S.C. Department of Health and Environmental Control

Western Capacity Use Area Groundwater Evaluation Report

Permitting Year 2024

Author and Editor _____

Co-Author Lacie Pichler

Section Manager _____

Division Director _____

Technical Report Number: **007-2023**
September 2023

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Introduction

The Western Capacity Use Area (Western Area), which includes the whole of Aiken County, Allendale County, Bamberg County, Barnwell County, Calhoun County, Orangeburg County, and the portion of Lexington County that lies south of the fall line, was the fifth of six currently designated areas of South Carolina's Coastal Plain to be incorporated into the Capacity Use Program. In the parts of the state designated as a Capacity Use Area, a groundwater withdrawer is defined as, "*a person withdrawing groundwater in excess of three million gallons during any one month from a single well or from multiple wells under common ownership within a one-mile radius from any one existing or proposed well*" (Groundwater Use and Reporting Act, 2000).

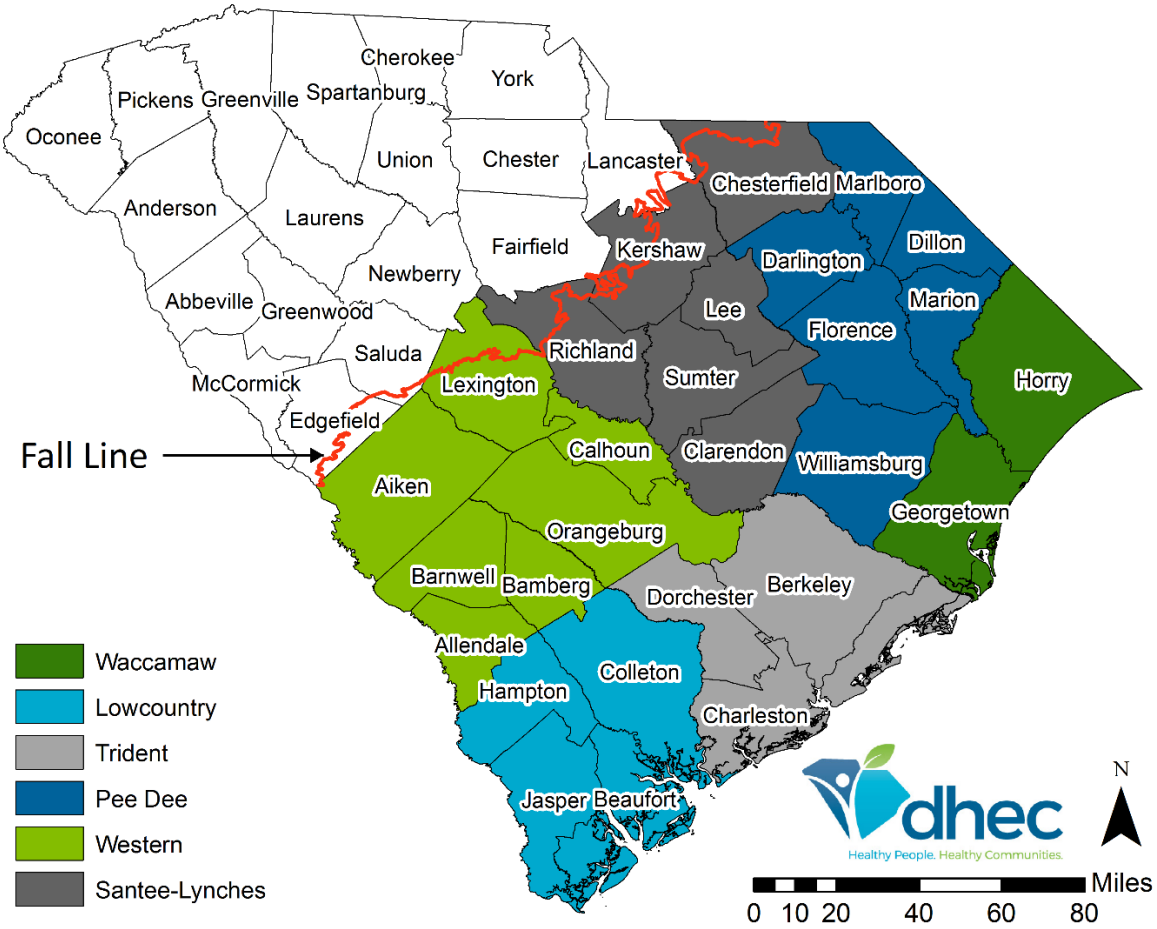

Figure 1. Map of SC DHEC Capacity Use Areas.

Regulatory History

In 1967, the S.C. Water Resources Planning and Coordination Act (Water Resources Act) established the S.C. Water Resources Commission (the Commission), which designated the Waccamaw Area (Horry and Georgetown Counties and Brittons Neck of Marion County) as the first Capacity Use Area in 1979. In 1993, under the Water Resources Act, the responsibilities of the Commission were distributed so that water permitting tasks became the responsibility of the S.C. Department of Health and Environmental Control

(SCDHEC) and water planning tasks became the responsibility of the S.C. Department of Natural Resources (SCDNR), and the Commission was dissolved. In 2000, the South Carolina Code of Laws (Title 49, Section 5) was revised to include what is now the current Groundwater Use and Reporting Act (Groundwater Use and Reporting Act, 2000). Significant changes enacted by the new law were 1) groundwater assessments to determine the necessity of establishing a Capacity Use Area could be initiated by SCDHEC as well as requested by local governments or non-governmental organizations within the state; and 2) a Groundwater Management Plan was now required for each Capacity Use Area. The Capacity Use Areas and associated counties were designated in the following order:

- **Waccamaw Area (1979):** Georgetown and Horry Counties, and Brittons Neck of Marion County
- **Lowcountry Area (1981):** Beaufort, Colleton, and Jasper Counties
- **Trident Area (2002):** Berkeley, Charleston, and Dorchester Counties
- **Pee Dee Area (2004):** Darlington, Dillon, Florence, Marion (including Brittons Neck, leaving only Georgetown and Horry Counties in the Waccamaw Area), Marlboro, and Williamsburg Counties
- **Lowcountry Area (2008):** Addition of Hampton County
- **Western Area (2018):** Aiken, Allendale, Bamberg, Barnwell, Calhoun, Lexington, and Orangeburg Counties
- **Santee-Lynches Area (2021):** Chesterfield, Clarendon, Kershaw, Lee, Richland, and Sumter Counties

The initial Western Groundwater Management Plan (WGMP) (Foxworth & Hughes, 2019) was approved by the SCDHEC Board of Directors on November 7, 2019. The stated goals of the WGMP are to:

1. Ensure sustainable use of the groundwater resources by management of groundwater withdrawals;
2. Monitor groundwater conditions to evaluate availability; and
3. Promote educational awareness of the resource and its conservation.

The WGMP addressed achieving these goals by evaluating the following aspects of groundwater use in the Western Area:

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

Following the guidelines set forth in the WGMP, this document provides an evaluation of current groundwater use and recommendations for its management.

Hydrogeologic Framework

Physiographic Provinces

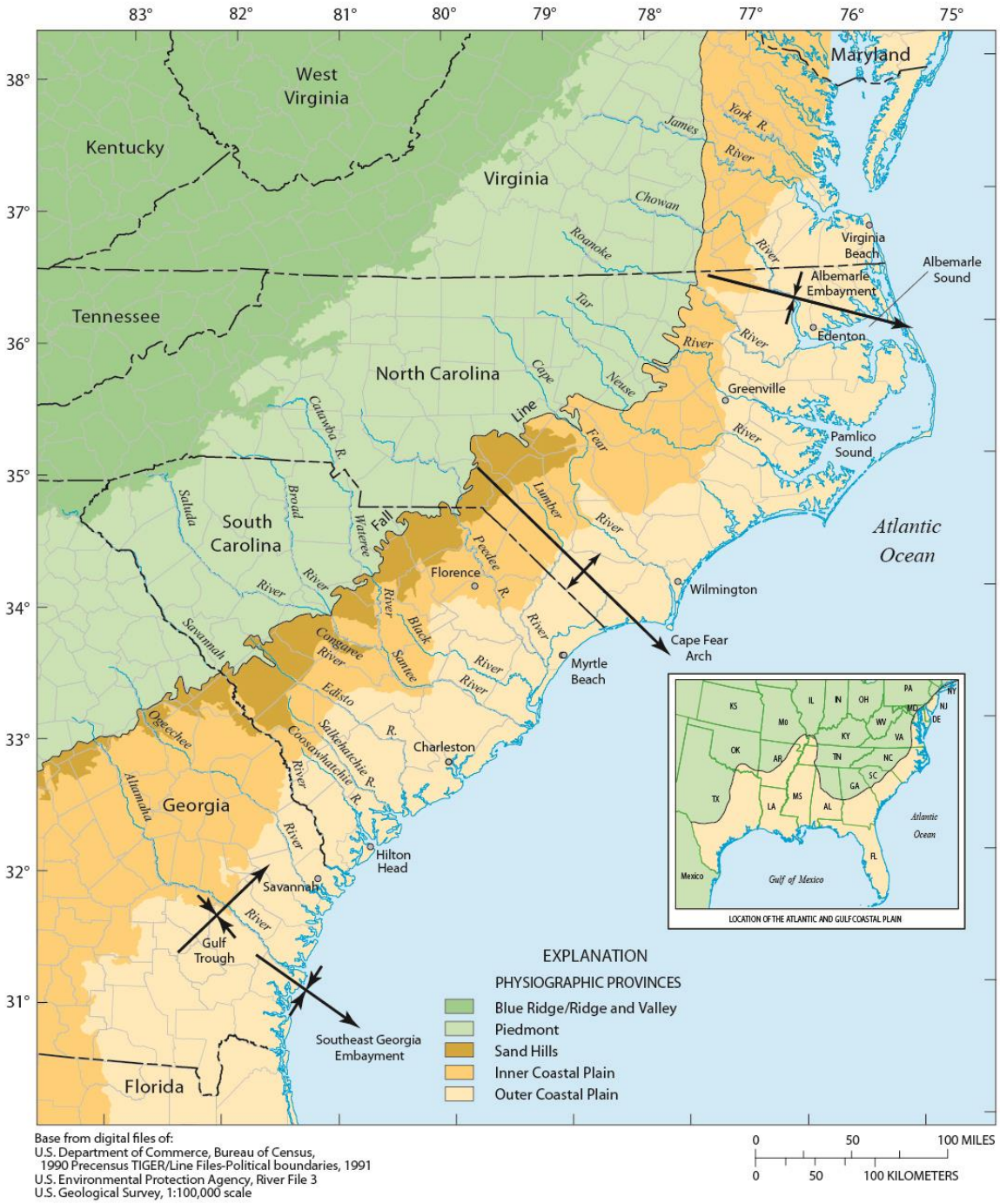

Figure 2. Map of the Atlantic Coastal Plain from North Carolina to Georgia and parts of northern Florida, Virginia, and Maryland. The inset map indicates the extent of the entire Atlantic and Gulf Coastal Plain. U.S. Geological Survey (usgs.gov/media/images/atlantic-coastal-plain-maryland-florida); accessed March 6, 2023.

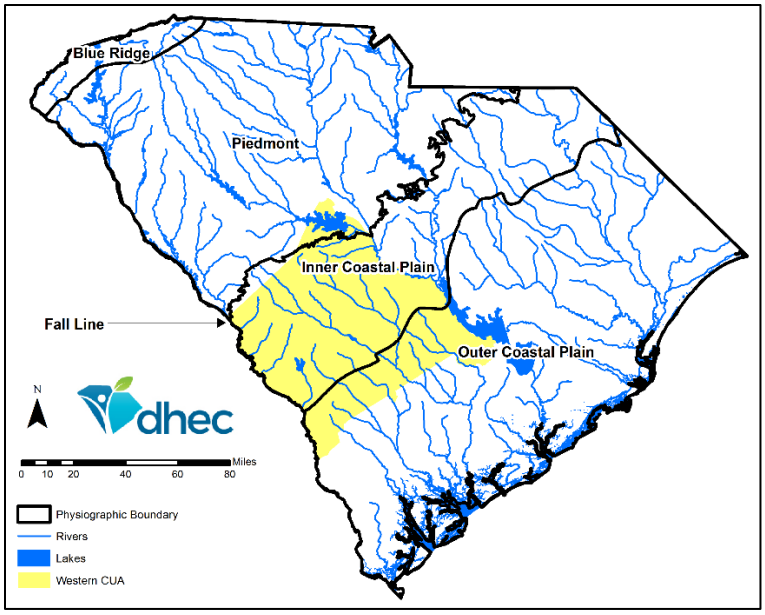

Figure 3. Map of the South Carolina physiographic provinces with the Western Area highlighted yellow.

The Coastal Plain of South Carolina (CPSC) is part of the larger Atlantic Coastal Plain (ACP). The ACP's northern boundary is in New Jersey and the southern boundary is in Florida. From west to east, the ACP extends from the Fall Line to the coastline with three regions that run roughly parallel to the Atlantic Coastline (Fig. 2).

The CPSC is typically divided into two regions: the Inner Coastal Plain and the Outer Coastal Plain. The Inner Coastal Plain includes the Sandhills Region and is defined by the Fall Line to the northwest and the inland border of the Brandywine terrace to the southeast (Logan & Euler, 1989), and the Outer Coastal Plain is identical to that of the ACP. The Inner Coastal Plain is characterized by rolling hills and deeply incised river valleys, while the Outer Coastal Plain is characterized by a series of coastal terraces dissected by numerous streams (Campbell, et al., 2010). The Western Area is located within both the Inner and Outer Coastal Plain physiographic provinces of South Carolina. The northwestern portion of Lexington County that is located within the Piedmont province falls outside of the regulatory authority of the Western Area (Fig. 3).

The topography of the Western Area ranges from 60 to 650 feet above mean sea level. Western Area counties experience occasional riverine flooding, with a record flood stage cresting event occurring in October 2015 (SC State Climatology Office, 2018). Both groundwater and surface water sources are available and utilized by water withdrawers in this area.

Aquifers

The hydrogeologic framework of the CPSC consists of wedge-shaped stratigraphy divided into layers of water-bearing, permeable sand, or carbonate deposits (aquifers) alternating with layers of fine-grained clays, silts, or low-permeability carbonate deposits (confining units) (Fig. 4). The hydrogeologic units underlying the CPSC were deposited during the late Cretaceous to Tertiary Periods. From oldest to youngest, the Cretaceous units are the Gramling, Charleston, McQueen Branch, and Crouch Branch. The Tertiary units, in the same chronological order, are the Gordon, Floridan (further divided into the Middle Floridan and Upper Floridan), and Surficial (Fig. 4) (Gellici & Lautier, 2010).

The Western Area is a diverse region in terms of groundwater sources. Of the Cretaceous units, the McQueen and Crouch Branch aquifers exist below all seven counties in the Western Area, but the Gramling and Charleston aquifers only exist below the southeastern portions of Allendale, Bamberg, and Orangeburg counties. The Tertiary units are also present below all seven Western Area counties, except for the Middle Floridan aquifer, which does not exist below Lexington County, and the Upper Floridan aquifer, which does not exist below Calhoun or Lexington County (Czwartacki, Wachob, & Gellici, 2019).

