon	30,722	32,062	1,340	**4.2%**
Florence	125,761	136,885	11,124	**8.1%**
Marion	35,466	33,062	-2,404	**-7.3%**
Marlboro	28,818	28,933	115	**0.4%**
Williamsburg	37,217	34,423	-2,794	**-8.1%**

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 three 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 approximately 23,322 people between 2000 and 2030, an increase of 7.17 percent. Florence County has the highest population (140,000 in 2015) and is projected to continue to have a higher population than the other counties, as well as experience the largest percent increase in population, followed by Dillon County (by percentage) and Darlington County (by actual population increase).

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

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**
Darlington	67,394	68,681	69,000	69,300	69,900	70,500	3,106	**4.61%**
Dillon	30,722	32,062	32,400	32,800	33,100	33,400	2,678	**8.72%**
Florence	125,761	136,885	140,000	143,100	147,000	150,900	25,139	**19.99%**
Marion	35,466	33,062	32,500	32,000	31,900	31,800	-3,666	**-10.34%**
Marlboro	28,818	28,933	29,000	29,000	29,100	29,200	382	**1.33%**
Williamsburg	37,217	34,423	33,800	33,100	33,000	,32,900	-4,317	**-11.60%**
Pee Dee Area	**325,378**	**334,046**	**336,700**	**339,300**	**344,000**	**348,700**	**23,322**	**7.17%**

***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*).**

Permitted withdrawal limits in the Pee Dee Area total 28,799 million gallons per year. Total reported usage for 2015 in the Pee Dee Area was 18,065.83 million gallons (Table 6).

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

Darlington

Permit	Permit Limit	Reported 2015 Use
16GC001	50	0.843
16IN001	500	13.123
16IN004	108	0
16IN005	1758	1655.548
16IN006	315	40.33
16IR016	381	280.3
16IR017	40	34.953
16IR018	30	24.561
16IR030	46	37.05
16IR041	79	45.75
16IR042	36	23.4
16IR081	93	106.92
16IR082	45	55.3
16IR083	24	0.5
16IR085	30	38
16IR086	63	42
16IR087	25	36
16IR088	34	1.583
16IR089	140	52
16IR090	30	17.5
16IR091	90	30
16IR092	60	86.693
16IR095	50	34.91
16PN001	663.6	367.492
16WS001	1800	1572.655
16WS002	375	293.268
16WS003	712	445.884
16WS005	40	26.287
Total	**7,617.60**	**5,362.85**

Dillon

Permit	Permit Limit	Reported 2015 Use
17IR001	40	39.5
17IR017	300	123.024
17IR018	23	3
17IR019	49.7	21.214
17IR020	54	9.462
17IR021	140	56.883
17IR022	50	16.2
17IR023	86	36.89
17IR024	34	10.7
17IR025	100	9.6
17WS001	554	353.658
17WS003	175	130.594
17WS004	1500	1070.188
17WS005	70	65.796
Total	**3,175.7**	**1,946.71**

Florence

Permit	Permit Limit	Reported 2015 Use
21GC005	154	64.55
21IN001	65	46.432
21IN002	900	639.904
21IN008	240	248.26
21IN010	76	65.045
21IN012	600	465.037
21IR012	40	15.56
21IR014	25	45
21IR015	135	127
21IR052	54	47
21IR054	50	43.75105
21WS001	300	170.849
21WS002	5940	3220.26
21WS005	661	563.6
21WS007	150	44.239
21WS008	50	37.105
21WS009	75	53.114
21WS010	58	48.036
Total	**9,573**	**5,944.74**

Marion

Permit	Permit Limit	Reported 2015 Use
33GC002	24	14.146
33IR026	201	122.15
33IR054	163	68.8
33IR055	35	18.5
33IR056	125	55.407
33IR057	318.5	78.335
33WS001	706	421.039
33WS002	675	519.633
33WS003	390	294.872
33WS004	20	8.039
Total	**2,657.5**	**1,600.92**

Marlboro

Permit	Permit Limit	Reported 2015 Use
34IN003	175	67.92
34IN006	180	0.95
34IR001	100	68.1
34IR003	169	116.81
34IR015	50	30
34IR016	60	0
34IR019	67	47.76
34IR020	48	15.5
34IR021	25	19
34IR022	125	8
34IR023	37	10
34IR024	61	33.3
34IR025	59	74.5
34IR027	68	18
34WS001	803	530.56
34WS002	480	429.93
34WS003	120	91.84
34WS004	100	84.28
34WS050	50	45.9
Total	**2,811**	**1,692.34**

Williamsburg

Permit	Permit Limit	Reported 2015 Use
45IN001	900	369.84
45IN003	109	0.066
45IR002	200	136
45IR003	24	11.5
45IR025	18	4
45WS001	288	139.44
45WS002	430	320.88
45WS003	54.2	25.93
45WS004	41	16.99
45WS005	36	8.75
45WS006	432	405.54
45WS007	432	79.32
Total	**2,964.2**	**1,518.26**

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 .24% per year.

Water Supply:

For 2015 in the Pee Dee Area, total groundwater withdrawal for water supply is approximately 11,518,482,500 gallons. Combined with reported surface water supply (1,583,936,000 gallons), the per capita use of water in the Pee Dee Area is approximately 54 million gallons per day. Utilizing this value (54 mgpd), projected population, and assuming groundwater will represent approximately 88% of the total water supply demand, groundwater demand is projected through 2030 (Table 7).

Table 7. Projected groundwater demand-water supply (million gallons) in Pee Dee Area.

2015	2020	2025	2030
11,518.48 MGY	11,656.01 MGY	11,795.33 MGY	11,936.24 MGY
31.55 MGD	31.93 MGD	32.32 MGD	32.70 MGD

Other:

Groundwater demand for all other categories through 2030 is calculated based on an estimated nominal and steady growth of .24% per year (Table 8).