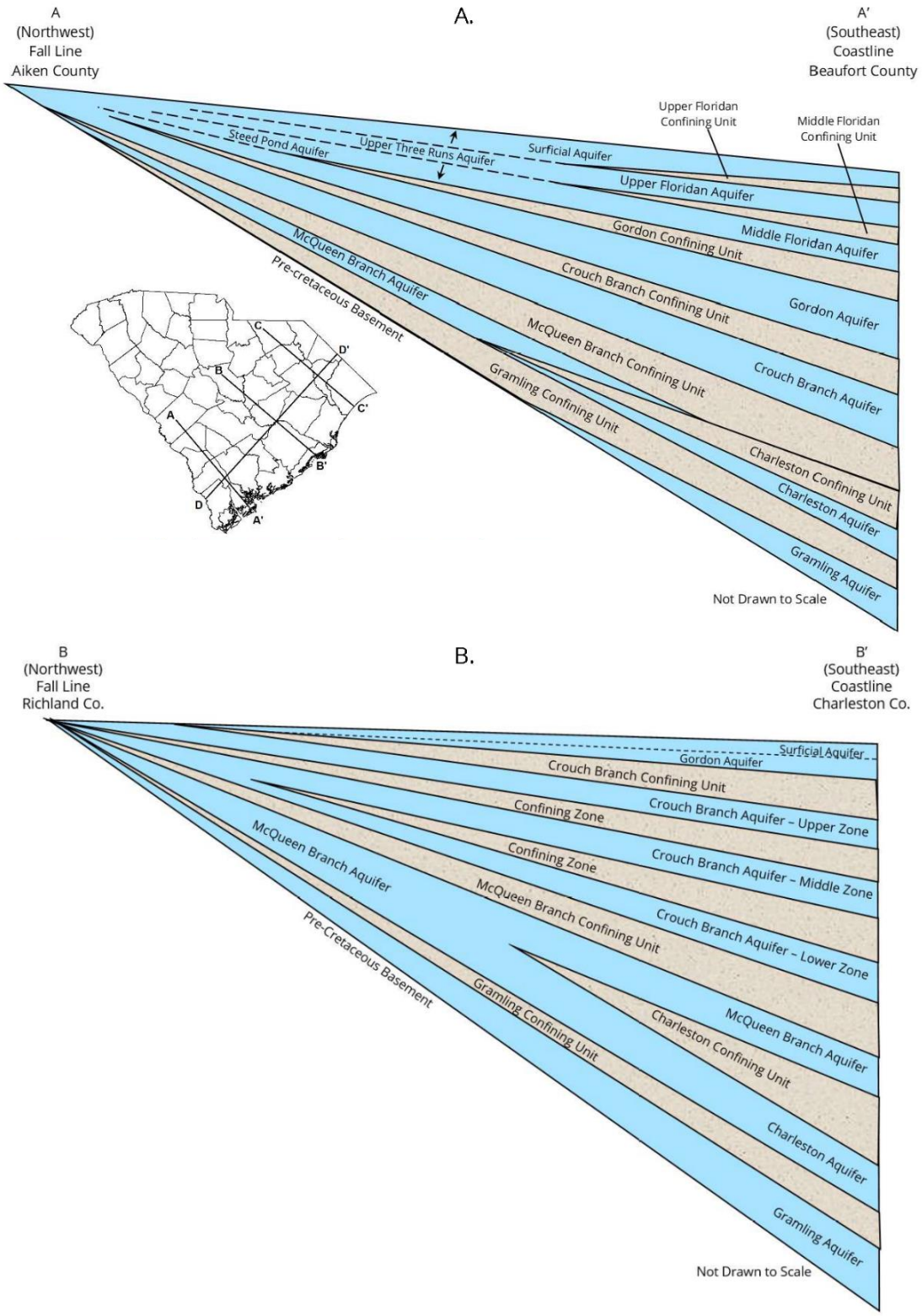

Figure 4. Generalized cross-sections of CPSC stratigraphy. The inset map shows the locations of the four (4) cross-sections. A. The A to A' line; B. The B to B' line; C. The C to C' line; and D. The D to D' line (Campbell, et al., 2010).

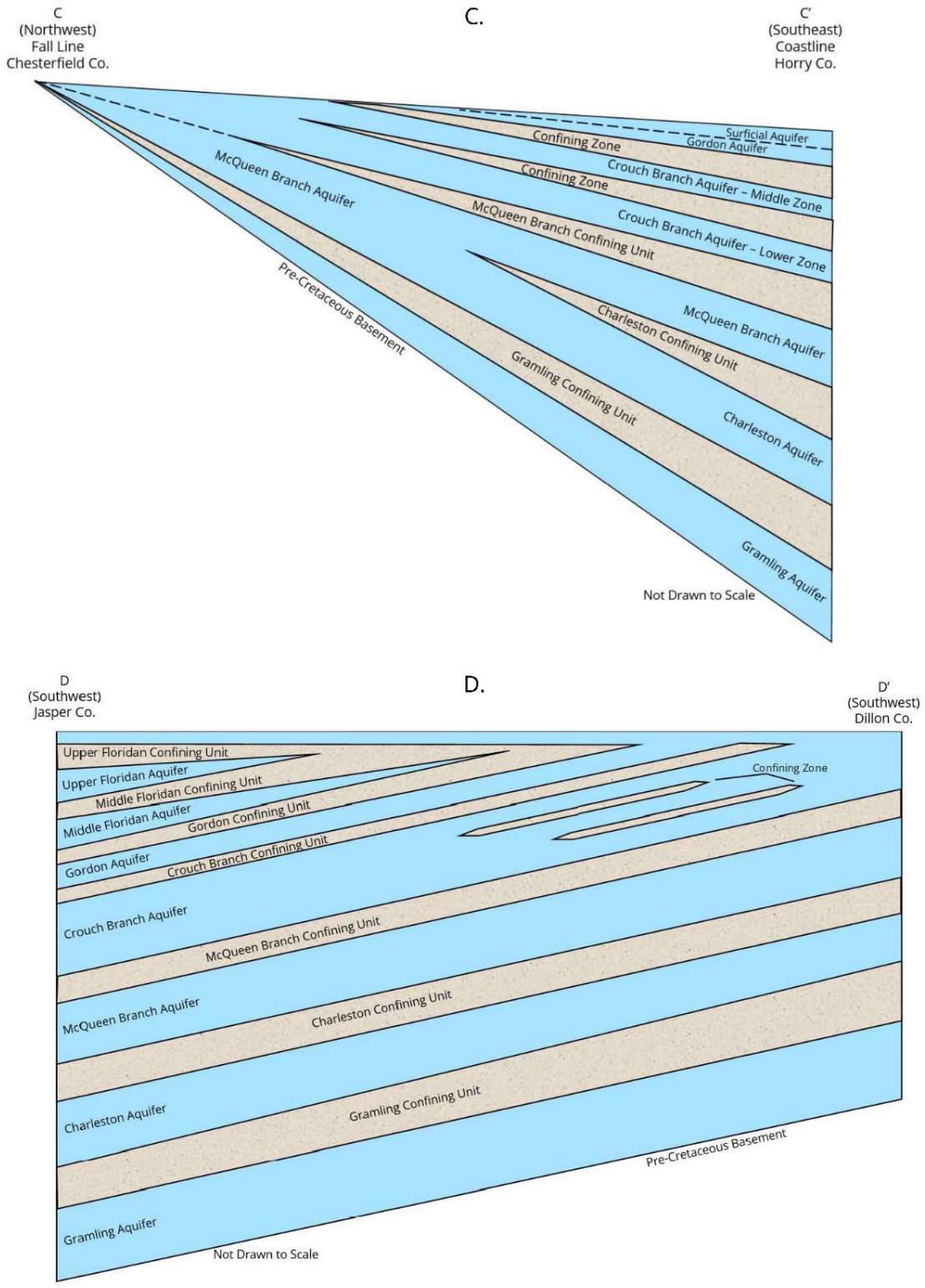

Figure 4, continued.

Recharge Areas

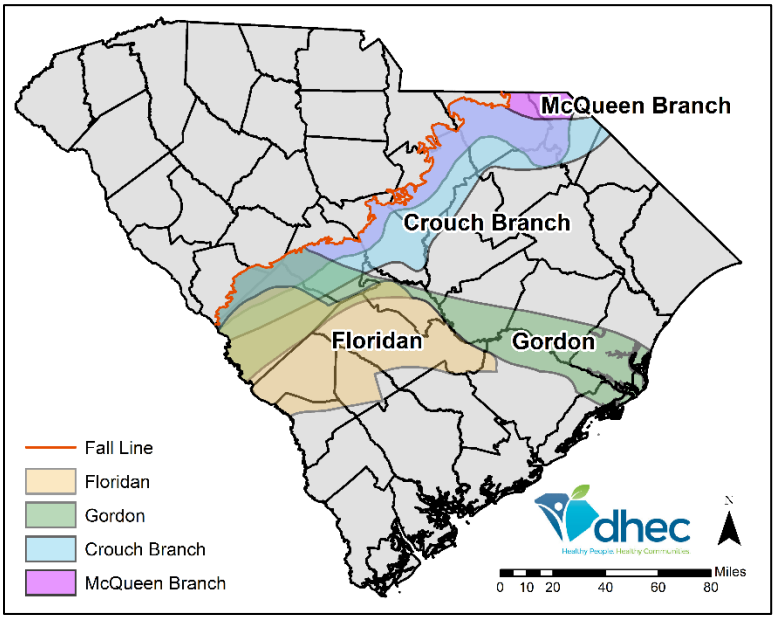

Figure 5. Map indicating the location and extent of the CPSC aquifer recharge areas.

The recharge areas for South Carolina's aquifers are primarily located within the Inner Coastal Plain (Fig. 5). The surficial aquifer receives direct recharge through infiltration of local precipitation and interactions with surface water bodies. In the Western Area, the confining units gradually thin and taper out to the northwest (geologically speaking, "up-dip"), causing the Surficial and Floridan Aquifers to connect and form the Upper Three Runs Aquifer, which then coalesces further up-dip with the Gordon Aquifer to form the Steed Pond Aquifer (Fig. 4). As a result, the aquifers closest to the Fall Line are shallower, more interconnected, and show a greater degree of surface water interaction than those in the southeastern extent of the Western Area, where aquifers are more distinct and separated by confining units (Campbell, et al., 2010). Consequently, the rate at which groundwater is replenished in the deeper aquifers in the southeastern portion of the Western Area is largely controlled by the rate at which groundwater travels from the recharge zones near the Fall Line and the transmissivity of the aquifer. Typical groundwater flow rates for silts to well-sorted sands range from 0.003 to 300 feet per day (Fetter, 2001). This means that once surface water and precipitation infiltrates into the groundwater system, it may take anywhere from a few years to hundreds of years to reach some locations below the Western Area.

Surface Water

The Western Area spans portions of the Saluda, Savannah, Salkehatchie, Santee, and Edisto River Basins in South Carolina (Fig. 6). Surface water sources are primarily rivers and streams, but locally impounded waters are used for irrigation as well. The entirety of the Western Area's southwestern border is defined by the Savannah River. Along the northeastern border, several water bodies define the Western Area's extent: Lake Murray, the Congaree River, and Lake Marion. Other major rivers that originate or flow through the Western Area are the North and South Fork Edisto Rivers which converge in southeastern Bamberg County to form the Edisto River, the Salkehatchie River, and the Coosawhatchie River (Fig. 6). Surface water bodies incise and interact heavily with aquifer systems within the Western Area, especially closest to the Fall Line.

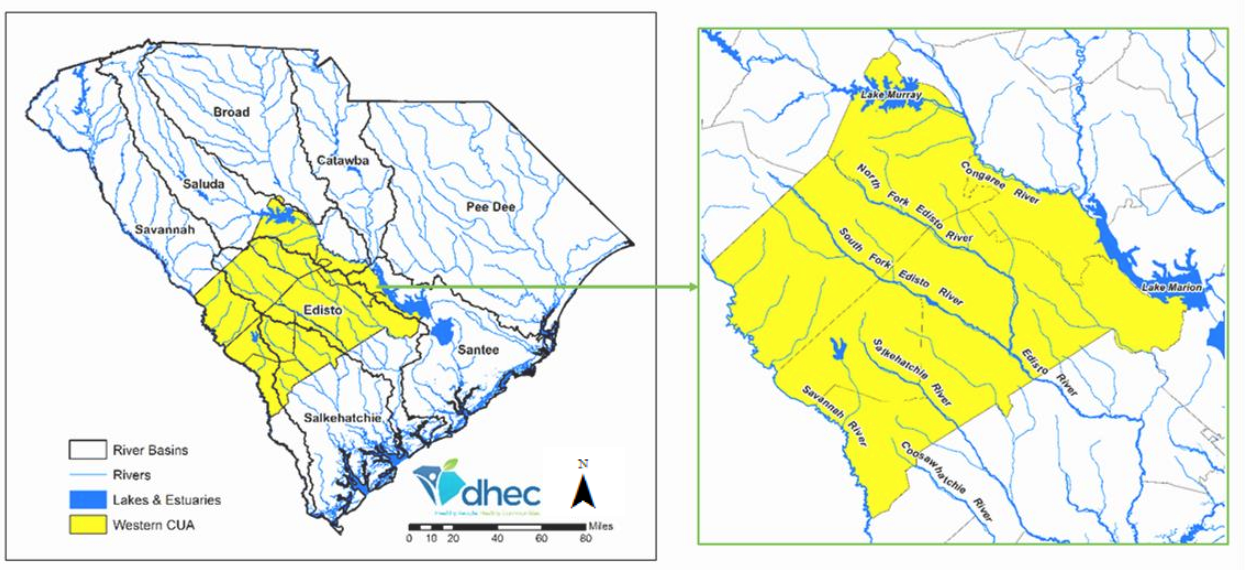

Figure 6. Surface water map of South Carolina with the Western Area highlighted yellow.

Current Groundwater Demand

In 2022 there were 374 facilities that reported water use from 1,261 wells in the Western Area counties. Of the permitted wells, 987 are permitted for agricultural irrigation (78%), followed by 168 for water supply (13%), 72 for industry (6%), 16 for golf course irrigation (1%), 11 for mining (1%), and 7 for thermopower (<1%). No wells were permitted for aquaculture, nuclear power or other. Approximately one-third of the wells are permitted in Orangeburg County (34%), followed by Aiken County (17%), Calhoun County (16%), Lexington County (10%), Bamberg County (8%), Barnwell County (8%), and Allendale County (6%) (Table 1, Fig. 7).

Table 1. Count of Western Area Capacity Use Wells by County and Use Category

Use Category	Aiken	Allendale	Bamberg	Barnwell	Calhoun	Lexington	Orangeburg	Total (%)
Golf Course Irrigation	10	0	0	0	1	2	3	16 (1%)
Agricultural Irrigation	80	58	92	82	189	86	378	987 (78%)
Industrial	41	2	0	4	1	15	9	72 (6%)
Mining	0	0	0	0	2	9	0	11 (1%)
Power Thermal	0	3	0	0	0	0	4	7 (1%)
Water Supply	85	13	6	20	9	18	16	168 (13%)
Total	216 (17%)	76 (6%)	98 (8%)	106 (8%)	206 (16%)	130 (10%)	429 (34%)	1,261 (100%)

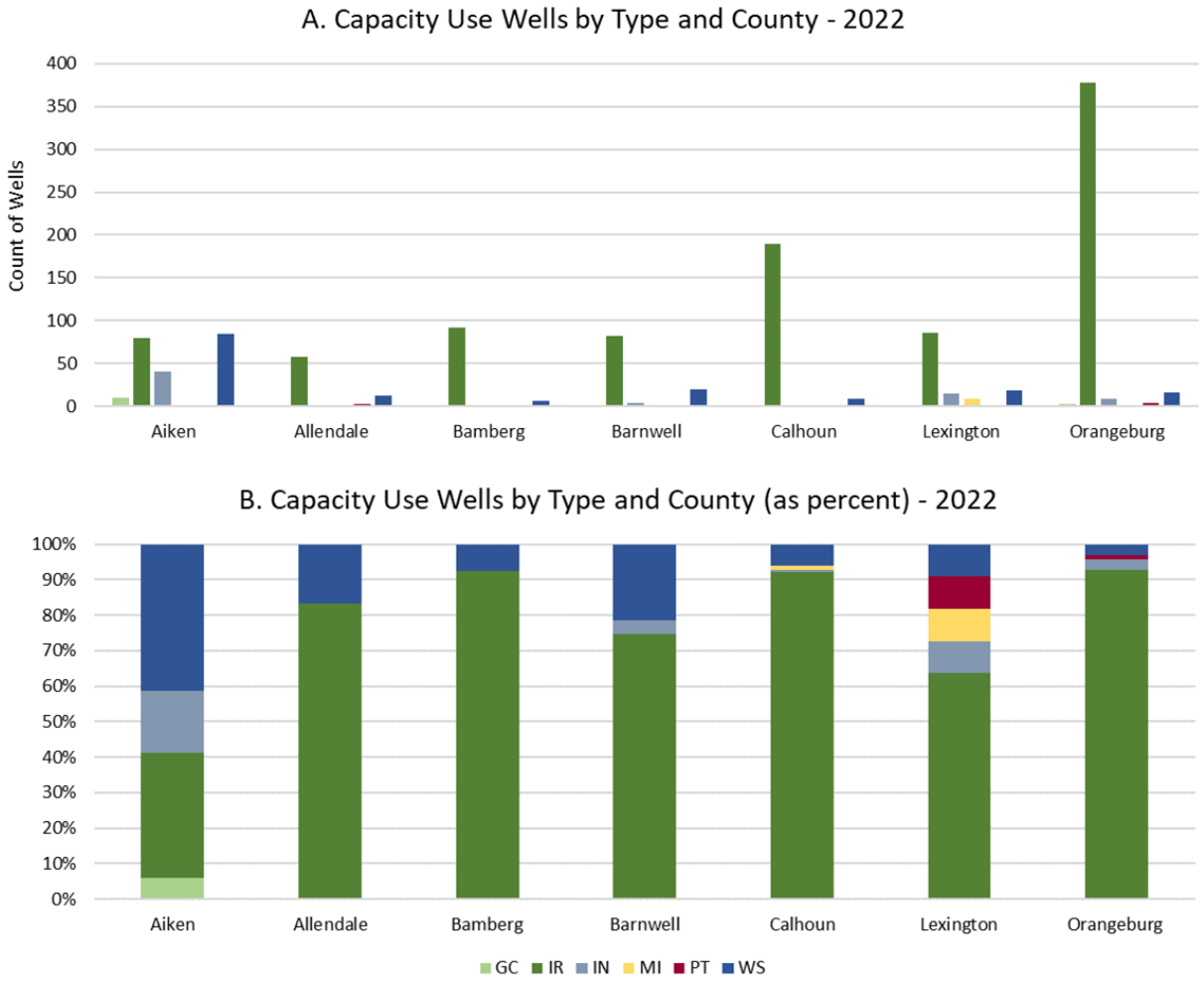

Figure 7. Graphs of Western Area Permitted Wells by Type and County – 2022. A. Number of each well type by county, and B. Each well type is presented as a percent of the total by county.

A total of 40,662.53 million gallons (MG) (or 40.662 billion gallons) was reported for groundwater use during 2022 for the Western Area (Table 2, Fig. 8). The largest volume of groundwater use reported was for agricultural irrigation at 70% of the total. Water supply was the next largest reported water use category at 21%, followed by industry (6%), and thermopower (3%). Less than 1% of the total reported groundwater use during 2022 was reported for both the golf course and mining use categories.

Table 2. Reported Water Use (MG) by County and Use Category

Use Category	Aiken	Allendale	Bamberg	Barnwell	Calhoun	Lexington	Orangeburg	Total
Golf Course (GC)	116.70	0	0	0	3.42	17.17	59.19	196.48 (<1%)
Irrigation (IR)	2,385.40	4,017.91	2,720.32	1,633.63	5,187.51	3,604.00	8,725.74	28,274.51 (70%)
Industry (IN)	714.54	515.48	0	157.52	2.03	381.77	689.73	2,461.07 (6%)
Mining (MI)	0	0	0	0	78.27	31.03	0	109.3 (<1%)
Thermopower (PT)	0	140.15	0	0	0	0	1,019.96	1,160.11 (3%)
Water Supply (WS)	5,299.51	449.51	345.93	919.28	478.32	578.48	350.04	8,421.06 (21%)
Total	8,516.15 (21%)	5,123.05 (13%)	3,066.25 (8%)	2,710.43 (7%)	5,749.55 (14%)	4,612.45 (11%)	10,844.66 (27%)	40,622.53 (100%)

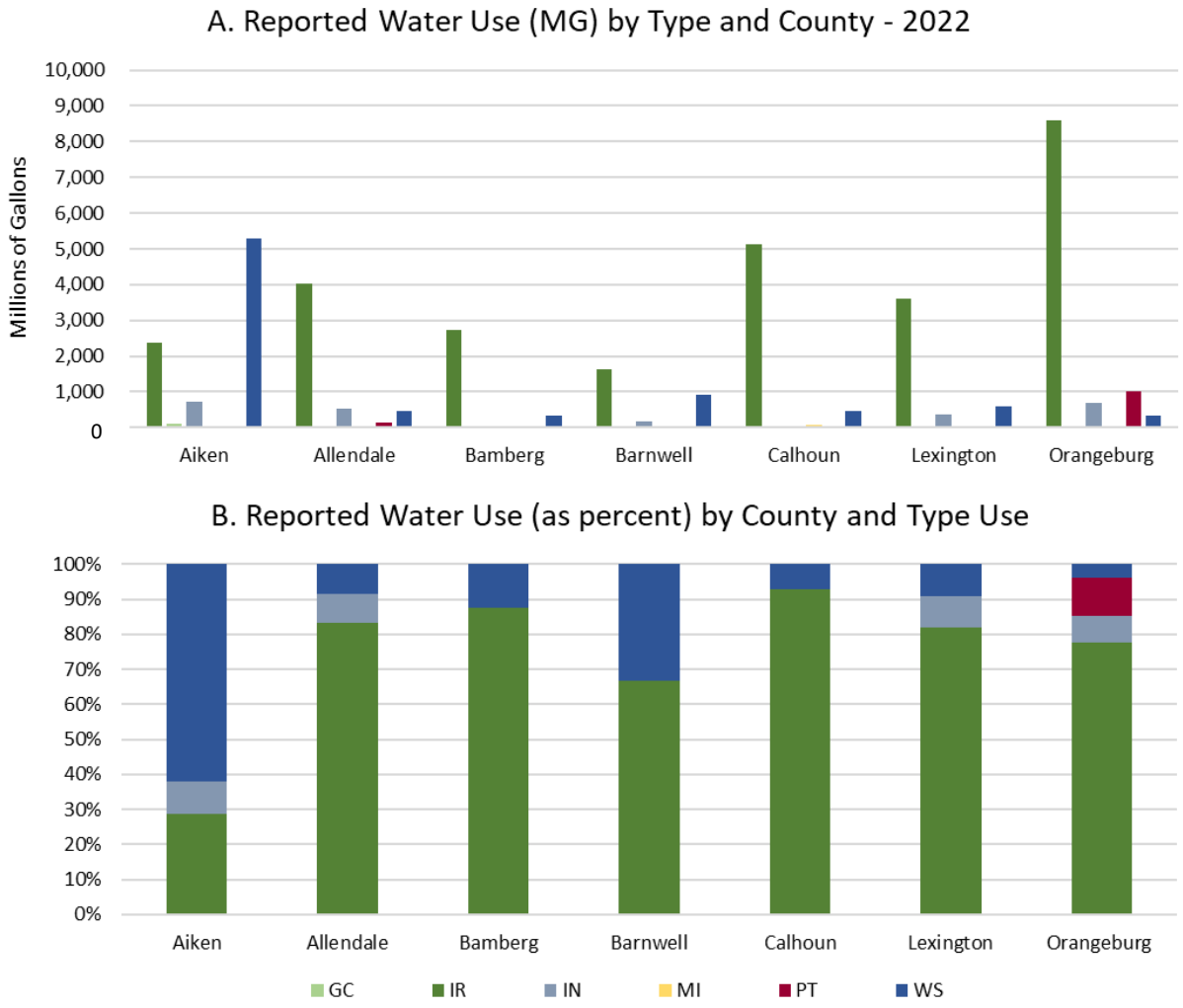

Figure 8. Graphs of Western Area Reported Water Use by Type and County – 2022. A. Reported water use for each county in millions of gallons. B. Reported water use is presented as a percentage of the total for each county.

Water supply is the category with the largest demand on groundwater in Aiken County, while agricultural irrigation is the leading category for Orangeburg, Calhoun, Lexington, Bamberg, Allendale, and Barnwell Counties, respectively. Of the seven Western Area counties, Orangeburg has the largest demand on groundwater at 27%, while Aiken accounts for 21%, followed by Calhoun (14%), Allendale (13%), Lexington (11%), Bamberg (8%), and Barnwell (7%) (Fig. 8).

Aiken County Details

Aiken County has 52 permitted facilities with a total of 216 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 69% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Aiken County are wells cross-screened in the Crouch Branch-McQueen Branch aquifers, supplying 39% (3,356.73 MG) of the total reported water use for 2022 (Table 3).

Table 3. Permit Limits and 2022 Reported Water Use – Aiken County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
Cedar Creek Golf Club	02GC011	34	7	Gordon
The Reserve Club	02GC052	24	0	Crouch Branch-McQueen Branch
Tree Farm Golf Course	02GC053	104	99.7	McQueen Branch
Kimberly-Clarke Beech Island Mill	02IN003	95.7	70.76	Crouch Branch
SRNS SRS A Area Ind	02IN012	303.4	444.09	Gordon
SRNS SRS H AREA IND	02IN015	50	42.77	McQueen Branch
Savannah River Mission Completion Defense Waste Processing Facility	02IN017	34.5	24.69	McQueen Branch
Savannah River Mission Completion T-Area Industrial Well	02IN018	18.1	17.21	Crouch Branch
Savannah River Mission Completion Saltstone Disposal	02IN022	34.6	19.54	Crouch Branch
ASCO Groundwater Extraction and Treatment System	02IN023	132.1	95.49	Gordon
Cowden Plantation Farms	02IR004	79.76	133.42	Crouch Branch
Watson Jerrold and Sons	02IR011	384	94.52	Middle Floridan
Quail Ridge Nursery	02IR019	88 266	3.93 92.84	Gordon Crouch Branch-McQueen Branch
Walther Farms	02IR025	397.6	0	McQueen Branch
Rucker Farms	02IR026	6	13.7	Crouch Branch-McQueen Branch
BC Farms, Inc. - Cameron	02IR029	1,012	728.2	McQueen Branch
BC Farms, Inc. - Salley	02IR031	189	99	McQueen Branch
LALA/Sally Sod, LLC	02IR032	200	185.1	McQueen Branch
Douglas Farm	02IR036	82.56	50.6	Crouch Branch
Windsor Park, LLC	02IR039	28	1	Crouch Branch
Brown's Bottom Farm	02IR040	21	9.5	McQueen Branch
Stockhaven Nursery	02IR041	102.9	87	Gordon
BC Farms, Inc. - Pearl Bonnett	02IR042	336	125.2	Crouch Branch-McQueen Branch
BC Farms, Inc. - Bussey	02IR043	292	200.36	Crouch Branch-McQueen Branch
Hartley Farms	02IR044	48	0 12	Crouch Branch McQueen Branch
Walthers Farms	02IR045	381.4	232.33	Crouch Branch-McQueen Branch
Toole Farm	02IR047	260	13 189	Gordon Crouch Branch
Givens Farms, Inc.	02IR049	58	5.6	Crouch Branch
Spring Steel Farm	02IR053	39.5	38	McQueen Branch
River Bluff Farms, LLC	02IR054	126	28	Crouch Branch
PRT USA	02IR055	54.12	0 0	Gordon Crouch Branch
Wagener (Town)	02WS001	41	29.48	Crouch Branch
City of Aiken	02WS002	3,370.71	527.54 1890.51	Crouch Branch Crouch Branch-McQueen Branch

Talatha Rural Water District	02WS003	56.8	52.25	Crouch Branch
Bath Water & Sewer District	02WS004	38.3	19	McQueen Branch
BREEZY HILL WTP	02WS005	593	104.02 392.64	Crouch Branch McQueen Branch
VALLEY PSA	02WS006	467.2	58.81 315.2	Crouch Branch McQueen Branch
Beech Island Rural Community Water District	02WS008	748	164.41 175.22 295.13	Crouch Branch Crouch Branch-McQueen Branch McQueen Branch
Langley Water Sewer and Fire District	02WS009	68	42.39	McQueen Branch
Montmorenci-Couchton Water and Sewer District	02WS011	200	105.24 22.43	Crouch Branch McQueen Branch
Jackson Town of	02WS012	136.15	120.4	Crouch Branch
Burnnettown Town of	02WS013	46	55.69	McQueen Branch
New Ellenton CPW	02WS014	478	366.86 0	Crouch Branch McQueen Branch
Town of Salley	02WS015	17	12.2	Crouch Branch
Perry Town of	02WS016	31.29	0 34.86	Gordon Crouch Branch
Town of Monetta	02WS017	49	15.48	Bedrock
College Acres Public Works District	02WS018	73	54.97 2.49	Gordon Crouch Branch
New Holland W/D	02WS019	23	0 17.4	Crouch Branch-McQueen Branch McQueen Branch
SRNS A-Area Domestic Water	02WS020	365	287.56	Crouch Branch
SRNS B Area WS	02WS021	17	7.82	McQueen Branch
Trolley Run Station Development	02WS028	151.6	66.57 62.96	Crouch Branch-McQueen Branch McQueen Branch
Old Barnwell Golf Course	WDR00080	30	11	Crouch Branch
	Totals	**12,282.29**	**8,516.15**	

Allendale County Details

Allendale County has 23 permitted facilities with a total of 76 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 67% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Allendale County is the Crouch Branch Aquifer supplying 71% (3,644.8 MG) of the total reported water use for 2022 (Table 4).

Table 4. Permit Limits and 2022 Reported Water Use – Allendale County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
Archroma Martin Plant	03IN001	815	515.48	Crouch Branch
Rouse Farms - Allendale	03IR001	146.25	145.23	Upper Floridan-Middle Floridan
Chappell Farms	03IR002	27.6	3	Gordon-Crouch Branch
J&J Farms of Estill, SC Inc.	03IR005	181.9	96.02	Upper Floridan
Sharp & Sharp Certified Seed	03IR006	922.8	5 901	Gordon Crouch Branch
Duncan Farms	03IR008	55	17.64	Crouch Branch
Creek Plantation, LLC	03IR009	685	370.58	Gordon
Oswald JCO Farms	03IR010	2,601.92	1,833.30	Crouch Branch
Connelly Farms	03IR011	397.8	186	Crouch Branch
Allendale Peanut Farms, LLC	03IR051	163	0	Gordon
CF Bowers & Son	03IR052	44	11.23	Crouch Branch
Coosaw Ag, LLC	03IR053	286.9	6 171.2	Upper Floridan Middle Floridan
T&M Farms	03IR054	325	41.5 50.5 110	Middle Floridan Gordon Crouch Branch
Chappell Farms	03IR055	20	3	Gordon
Chappell Farms	03IR056	15	1	Gordon-Crouch Branch
Nimmer Sycamore Farm	03IR057	120	32.31	Middle Floridan
Carolina Turfgrass	03IR058	15	33.4	Gordon
Allendale Biomass, LLC	03PT001	167.73	140.15	Middle Floridan
Allendale Water System	03WS001	308	272.24	Middle Floridan
Town of Fairfax	03WS002	122	96.1	Middle Floridan
Town of Ulmer	03WS003	30	10.53	Gordon
Allendale Industrial Park	03WS004	145	70.17	Crouch Branch
Norbord South Carolina, Inc.	03WS005	60	0.47	Middle Floridan
	Totals	**7,654.90**	**5,123.05**	

Bamberg County Details

Bamberg County has 38 permitted facilities with a total of 98 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 54% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Bamberg County is the Crouch Branch Aquifer -supplying 56% (1,706.96 MG) of the total reported water use for 2022 (Table 5).