Table 8. Projected groundwater demand-other (million gallons) in Pee Dee Area.

2015	2020	2025	2030
6,547.34 MGY	6,625.56 MGY	6,704.71 MGY	6,784.80 MGY
17.94 MGD	18.15 MGD	18.37 MGD	18.59 MGD

Total Projected Water Demand:

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

Table 9. Total projected groundwater demand-Pee Dee Area (million gallons).

	2015	2020	2025	2030
Water Supply	11,518.48	11,656.08	11,795.33	11,936.24
Other	6,547.34	6,625.52	6,704.71	6,784.80
Total MGY	18,065.83	18,281.64	18,500.04	18,721.04
Total Mgal/day	49.50	50.09	50.69	51.29

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 Pee Dee 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 Pee Dee 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 Pee Dee 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. 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;
- 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;
- 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.

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 Pee Dee Area. Both the USGS (Southeast Region) and the SCDNR maintain several groundwater level monitoring locations in the Pee Dee area. The table below lists the wells currently being used to monitor groundwater levels in the Pee Dee Capacity Use Area.

County	Well Id	Aquifer	Agency
Darlington	DAR-0228	Middendorf	SCDNR
Darlington	DAR-228	Middendorf	USGS
Dillon	DIL-0121	Middendorf	SCDNR
Dillon	DIL-0173	Middendorf	USGS
Dillon	DIL-0174	Black Creek	USGS
Dillon	DIL-0175	Middendorf	USGS
Florence	FLO-0128	Middendorf	SCDNR
Florence	FLO-0274	Middendorf	SCDNR
Florence	FLO-0276	Black Creek	SCDNR
Marion	MRN-0077	Black Creek	SCDNR
Marion	MRN-78	Cape Fear	USGS
Marlboro	MLB-0112	Middendorf	SCDNR
Williamsburg	WL-0355	McQueen Branch	SCDNR
Williamsburg	WL-12	Black Creek	USGS

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 Pee Dee area.

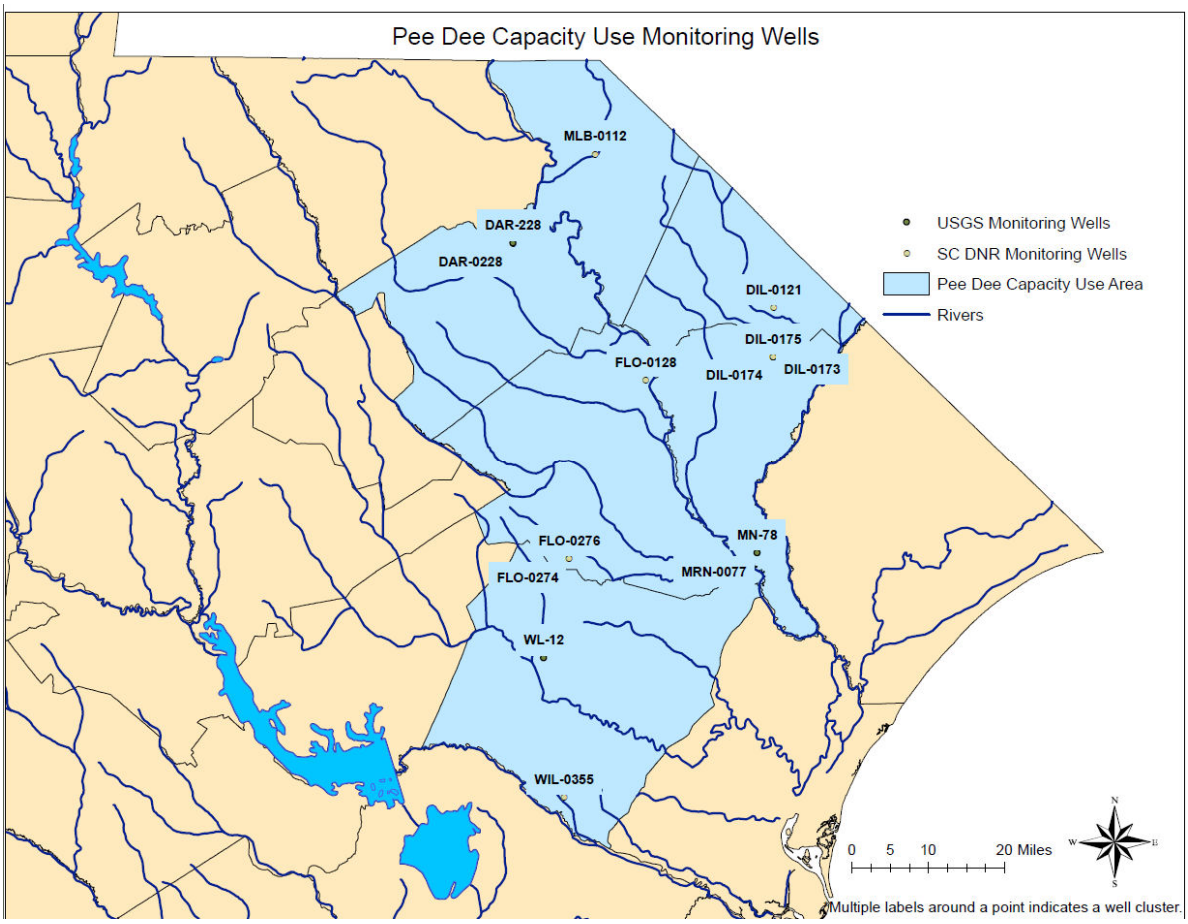

Figure 21. Locations of current monitoring wells.

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.