Table 5. Permit Limits and 2022 Reported Water Use – Bamberg County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
Shivers Trading and Operating Company	05IR005	133	99.5	Crouch Branch
Brubaker Farms, Inc	05IR007	225	4.6 138 47	Upper Floridan Gordon Crouch Branch
Phil Sandifer & Sons Farms	05IR012	184.8	39.9 103.2	Gordon Crouch Branch
Platt Farm - Home Place	05IR020	15	28	Crouch Branch
Phil Sandifer & Sons Farms	05IR021	159	108.1	Crouch Branch
Gary Hege Farm	05IR023	500	27.25	Crouch Branch
Sunrise Dairy - Bamberg	05IR025	90	10 63	Upper Floridan Gordon-Crouch Branch
Diem Farm	05IR033	25	11.8	Crouch Branch
Triple R Farms of Ehrhardt, LLC	05IR052	135	94	Crouch Branch
Laurie W. Copeland Farms	05IR053	180	112.4	Gordon-Crouch Branch
Double B Farm	05IR057	220.4	7.28 108.95	Gordon Crouch Branch
Kirkland Creek Farms	05IR058	63.5	1.5 17.5	Middle Floridan Gordon
Old Salem Dairy LLC	05IR059	549	439.5	Middle Floridan-Gordon Gordon-Crouch Branch
Federate Farm, LLC	05IR060	30	25.2	Crouch Branch
Sease Farm, LLC	05IR061	22.8	11.5	Gordon
Richard Rentz Farm	05IR065	35	11.5	Crouch Branch
Tractor Road Bamberg SC LLC - Tractor Road	05IR066	275.4	34.55	Crouch Branch
FPI Properties, LLC - Cypress Bay Farm	05IR067	400	66.1	Crouch Branch
FPI Properties, LLC - Olar Farm	05IR068	618	48 78	Middle Floridan Crouch Branch
England Cell Tower/RRR Farms LLC	05IR069	70	31.03	Crouch Branch
England Jolly Field/RRR Farms LLC	05IR070	70	36	Crouch Branch
England Dirt Road/RRR Farms LLC	05IR071	70	46.25	Crouch Branch
Hughes Field	05IR072	61	10.04	Crouch Branch
Chitty Farm	05IR073	38	20.5	Crouch Branch
Jade Collins Farms, LLC	05IR074	81	73.9	Crouch Branch

Triple R Farms of Ehrhardt, LLC	05IR075	54	20	Crouch Branch
Herndon Farms	05IR076	20	14.5	Crouch Branch
Cypress Dairy	05IR077	123	4.2 18.29 0	Upper Floridan Upper Floridan-Middle Floridan Crouch Branch
Jason Still Farms - Honey Ford	05IR078	323.64	0 209	Gordon Crouch Branch
Jason Still Farms - Olar	05IR079	32	46	Gordon
Carolina Turfgrass and Landscape Supply	05IR080	20	15.6	Middle Floridan-Gordon
Sease Farm, LLC	05IR081	33.8	0 7.3	Middle Floridan Gordon
Travis Still Farms	05IR082	75.7	14.85 0	Gordon Crouch Branch
Travis Still Farms	05IR083	40.7	34.7	Crouch Branch
Travis Still Farms	05IR084	81.4	2.91 49.36	Gordon Crouch Branch
Bamberg Board of Public Works	05WS001	363	0 93.88 56.83	Crouch Branch Crouch Branch-McQueen Branch McQueen Branch
City of Denmark Water System	05WS002	224	121.8 73.42	Middle Floridan-Gordon Gordon
Brubaker Farms	06IR044	216	41 79	Gordon Crouch Branch
	Totals	**5,698.14**	**3,066.25**	

Barnwell County Details

Barnwell County has 40 permitted facilities with a total of 106 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 47% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Barnwell County is the Gordon Aquifer supplying 35% (941.1 MG) of the total reported water use for 2022 (Table 6).

Table 6. Permit Limits and 2022 Reported Water Use – Barnwell County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
SRNS SRS H Area IND	06IN054	275	126.16	McQueen Branch
US DOE Owner and SRNS Operator - D Area Ind	06IN055	120	31.36	McQueen Branch
Edisto Research & Education Center	06IR002	153	55.68	Gordon
Phil Sandifer & Sons Farms	06IR018	229	77.5	Crouch Branch
Walker Nix Farms, LLC	06IR019	407	104.68	Gordon-Crouch Branch
Rob Bates Farm	06IR020	345	3 18 158	Upper Floridan-Middle Floridan Gordon Gordon-Crouch Branch
JWB Farming, LLC	06IR023	61	24.82	Middle Floridan-Gordon
Jason Still Farms	06IR026	50.8	65.5 32	Upper-Middle-Lower Floridan Gordon
Walther Farms Wiley Forks Project	06IR027	605.8	307.1	Crouch Branch-McQueen Branch
Muns Farm	06IR029	40	15.87	Crouch Branch
Blackville Farm	06IR031	250	120.68	Crouch Branch
Jason Still Farms - Barry Creech	06IR033	15	24	Gordon
Youngblood Farms	06IR034	228	14.66 18.73	Gordon Crouch Branch
Heritage Green	06IR035	170	102	Gordon
BC Farms, Inc. - Wiley Fork	06IR038	119	61.31	Crouch Branch-McQueen Branch
CHAPPELL FARMS	06IR039	42	1 4	Middle Floridan Gordon-Crouch Branch
Sunrise Dairy - Barnwell	06IR040	90	88	Crouch Branch
Sandifer & Son Farms, LLC	06IR041	50	19.5	Gordon
Givens Farms, Inc	06IR042	41	7	Crouch Branch
Travis Still Farms	06IR043	163	99.5	Crouch Branch
Brubaker Farms, Inc.	06IR044	216	41 79	Gordon Crouch Branch
Matthew Urwick Farm	06IR045	73.4	0 3.12 33	Upper Floridan Gordon Crouch Branch
Travis Still Farms	06IR046	58	15.57	Gordon
Carolina Ag-Research Service, Inc.	06IR047	27.9	3.54 13.74	Upper-Middle Floridan Gordon
Jason Still Farms - Boyd	06IR048	10	0	Upper Three Runs
Jason Still Farms - Hwy 304	06IR049	12	22	Upper Three Runs
Jason Still Farms - Robertson Circle	06IR050	10	14	Upper Three Runs
Jason Still Farms - Patty	06IR051	10	0	Upper Three Runs

Travis Still Farms	06IR052	56.16	11.26	Gordon-Crouch Branch
Travis Still Farms	06IR053	24.9	3.12	Gordon
Jr's Farm	06IR055	9.72	6.51	Upper Three Runs
Walker Nix Farm	06IR056	55	7.6	Crouch Branch
Jason Still Farms LLC	06IR057	8	0	Upper Three Runs
Samuel L. Grubbs Farm, LLC	06IR058	0	0	Gordon
Williston Town of	06WS001	239	146.89	Crouch Branch-McQueen Branch
Blackville Town of	06WS002	200	60 55.95	Gordon Gordon-Crouch Branch
Barnwell City of	06WS003	748	547	Gordon
Bamberg Board of Public Works	06WS004	229.7	88.32	McQueen Branch
Hilda Town of	06WS005	14.2	7.77	Gordon
Town of Elko Public Water Supply	06WS007	37	13.5	Upper Floridan
	Totals	**5,809.58**	**2,710.43**	

Calhoun County Details

Calhoun County has 64 permitted facilities with a total of 206 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 46% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Calhoun County is the Crouch Branch Aquifer supplying 85% (4,908.9 MG) of the total reported water use for 2022 (Table 7).

Table 7. Permit Limits and 2022 Reported Water Use – Calhoun County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
Calhoun Hills Golf Complex	09GC001	12	3.42	Crouch Branch
Devro, Inc.	09IN002	4.25	2.03	McQueen Branch
Rast J D & Sons	09IR001	282	70.03 40.79	Crouch Branch McQueen Branch
COTTON LANE FARM	09IR003	40	0.23	Crouch Branch
Cameron Farms	09IR005	121.2	145.5	McQueen Branch
DARGAN CULCLASURE FARM	09IR007	30.5	13.76	Crouch Branch
HAIGLER FARMS	09IR009	2,367.10	1,059.60 235.9	Crouch Branch McQueen Branch
W.M. Smith & Sons	09IR010	120	54.94	Crouch Branch
Longstreet Farms Inc	09IR012	55.4	10.9	Crouch Branch
BRH Farm Properties, LLC	09IR013	551	86	Crouch Branch
Low Falls Wholesale Nursery	09IR014	167	109.26	Crouch Branch
Low Falls Wholesale Nursery	09IR033	23	11.85	Crouch Branch
Michael Shirer Farms	09IR034	62.7	40	Crouch Branch
PALMETTO FARM	09IR035	800	403.3	Crouch Branch
Jeff Reeves Farm	09IR036	14	20	Crouch Branch
John Olson Farm	09IR038	94.7	77.6	Crouch Branch
J & G Farms	09IR039	87.2	95.5	Crouch Branch
K & R Farms LLC	09IR040	628	229	Crouch Branch
Moore Farms	09IR041	54.8	18.4	Crouch Branch
Haigler and Sons Farms	09IR042	32	8.9	Crouch Branch
Kaigler Farms	09IR043	93.6	57.21	Crouch Branch
LB Wannamaker Seed	09IR044	38.4	12	Crouch Branch
Richard's Farms	09IR045	167	25.8	Crouch Branch
Holman Farms	09IR047	175	75.23	Crouch Branch
Moss H Perrow Farms	09IR048	589.7	156.55	Crouch Branch
Randy Stabler Farm	09IR051	331	333	Crouch Branch
Edward M. Rast Jr. Farms - Longview	09IR052	97	35	Crouch Branch
Edward M. Rast Jr. Farms - Belleville	09IR053	136	73.5	Crouch Branch
Edward M. Rast Jr. Farms - Clinkscales	09IR054	95	26.3	Crouch Branch
Belleville Farms LLC	09IR057	72	30	Crouch Branch
Lyons Brothers Farm	09IR058	586.5	54.45	Crouch Branch
Lyons Brothers Farm	09IR059	112.4	20.68	Crouch Branch
Kendall Wannamaker Farm	09IR060	586.5	73.6	Crouch Branch
Jeff Reeves Farm	09IR061	20	12	Crouch Branch

Jeff Reeves Farm	09IR062	20	12	Crouch Branch
W. H. Bull Farms	09IR063	75.8	8.29	Crouch Branch
W. H. Bull Farms	09IR064	50.5	7.56	Crouch Branch
Sikes Farm	09IR065	767.9	412	Crouch Branch
Inabinet Farms	09IR066	41.7	39.56	Crouch Branch
Inabinet Farms	09IR067	250.4	176.7	Crouch Branch
Inabinet Farms	09IR068	43.5	35.7	Crouch Branch
Inabinet Farms	09IR069	366.6	276.2	Crouch Branch
Inabinet Farms	09IR070	195.8	157.7	Crouch Branch
Bozard Farms, LLC	09IR071	25.2	15.6	Crouch Branch
Riley Farms	09IR072	9	6.5	Crouch Branch
Bardin Farm	09IR073	32	6.4	Crouch Branch
Spiers Farm	09IR074	55	6.5	Crouch Branch
Carson Farms	09IR075	455	89	Crouch Branch
Bickley Farms	09IR076	90	6.2	Crouch Branch
William Shirer Farm	09IR077	58.8	6.3	Crouch Branch
Calhoun Trading Co.	09IR078	87.6	29	Crouch Branch
Calhoun Trading Co.	09IR079	48	20	Crouch Branch
Calhoun Trading Co.	09IR080	62.4	24	Crouch Branch
Bookhart Farms 3 LLC	09IR081	31	31	Crouch Branch
Reed &Sons Farms, LLC	09IR082	183	0.11 0.52 4	Middle Floridan Crouch Branch McQueen Branch
Bookhardt Farms 3 LLC - Community Club	09IR083	42	62	Crouch Branch
Crawford Farm	09IR084	90	18	Crouch Branch
Holman Farms	09IR085	61.4	0	Crouch Branch
Calhoun Sand Mine	09MI001	306.23	78.27	McQueen Branch
St. Matthews Town of	09WS001	125	93.9	Gordon-Crouch Branch
Calhoun County Municipal Water and Sewer - Belleville	09WS003	71.61	80.76	Crouch Branch
Calhoun County Municipal Water and Sewer - Sandy Run	09WS004	230.51	243.08	McQueen Branch
Bull Swamp Rural Water Company	09WS005	63	60.58	Crouch Branch
Haigler Farms Partnership	38IR133	204.4	19.9	Crouch Branch
	Totals	**12,544.45**	**5,749.54**	

Lexington County Details

Lexington County has 33 permitted facilities with a total of 130 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 51% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Lexington County is the McQueen Branch Aquifer supplying 58% (2,654.3 MG) of the total reported water use for 2022 (Table 8).

Table 8. Permit Limits and 2022 Reported Water Use – Lexington County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
Charwood Golf Club	32GC002	28.5	17.17	Crouch Branch
Michelin North America	32IN007	50	30.73	Crouch Branch-Bedrock
US Silica Company - Columbia Plant	32IN008	1,660	356.03	Crouch Branch
Nephron Nitrile, LLC	32IN053	151.78	2.02	McQueen Branch
AMC/Lanier Sand Operation	32IN054	337.9	0.63 0.39	Crouch Branch McQueen Branch
Deer Hill Farms	32IR006	251.1	34.56 76.09 126.72	Crouch Branch Crouch Branch-McQueen Branch McQueen Branch
Miller Family Farms, LLC	32IR010	49.1	18.2	Gordon
Rawl & Sons Farm	32IR013	2,042	2037.37	McQueen Branch
Huley G. Shumpert - Rudy	32IR031	18.2	12.884	Crouch Branch
Delano R Kneece and Son, Inc.	32IR034	222	0.39 190.02	Crouch Branch Crouch Branch-McQueen Branch
Delano R Kneece and Son, Inc.	32IR048	440	200.31	McQueen Branch
T&E Farms C/O Tony Rucker	32IR049	181	122.21	Gordon-Crouch Branch
Thomas Fink Farm	32IR050	96	16.1	Crouch Branch
Andy Jackson Farm	32IR051	41	7.44	McQueen Branch
Andy Jackson Farm	32IR053	259.3	13.73 33.04	Crouch Branch-McQueen Branch McQueen Branch
Russell Hoffman Farms	32IR054	40	36.7	Crouch Branch
Rucker Farms	32IR055	80	41.66	McQueen Branch
Sand Pit	32IR057	15	5.03	Gordon
Clayton Rawl Farms Inc.	32IR059	660	2.5 116.4	Gordon Crouch Branch
Clayton Rawl Farms Inc.	32IR060	40	17.65	Crouch Branch
Rucker Farms	32IR061	90.7	27.97	McQueen Branch
Sharpe Farms	32IR062	38	10.24	Crouch Branch-McQueen Branch
Deer Hill Farms	32IR063	152.1	177.41	McQueen Branch
Walter P. Rawl and Sons, Inc.	32IR064	41	13.9	Crouch Branch-Bedrock
Walter P. Rawl and Sons, Inc.	32IR065	296	111.29	Crouch Branch
Walter P. Rawl and Sons, Inc.	32IR066	234	145.1	Crouch Branch
Ricard Farms	32IR067	45	0	Gordon-Crouch Branch
Andy Jackson Farm	32IR068	48.5	9.1	Crouch Branch-McQueen Branch
Andy Jackson Farm	32IR069	69.2	0	Crouch Branch-McQueen Branch
Edmund Sand Mine	32MI002	680.26	0	Crouch Branch
AMC Dixiana	32MI003	72	31.03	Crouch Branch-Bedrock
Gaston Rural Community Water District	32WS006	354.84	324.5	Crouch Branch
Gilbert-Summit Rural Water District	32WS012	344	230.06 15.88	Crouch Branch Bedrock
	Totals	**9,128.48**	**4,612.45**	

Orangeburg County Details

Orangeburg County has 124 permitted facilities with a total of 429 capacity use wells. Note that each permitted facility is owned or operated by a groundwater withdrawer and there are groundwater withdrawers that own or operate more than one permitted facility, some of which have the same name. The total reported withdrawals for 2022 were 51% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for Orangeburg County is the Crouch Branch Aquifer supplying 70% (7,548.9 MG) of the total reported water use for 2022 (Table 9).

Table 9. Permit Limits and 2022 Reported Water Use – Orangeburg County

Facility	Permit No.	Permitted Limit per Year (MGY)	Reported Water Use in 2022 (MGY)	Aquifer(s)
ORANGEBURG COUNTRY CLUB	38GC004	81	54.35	Crouch Branch
Santee-Cooper Resort, Inc. - Lake Marion Golf Club	38GC007	36	4.84	Crouch Branch
Santee National at Chapel Creek Plantation	38GC010	42.8	0	Crouch Branch
Holcim (US) Inc. - Holly Hill, SC	38IN001	560.12	284.1 273.81	Gordon Crouch Branch
Carolina Chips, Inc.	38IN010	122.4	131.82	Gordon
Weathers Farms Inc	38IR001	200	19.6	Crouch Branch
MILLWOOD FARM	38IR004	684.6	116.1	Crouch Branch
Haigler Farms Partnership	38IR008	303.3	151.8	Crouch Branch
Super Sod Carolina	38IR009	1,560	674.58 233.57	Crouch Branch McQueen Branch
Bickley Farms	38IR011	80	4.032	Crouch Branch
JAMESON FARMS INC	38IR019	356	1.82 140.29	Middle Floridan Crouch Branch
BACKMAN FARMS	38IR020	175	34	McQueen Branch
St. Julian Plantation	38IR024	19	3.12	Gordon
KIRBY BROWN & SONS FARM	38IR026	65.6	22.4	Crouch Branch-McQueen Branch
Triple G Farms LLC	38IR028	490.9	109.1	Crouch Branch
Jameson Farms Inc. Bonnette Farm	38IR034	120	23.398	Crouch Branch
Felkel Farms	38IR036	275	72.6 69.9	Crouch Branch McQueen Branch
Embeford Farm of SC, LLC	38IR038	194	0 13.824 90.396	Surficial Gordon Crouch Branch
Newlife Turf	38IR039	140.1	97.975	Crouch Branch
SHADY GROVE PLANTATION & NURSERY INC	38IR040	872	83.22 49.82 130.17	Gordon Gordon-Crouch Branch Crouch Branch
Glenn Barr Farm	38IR041	30	14.5	Crouch Branch
WILLSHIRE FARMS INC	38IR043	159	45.6 28.4 11.4	Crouch Branch McQueen Branch Charleston
A.L. Felder Farms Inc.	38IR048	460.6	15 107	Middle Floridan Crouch Branch
CFJ Farms LLC	38IR063	41.5	10.4	Crouch Branch
NORWAY FARM	38IR067	20	0	Crouch Branch
Martin Williams Farms	38IR068	29	17.69	Crouch Branch
Russell Farms - Station Rd Well	38IR069	38	12	Crouch Branch
Strock Farms Partnership	38IR070	102	94	Gordon
Holstein Farms LLC	38IR071	187	17.7 96.8	Gordon Crouch Branch
Seven Oaks Farm	38IR072	390	241.1	Crouch Branch

Haywood Farms, LLC	38IR073	60.9	10.5	Crouch Branch
Shuler Farms - Hart Bigfield	38IR074	36.3	42.826	Crouch Branch
TAMPA CREEK FARMS	38IR075	180	94.5	Crouch Branch-McQueen Branch
TURF CONNECTIONS - SPRINGFIELD	38IR078	22	15.71	McQueen Branch
Carolina Fresh Farms	38IR079	952.2	644.4	Crouch Branch
D&J Farms	38IR083	23	8.256	Crouch Branch
Hutto Brothers Partnership	38IR084	202	77.3	Crouch Branch
Holman Farms	38IR085	42	15.55	Crouch Branch
Dantzler Farms	38IR086	120	58	Crouch Branch
Walker Bros. Farm LLC	38IR088	72	42 29.5	Gordon Crouch Branch
Bozard Farms, LLC	38IR089	259.8	120.32	Crouch Branch
Leaning Tree Farm	38IR090	4	6	Crouch Branch
Mixon Farms	38IR091	112.9	29	Crouch Branch
Cotton Lane Farms	38IR092	228.9	108.95 39.53	Crouch Branch McQueen Branch
Haigler Farms Partnership	38IR093	541.2	418.7 68.4	Crouch Branch McQueen Branch
Shuler Farms - Behind Bert Field	38IR094	36	13.134	Crouch Branch
Gunter Farms	38IR095	205	6.6 15.2	Gordon Crouch Branch
Old Rast Place	38IR096	175	17	Crouch Branch
Lewis W. Way III Farms	38IR097	24	23.7	Crouch Branch
R & W Farms	38IR098	17.5	4.21	Middle Floridan
Salley Farm	38IR099	174	44.2	Crouch Branch
Stillinger Farm	38IR100	431.6	587.3	Crouch Branch
Jeff Lucas Farm	38IR101	60.2	32.2	Crouch Branch
Wimco Farm, LLC	38IR102	331.3	0 4.176	Gordon Crouch Branch
Ted Shuler & Sons	38IR103	91	36.52 29.73	Crouch Branch McQueen Branch
Lyons Bros. Farm	38IR104	48.4	6.078	Crouch Branch
Tractor Road Bamberg SC LLC - Slab Landing	38IR105	176	26.325	Crouch Branch-McQueen Branch
Tractor Road Bamberg SC LLC - Cope Rd Depot	38IR106	175.2	41.02	McQueen Branch
FPI Properties, LLC - Springfield Farm	38IR107	427	56	Crouch Branch-McQueen Branch
Norway Farm/RRR Farms LLC	38IR109	80	148	Crouch Branch
Funchess Brothers Farm	38IR110	180	12.9 148.4	Gordon Crouch Branch
Triple A Farm LLC	38IR111	70	46	Middle Floridan
Hungerpiller Farms	38IR113	30.5	14.6115	Crouch Branch
Whetsell Farms LLC	38IR114	100	69	Crouch Branch
Riley Farms	38IR115	84.7	38	Crouch Branch
Riley Farms	38IR116	25	11.5	Crouch Branch
Riley Farms	38IR117	31.4	20.5	McQueen Branch
Riley Farms	38IR118	81	9.5 31	Crouch Branch McQueen Branch
Cantley Farms	38IR119	198.7	55 16	Gordon Crouch Branch
Strock Farms Partnership	38IR121	152.5	43 35	Crouch Branch McQueen Branch
Strock Farms Partnership	38IR122	87.9	26 39	Crouch Branch McQueen Branch
Jeff Reeves Farm	38IR123	35	17	Crouch Branch
W. H. Bull Farms	38IR124	172.4	28.013	Crouch Branch
JJJ Farms General Partnership - Magnolia Lane	38IR125	80	40	Crouch Branch
JJJ Farms General Partnership - Fogle Pond	38IR126	40	15	Crouch Branch
Stowe Place	38IR127	70	30	Crouch Branch
Jeff D. Wiggins Farm	38IR128	66	102	Crouch Branch

Edward M. Rast Jr. - Cope	38IR130	176	138.1	Crouch Branch
O'Reilly Farms, LLC	38IR132	100	24.36 55.86	Crouch Branch Crouch Branch-McQueen Branch
Haigler Farms Partnership	38IR133	204.4	122.3	Crouch Branch
Berry Dairy Farms LLC	38IR134	120.7	10.02 6.8	Middle Floridan Crouch Branch
Shull Farms	38IR135	0	5	McQueen Branch
Whetsell Farms LLC	38IR136	50	33	Crouch Branch
Haigler Farms Partnership	38IR137	107.4	48.9	Crouch Branch
Haigler Farms Partnership	38IR138	587.5	352.5	Crouch Branch
Sanders Farm	38IR140	632	36 231	Gordon Crouch Branch
Titan Farms	38IR141	112	42	Gordon
Summers Estates	38IR142	52	0.86	Crouch Branch
Sharpe Farms	38IR143	24.5	6.415	Crouch Branch
Riley Farms	38IR145	9	6	Crouch Branch
Hutto Brothers Partnership	38IR146	20	10.6	Crouch Branch
Hutto Brothers Partnership	38IR147	32	18.7	Crouch Branch
Hutto Brothers Partnership	38IR148	32	13.8	Crouch Branch
Traywick & Son Farm	38IR149	61	14.3	Crouch Branch
Traywick & Son Farm	38IR150	47.5	9.5	Crouch Branch
Traywick & Son Farm	38IR151	95	24.23	Crouch Branch
Wimco Farm, LLC	38IR152	86.9	0	Crouch Branch
Wimco Farm, LLC	38IR153	190.7	9	Crouch Branch
Goodland Farms, LLC	38IR154	185.7	124.6	Crouch Branch
Edward M. Rast Jr. Farms - Roof	38IR155	35.3	14.2	Crouch Branch
Bookhart Farms 3 LLC	38IR157	73.8	1 73.7	Gordon Crouch Branch
Myers Farm	38IR159	205.2	27.82 1.8 24.1	Middle Floridan Gordon Crouch Branch
Home Place Farm	38IR160	58.2	55.55	Crouch Branch
Emerald Lea Farms, Inc.	38IR162	294	68 113 40	Middle Floridan Crouch Branch McQueen Branch
Holman Farms	38IR163	60	23.82	Crouch Branch
Ted Shuler & Sons	38IR165	59	43.24	Crouch Branch
NewLife Turf	38IR166	34.4	24.14	Crouch Branch
Toole Farm	38IR167	139	102	Crouch Branch-McQueen Branch
Over Branch	38IR168	33.9	7.86	Crouch Branch
Titan Farms	38IR169	20	17.5	Crouch Branch
Bookhart Farms 3 LLC - Ulmer	38IR170	38	31	Crouch Branch
Inabet Farms	38IR171	0	33.7	Crouch Branch
R+R Farms	38IR172	95	48.9	Gordon
DOMINION ENERGY SC, INC - COPE STATION	38PT001	1,991	66.63 953.33	Crouch Branch McQueen Branch
North Town of	38WS003	72	36.6	Gordon-Crouch Branch
Elloree Water System	38WS004	100	83.9	Crouch Branch
Holly Hill Town of	38WS005	100	49.112	Crouch Branch
Branchville Town of	38WS007	72	41.57	McQueen Branch
Springfield Town of	38WS009	27	26.32	Crouch Branch
Eutawville Town of	38WS010	20	16.43	Crouch Branch
Silver Springs Water District Water System	38WS011	116	66.99 0.04	Gordon Crouch Branch
Bull Swamp Rural Water Company	38WS051	78	11.67 17.45	Gordon Crouch Branch
Randy Brown Farm	WDR000078	64	0	Crouch Branch
Buck Branch Farms, LLC	WDR000111	45	9	Crouch Branch
	Total	**21,406.52**	**10,844.66**	

Aquifer Demand Details

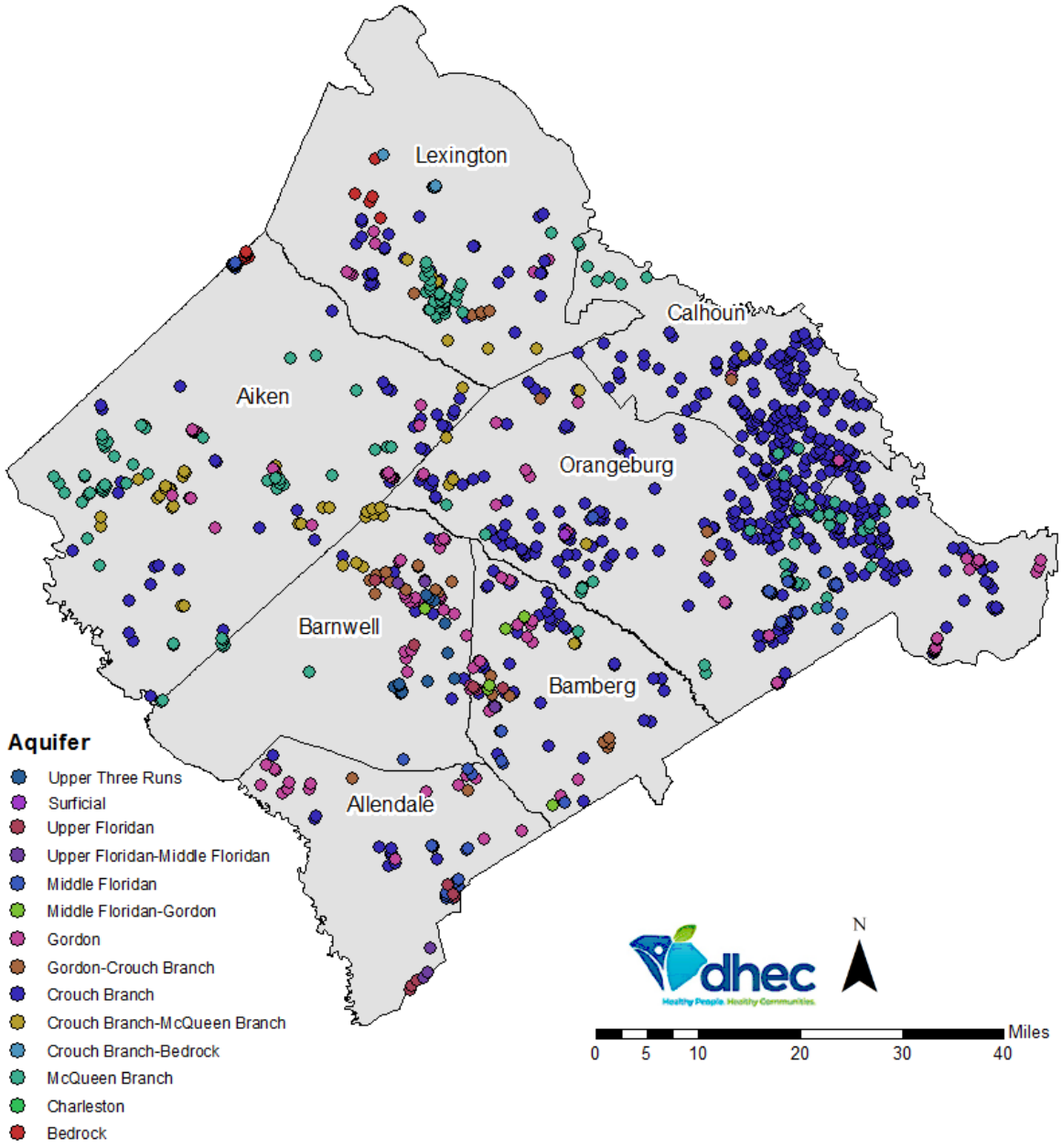

Figure 9. Western Area map showing the locations of capacity use wells with reported water use for 2022. Different symbol colors represent the aquifer into which each well is screened.

In terms of number of wells, the Crouch Branch aquifer is the most heavily accessed aquifer in the Western Area (695, 55%), followed by the Gordon (164, 13%), McQueen Branch (147, 12%), Middle Floridan (85, 7%), Bedrock (13, 1%), Upper Three Runs (18, 2%), and Upper Floridan (13, 1%) aquifers. The Surficial and Charleston aquifers each have only one well, which are a fraction of a percent. The most heavily used

aquifer in terms of groundwater demand as reported for 2022 is the Crouch Branch aquifer (54%), followed by the McQueen Branch (20%), Gordon (8%), and Middle Floridan (2%) aquifers.

The Western Area contains wells that are screened in more than one aquifer, or cross-screened wells, which allow water to be withdrawn from each aquifer where a screen is present. Wells that are cross-screened were grandfathered into the groundwater withdrawal permitting program. In accordance with S.C. Regulation 61-71 Well Standards, the Department no longer issues permits for the construction of new wells that are screened across multiple aquifers due to the potential for cross-contamination or water depletion in the aquifer(s) (2016). The largest number of cross-screened wells in the Western Area are in the Crouch Branch-McQueen Branch (59, 5%), followed by the Gordon-Crouch Branch (35, 3%), Crouch Branch-Bedrock (14, 1%), Upper Floridan-Middle Floridan (6, <1%) and Middle Floridan-Gordon (6, <1%) aquifers (Table 10).

Table 10. Number of Wells and 2022 Reported Water Use by Aquifer – Western Area

Aquifer	Number of Wells (%)	2022 Water Use MG (%)
Surficial	1 (<1%)	0 (0%)
Upper Three Runs	18 (2%)	50.01 (<1%)
Upper Floridan	13 (1%)	134.17 (<1%)
Upper Floridan-Middle Floridan	6 (1%)	170.06 (<1%)
Middle Floridan	85 (7%)	1,071.45 (3%)
Middle Floridan-Gordon	6 (1%)	275.21 (<1%)
Gordon	164 (13%)	3,256.46 (8%)
Gordon-Crouch Branch	35 (3%)	1,114.28 (3%)
Crouch Branch	695 (55%)	21,909.37 (54%)
Crouch Branch-Mcqueen Branch	59 (5%)	4,622.17 (11%)
Crouch Branch-Bed Rock	14 (1%)	75.66 (<1%)
McQueen Branch	147 (12%)	7,900.92 (19%)
Charleston	1 (<1%)	11.40 (<1%)
Bedrock	13 (1%)	31.36 (<1%)
Total	**1,261 (100%)**	**40,662.52 (100%)**

Historic Reported Water Use: 2001 – 2022

Overall, groundwater use in the Western Area has been increasing since the early 2000s (Fig. 10). From 2001 through 2013, water use increased gradually but, beginning in 2014, reported water use increased rapidly until it reached a maximum of 48,772.98 MG in 2019. This spike in reported use corresponds with 1) the Western Area's designation as a Capacity Use Area which likely resulted in additional reporting, and 2) a period of drought in the Western Area counties (Appendix A, Fig. A1) (NIDIS, 2023). The initial increase in reported groundwater use primarily occurred in the irrigation use category, as all other use categories have remained relatively constant (GC, IN, and WS) or have decreased (MI and PT) in recent years. The declines in reported use volumes in 2003 and 2013 correspond with years during which the Western Area counties received increased precipitation during the spring growing season thus decreasing demands on groundwater (NIDIS, 2023).

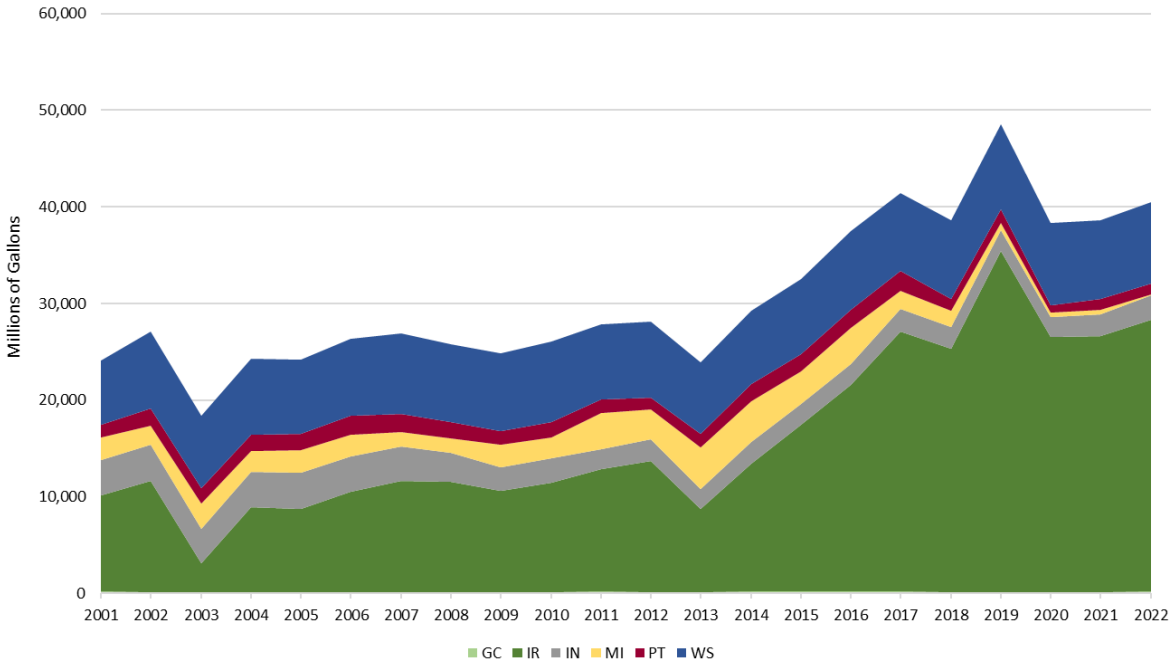

Figure 10. Western Area reported water use by category from 2001 to 2022.

Comparing historic (2001 to 2022) reported groundwater use across the Western Area shows that Orangeburg County has consistently reported larger volumes of groundwater use than the other Western Area counties (Fig. 11). Orangeburg County's water use remained relatively constant from 2001 through 2019 but reported use has increased slightly since 2019. This increase is likely a result of increased reporting due to the Western Area's designation as a Capacity Use Area in 2019. Reported use in Allendale and Lexington Counties has also remained relatively constant since the early 2000s, while Aiken, Bamberg, Barnwell, and Calhoun Counties have reported increased groundwater use volumes since 2013. The increased groundwater use in these counties corresponds with the increase in the irrigation use category over the same period (Fig. 10).

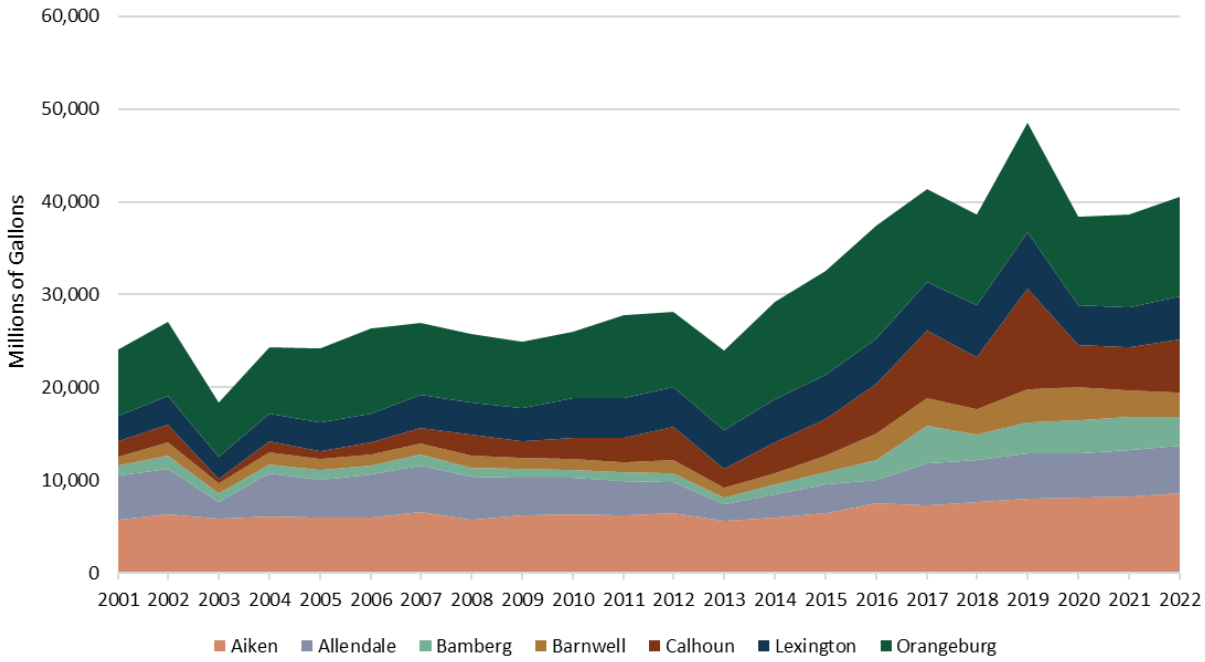

Figure 11. Western Area reported water use by county from 2001 to 2022.

The total population in the Western Area has increased by 94,288 people over the past 20 years, primarily the result of population growth in Lexington County (Fig. 12). Aiken County has also experienced some growth, but to a lesser degree. While reported groundwater use in Aiken County has increased slightly in recent years, Lexington County's reported groundwater use has remained relatively constant since the early 2000s. Allendale, Bamberg, Barnwell, Calhoun, and Orangeburg Counties all experienced net decreases in population since 2001 while reported groundwater use in Bamberg, Barnwell, and Calhoun Counties has increased since 2013 and has remained relatively constant in Allendale and Orangeburg Counties. Increased volumes of groundwater use since 2013 can be attributed to increased groundwater use for the irrigation use category (Fig. 10) as opposed to population growth in the Western Area.

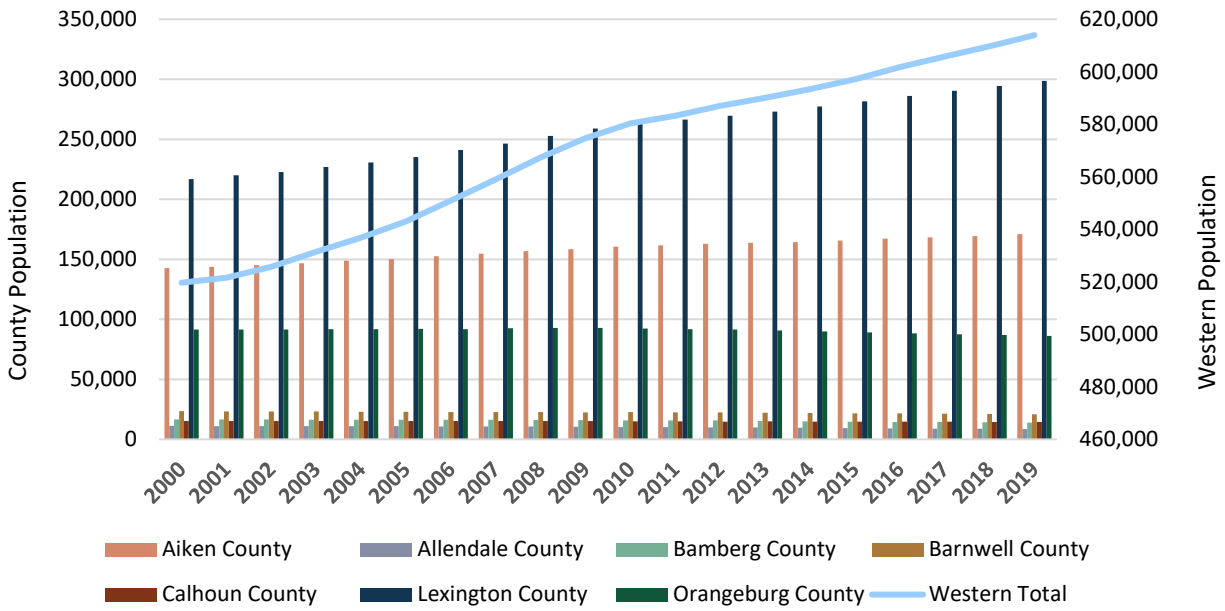

Figure 12. Population estimates and census data for the Western Area (blue line) and each county (vertical bars). www.census.gov; accessed May 22, 2023.

Groundwater Impacts

To assess the ongoing conditions of the aquifers in South Carolina, water levels are measured manually or by using automatic data recorders (pressure transducers) in wells screened in each of the CPSC aquifers. The groundwater monitoring network used for these measurements is maintained by SCDNR. These water level measurements are used to understand the impact of groundwater withdrawals over time, as well as provide an aerial snapshot of groundwater conditions at a specific time. The full extent of the SCDNR Monitoring Network may be seen in the map in Appendix B.

Groundwater Trends

There are currently 75 monitoring wells located in Western Area counties, 21 of which are discussed in this report (Table 7). The length of time for which there are groundwater level measurements ranges from 4.2 years to 35.8 years.

Table 11. List of SCDNR monitoring wells in Western Area counties with aquifer and length of well record.

Well ID	Agency	County	Aquifer	Record Length (years)
AIK-0826	SCDNR	Aiken	McQueen Branch	34.5
AIK-0847	SCDNR	Aiken	Crouch Branch	30.9
AIK-2733	SCDNR	Aiken	Gordon	6.1
ALL-0364	SCDNR	Allendale	Middle Floridan	28
ALL-0367	SCDNR	Allendale	Crouch Branch	28.1
ALL-0375	SCDNR	Allendale	Gordon	27.3
ALL-0377	SCDNR	Allendale	McQueen Branch	27.2
BRN-0349	SCDNR	Barnwell	McQueen Branch	35.8
BRN-0350	SCDNR	Barnwell	Middle Floridan	35.8
BRN-0351	SCDNR	Barnwell	Upper Floridan	35.8
BRN-0352	SCDNR	Barnwell	Gordon	34.2
BRN-0355	SCDNR	Barnwell	Crouch Branch	34.3
CAL-0193	SCDNR	Calhoun	Gordon	9.7
CAL-0195	SCDNR	Calhoun	Crouch Branch	10.2
CAL-0215	SCDNR	Calhoun	McQueen Branch	4.2
LEX-0823	SCDNR	Lexington	Crouch Branch	9.7
LEX-0844	SCDNR	Lexington	McQueen Branch	24
ORG-0079	SCDNR	Orangeburg	McQueen Branch	12.8
ORG-0393	SCDNR	Orangeburg	Crouch Branch	22.5
ORG-0430	SCDNR	Orangeburg	Gordon	22.5
ORG-0431	SCDNR	Orangeburg	Middle Floridan	22.5

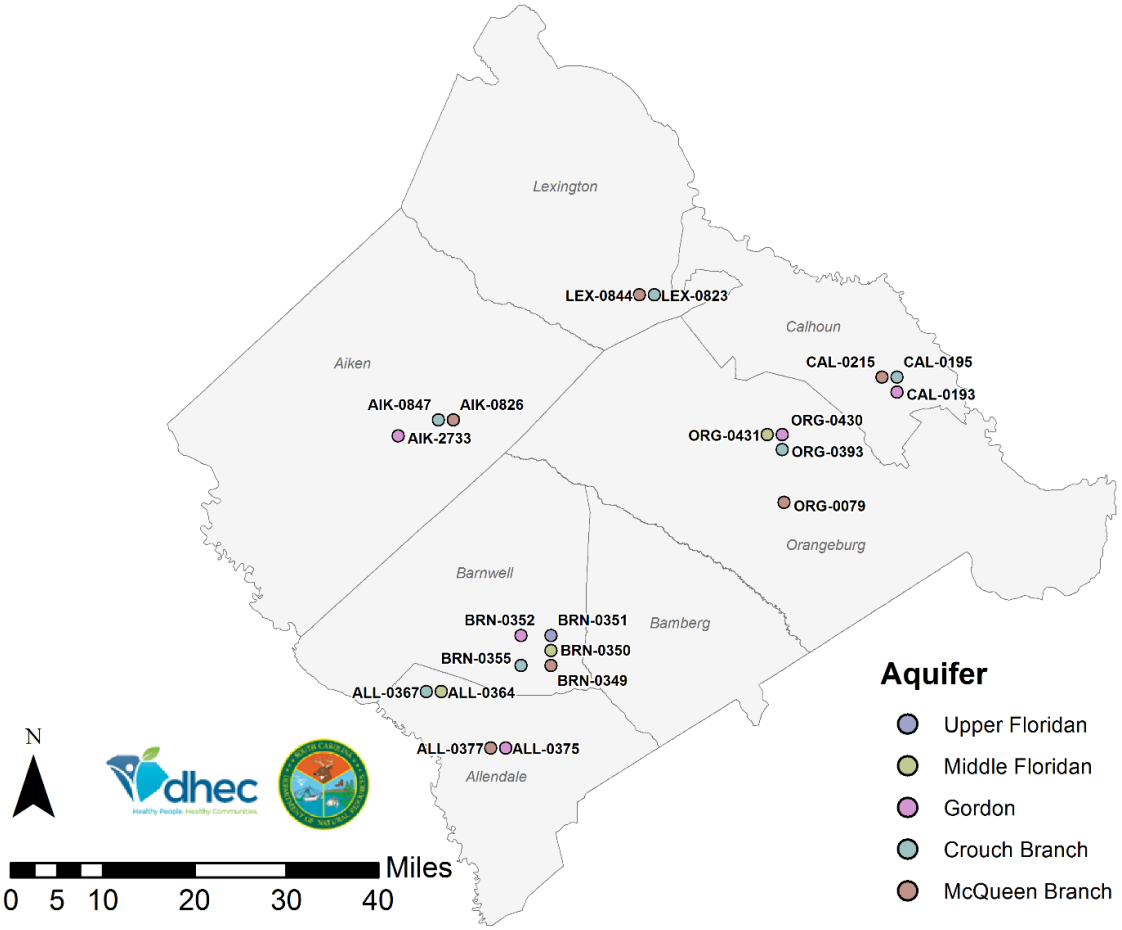

Figure 13. Map of SCDNR monitoring wells in the Western Area. Different symbol colors represent the aquifer into which each well is screened. The water levels for each are presented below. https://hydrology.SCDNR.sc.gov/well-database.html; accessed March 31, 2023.

Floridan and Gordon Aquifers

The shallower aquifers, which provided approximately 15% of all reported groundwater withdrawals in the Western Area for 2022, are hydrologically connected in the Western Area. In southeastern Allendale, Bamberg and Orangeburg Counties, the Surficial aquifer coalesces with the Upper and Middle Floridan aquifers to form the Upper Three Runs aquifer and further up-dip in Aiken and Lexington Counties, the Upper Three Runs aquifer combines with the Gordon aquifer to form the Steed Pond aquifer. As the confining units gradually thin and taper out towards the Fall Line, the shallow aquifers behave as unconfined aquifers, meaning they are heavily impacted by climatic conditions and surface water interactions as is evidenced in the hydrographs produced from monitoring wells AIK-2733, ALL-0364, ALL-0375, BRN-0350, BRN-0351, BRN-0352, CAL-0193, ORG-0430, and ORG-0431 (Fig. 14, C-D, F, I-K, M, and T-U). Water levels at the ALL-0375, BRN-0352, CAL-0193, and ORG-0431 monitoring locations are also influenced by seasonal withdrawals which are represented graphically as drawdowns during the summer and fall months followed by a rebound to normal or near-normal levels during the winter and early spring months. Water levels at the Aiken, Calhoun, and Orangeburg monitoring locations have increased (+4.5 feet at AIK-2733, +1 foot at CAL-0193, and +4 feet at ORG-0431) since the onset of data recording at each well. These water level increases are likely attributed to the high number of climatically wet periods on record in recent years in conjunction with access to aquifer recharge in this region (NIDIS, 2023).

Contrarily, water levels have declined further down-dip in southern Allendale County (ALL-0375) by approximately 8 feet and up to approximately 5 feet in Barnwell County (BRN-0350, BRN-0351, and BRN-0352) since data recording began at these locations in the late-1980s and 1990s. The decreased water levels at these monitoring locations are likely due to the increased distance from the recharge areas and, consequently, the longer recharge and recovery times of the aquifers in this region. Water levels at the ALL-0364 and ORG-0430 monitoring locations have remained relatively stable since the late-1990s and early-2000s.

Crouch Branch Aquifer

The Crouch Branch aquifer is the most utilized aquifer in the Western Area, providing approximately 53% of all reported withdrawals for 2022. The Crouch Branch is also the most developed aquifer in the Western Area, providing water to approximately 54% of all capacity use wells in the region. Many of the SCDNR monitoring wells in the Western Area are screened in the Crouch Branch aquifer including AIK-0847, ALL-0367, BRN-0355, CAL-0195, LEX-0823, and ORG-0393 (Fig. 14, B, E, L, N, P, and S). Due to the proximity to the Fall Line and because the past 10 years have been climatically wet (NIDIS, 2023), water levels at monitoring well LEX-0823 have increased by approximately 7 feet since 2013. Conversely, water levels in the Crouch Branch aquifer have declined in Aiken, Allendale, Barnwell, and Orangeburg Counties (-9 feet at AIK-0847, -10 feet at ALL-0367, -13 feet at BRN-0355, and -9 feet at ORG-0393) since the late-1990s and early-2000s. Water levels in the Crouch Branch aquifer in the Western Area are strongly influenced by seasonal withdrawals, and further down-dip of the Fall Line the aquifer is unable to recover to previous levels during the offseason. Although strongly influenced by seasonal drawdown and recovery, water levels at monitoring location CAL-0195 have remained relatively stable since 2013, likely due to interactions with surface water bodies at this location.

McQueen Branch Aquifer

The McQueen Branch aquifer accounted for approximately 20% of all reported withdrawals for 2022 in the Western Area. The majority of the SCDNR monitoring wells in the Western Area are screened in the McQueen Branch aquifer including AIK-0826, ALL-0377, BRN-0349, CAL-0215, LEX-0844, and ORG-0079 (Fig. 14, A, G-H, O, and Q-R). The water level profile observed at AIK-0826 (McQueen Branch) closely resembles that observed at AIK-0847 (Crouch Branch) indicating that the Crouch Branch and McQueen Branch aquifers are interconnected in the up-dip region of the Western Area near the Fall Line. Like AIK-0847, monitoring location AIK-0826 indicates that water levels have declined by approximately 8 feet since the late-1980s. Water levels have also declined in the McQueen Branch aquifer in Allendale (-14 feet at ALL-0377), Barnwell (-12 feet at BRN-0349), and Orangeburg (-9 feet at ORG-0079) Counties since data recording began at each respective location, likely due to increased water demand and longer aquifer recovery times in the region. Monitoring location LEX-0844 also indicates water level declines through the mid- to late-2010s with observed increases in recent years, likely due to the past 10 years being climatically wet compared to previous years (NIDIS, 2023). While CAL-0215 does not have enough long-term data to determine whether water levels at this location are increasing or decreasing, a clear pattern of seasonal variability is present with declines during the summer and fall months and recovery during the winter and spring months.

Charleston Aquifer

One Western Area capacity use well is screened in the Charleston aquifer, and it accounted for <1% of all reported withdrawals in 2022; however, there are currently no SCDNR monitoring wells in the Charleston aquifer in the Western Area.

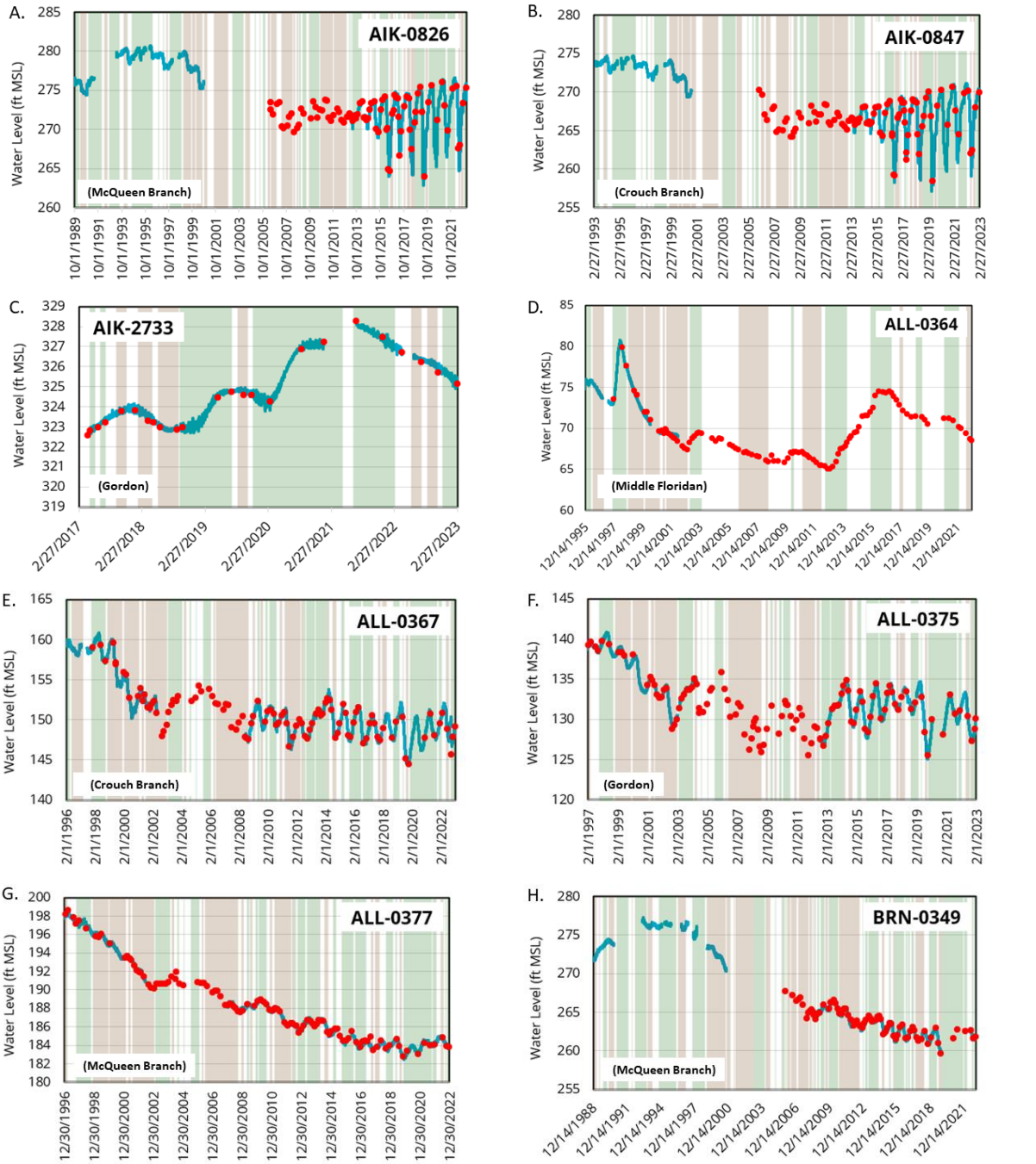

Figure 14. Water level plots from SCDNR monitoring wells in the Western Area. Water levels are in feet relative to sea level (MSL). The blue lines represent automatic data recordings and red dots represent manual water level measurements. The green background indicates wet periods, and the brown background indicates dry periods. http://hydrology.SCDNR.sc.gov/groundwater-data/ and https://www.drought.gov/states/south-carolina; accessed March 31, 2023.

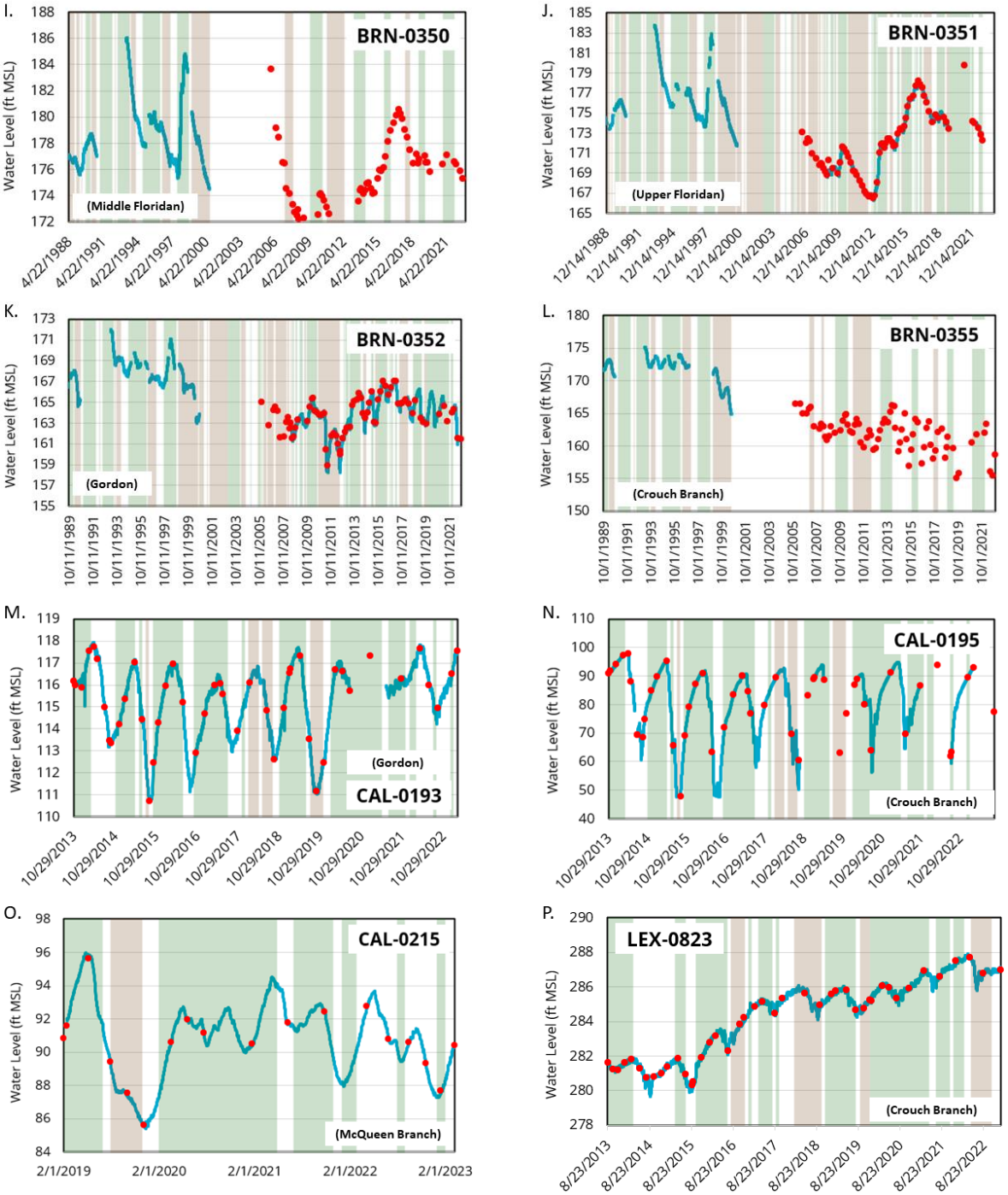

Figure 14, continued.

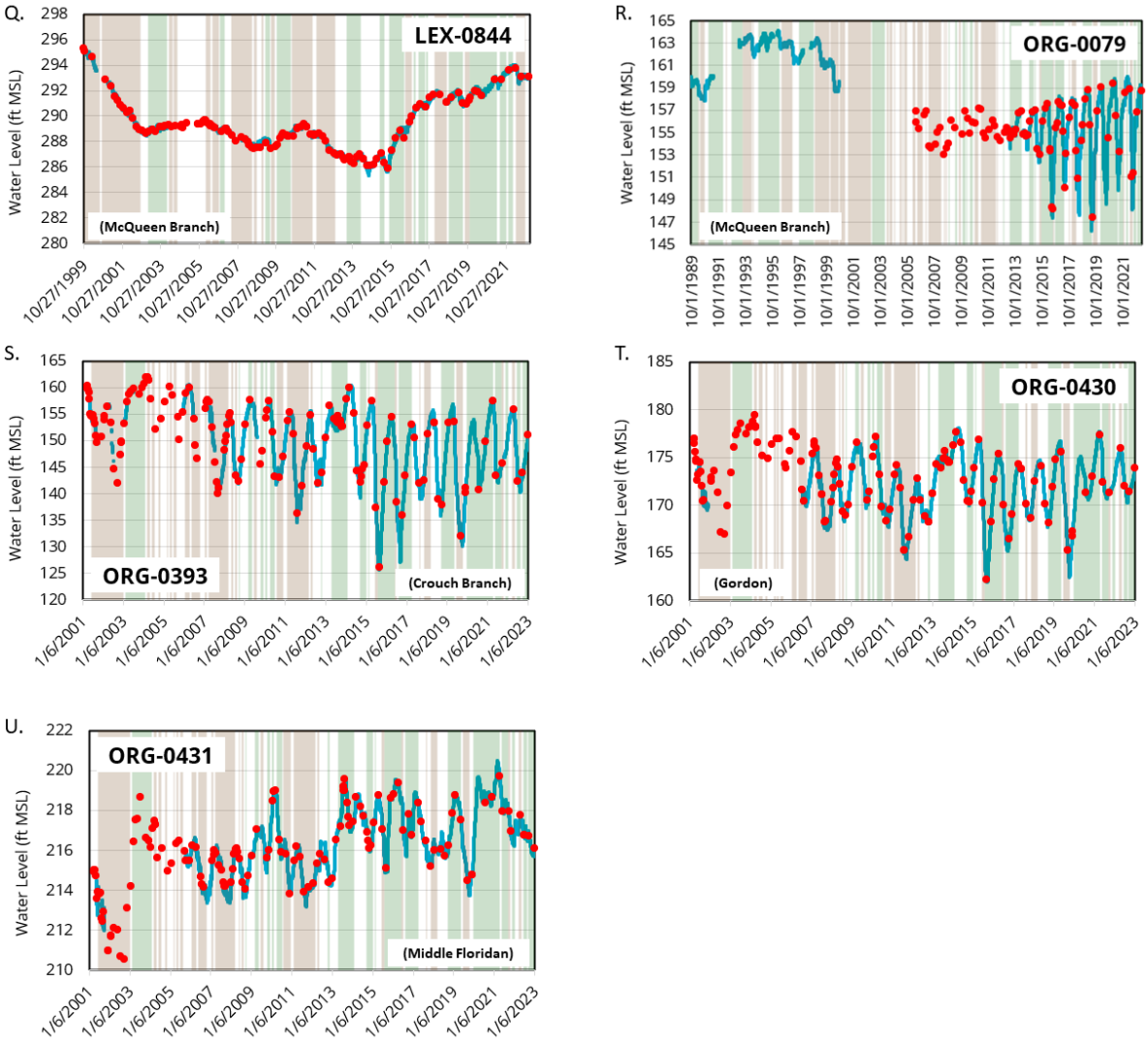

Figure 14, continued.

Potentiometric Maps

Water level measurements also indicate the surface of the water table or the potentiometric surface at the well location (Fig. 15). The water table is the free surface of the groundwater in the Surficial aquifer that receives recharge directly from precipitation. The potentiometric surface is the water level measured in a confined aquifer and represents the pressure of the overlying water and sediment at that location (the pressure surface). Concurrent water level measurements at several locations within a single aquifer can be combined to create a water table (surficial aquifer) or potentiometric (confined aquifer) map. Just as contour maps are made of the land surface by connecting points of equal elevation, water table and potentiometric maps are created by connecting points of equal water elevation or pressure.

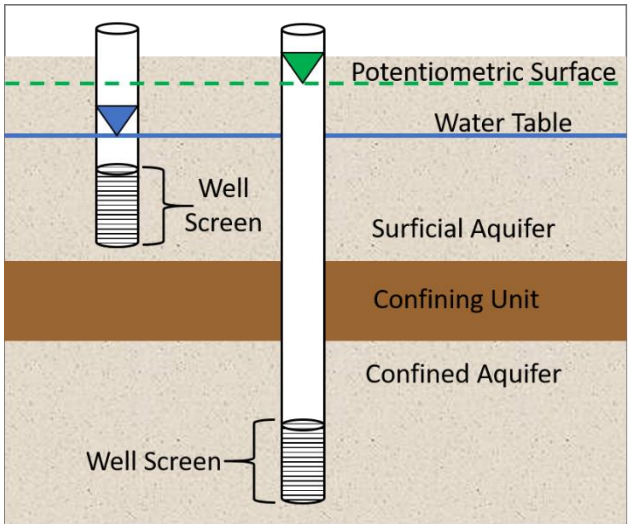

Figure 15. Illustration of a water table and potentiometric surface. Water levels in the wells are indicated by the blue (water table) and green (potentiometric surface) triangles.

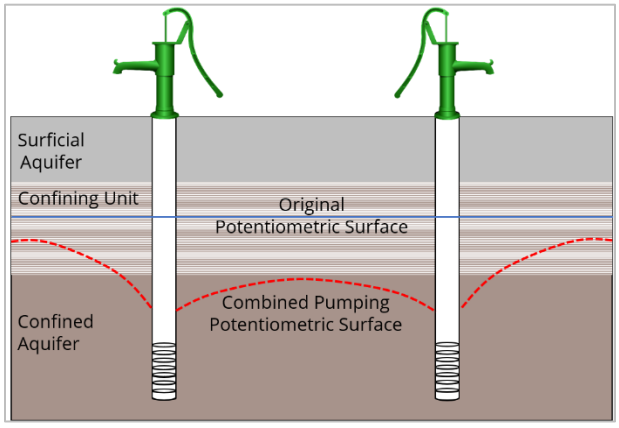

Figure 16. Illustration of the effect of combined pumping on a potentiometric surface.

These maps are used to evaluate groundwater conditions within an aquifer because groundwater withdrawal results in changes to these contour lines. Changes to the contour lines are especially important to note in confined aquifers in areas that take much longer to recharge. Groundwater withdrawal creates a greater impact in confined aquifers when large capacity wells are pumped in close proximity. The combined effect can create pumping cones (or cones of depression) that alter the potentiometric surface for miles from the pumping center (Fig. 16).

The contours of a potentiometric surface or water table map also point to changes in the direction of groundwater flow because groundwater flows perpendicular to (at right angles to) the contour lines from high to low water elevation (or pressure). Pumping cones change inland flow paths which can introduce contaminants to wells from nearby source(s), cause other wells to experience reduced flow, and reduce the discharge to local streams and rivers.

Pre-development potentiometric maps were digitized by SCDNR from the maps in a 1985 USGS report (Aucott & Speiran, 1985), and are considered to be the potentiometric surfaces of the aquifers in the year 1900. In 1987, SCDNR began publishing potentiometric maps from water level measurements in the aquifers of the CPSC. In addition to the SCDNR monitoring wells presented previously, other wells belonging to a variety of water suppliers, irrigators, and industry are also used. The following figures are

a combination of these potentiometric maps with water use data reported to SCDHEC. Groundwater withdrawal density maps were created using the annual reported groundwater withdrawal amounts from wells in the Western Area. Clusters with darker shading represent higher concentrations of groundwater withdrawals and areas with lighter or no shading represent lesser amounts of groundwater withdrawals. Each density map was overlain with the corresponding potentiometric map for each year of withdrawal to show how the pressure surface has changed over time.

Floridan Aquifer System

The Floridan Aquifer System, formerly known as the Tertiary Aquifer System and Black Mingo Aquifer System, contains what are now known as the Upper and Middle Floridan aquifers and the Gordon aquifer (Gellici & Lautier, 2010). The pre-development map was made using historic water level data from wells screened in the Upper and Middle Floridan aquifers and the Gordon aquifer. The most recent measurements were published in 2018 as separate maps of the Upper and Middle Floridan aquifers and the Gordon aquifer (Czwartacki, Wachob, & Gellici, 2019).

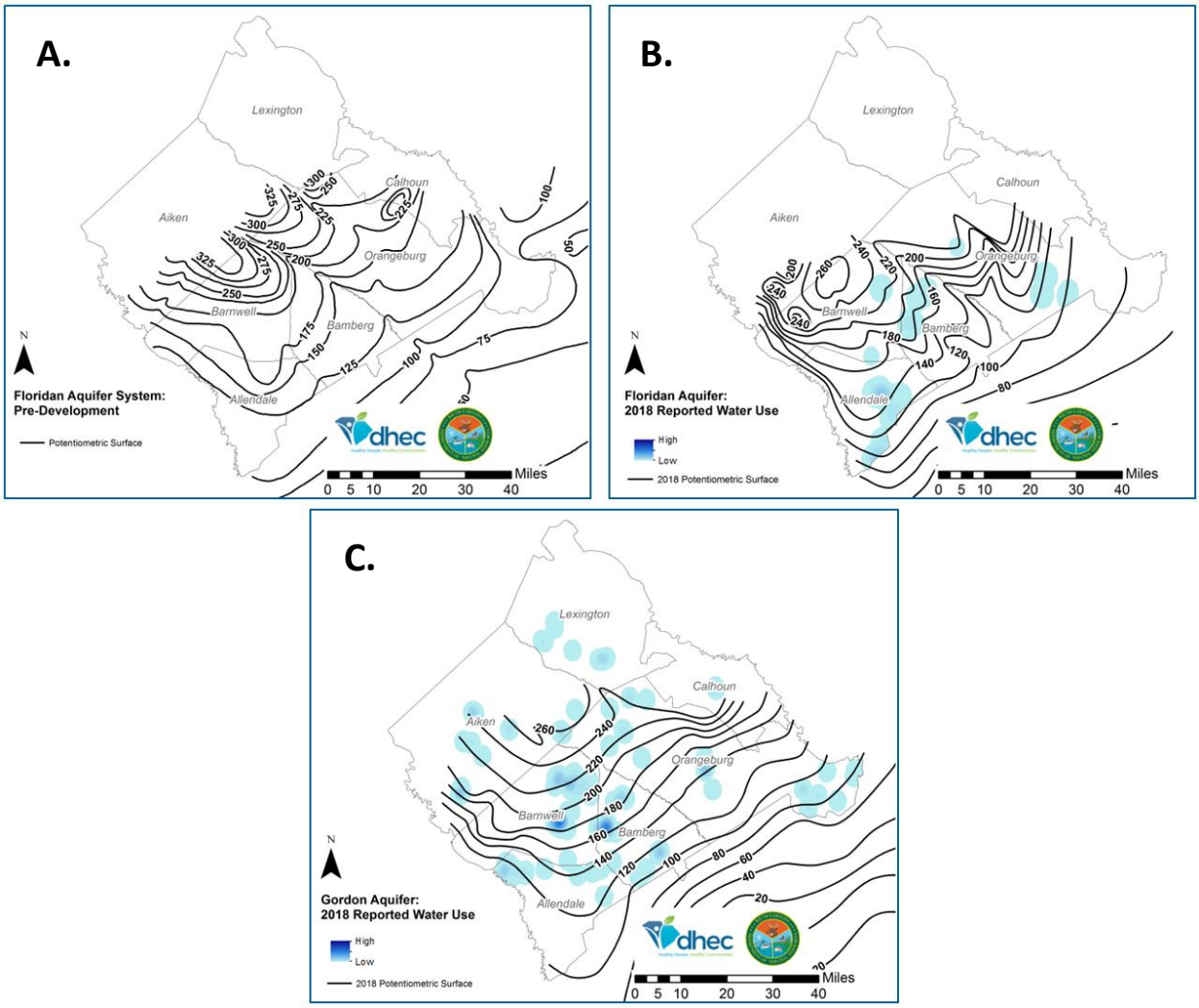

Figure 17. A. Pre-development potentiometric map of the Floridan Aquifer System in the Western Area (Aucott & Speiran, 1985). B. 2018 potentiometric map of the Floridan Aquifer (Czwartacki, Wachob, & Gellici, 2019). C. 2018 potentiometric map of the Gordon Aquifer (Czwartacki, Wachob, & Gellici, 2019). Contour lines are in feet relative to MSL.

The pre-development potentiometric surface map indicates that the water level ranged from approximately 325 feet above MSL near the Fall Line to approximately 100 feet above MSL down-dip in southeastern Allendale, Bamberg, and Orangeburg Counties. The flow of groundwater was in a generally southeasterly direction.

As of 2018, the groundwater flow paths remain in a southeasterly direction across the region, and water levels range from approximately 260 feet above MSL in the northwestern extent of the Western Area to approximately 100 feet above MSL in southeastern Allendale, Bamberg, and Orangeburg Counties (Fig. 17, B-C) (Czwartacki, Wachob, & Gellici, 2019). Due to access to recharge, the potentiometric surface of the Floridan Aquifer System (including the Floridan and Gordon aquifers) has not been significantly impacted since pre-development in the Western Area.

Crouch Branch Aquifer

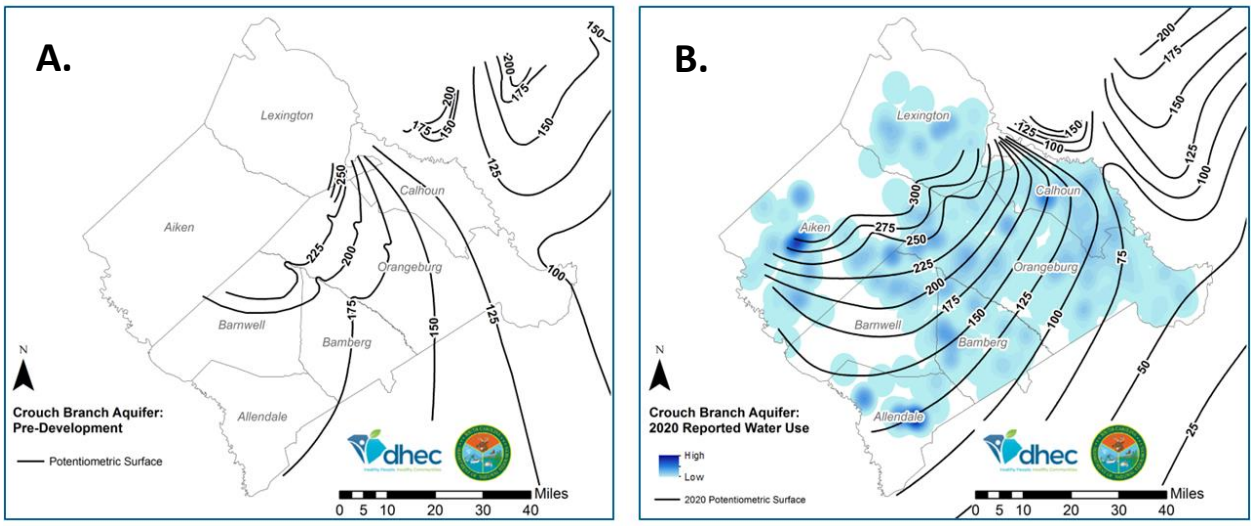

Figure 18. A. Pre-development potentiometric map of the Crouch Branch Aquifer in the Western Area (Aucott & Speiran, 1985). B. 2020 potentiometric map of the Crouch Branch Aquifer (Czwartacki & Wachob, 2021). Contour lines are in feet relative to MSL.

The pre-development potentiometric surface of the Crouch Branch aquifer indicates that groundwater flowed in a northeasterly direction and water levels ranged from 225 feet above MSL below western Orangeburg County and northern Barnwell County to 100 feet above MSL below eastern Orangeburg County (Fig. 18, A). By 2020 the pressure surface had lowered by 50 feet in Allendale, eastern Bamberg, eastern Calhoun, and eastern Orangeburg Counties (Fig. 18, B), and the groundwater flow shifted from a northeasterly direction to a southeasterly direction across the Western Area. The Crouch Branch aquifer is heavily influenced by high-capacity pumping in the region, especially down-dip in Allendale, Bamberg, Calhoun, and Orangeburg Counties where it takes longer for the aquifer to receive recharge.

Middendorf Aquifer System

The McQueen Branch, Charleston, and Gramling aquifers are collectively known as the Middendorf Aquifer System in South Carolina. They are now referenced individually as the McQueen Branch, Charleston, and Gramling aquifers. The pre-development potentiometric map was created for the

Middendorf Aquifer System, and SCDNR continues to publish potentiometric maps by combining data from all three of the Middendorf aquifers; therefore, it is not possible to determine the pressure surface changes unique to each aquifer.

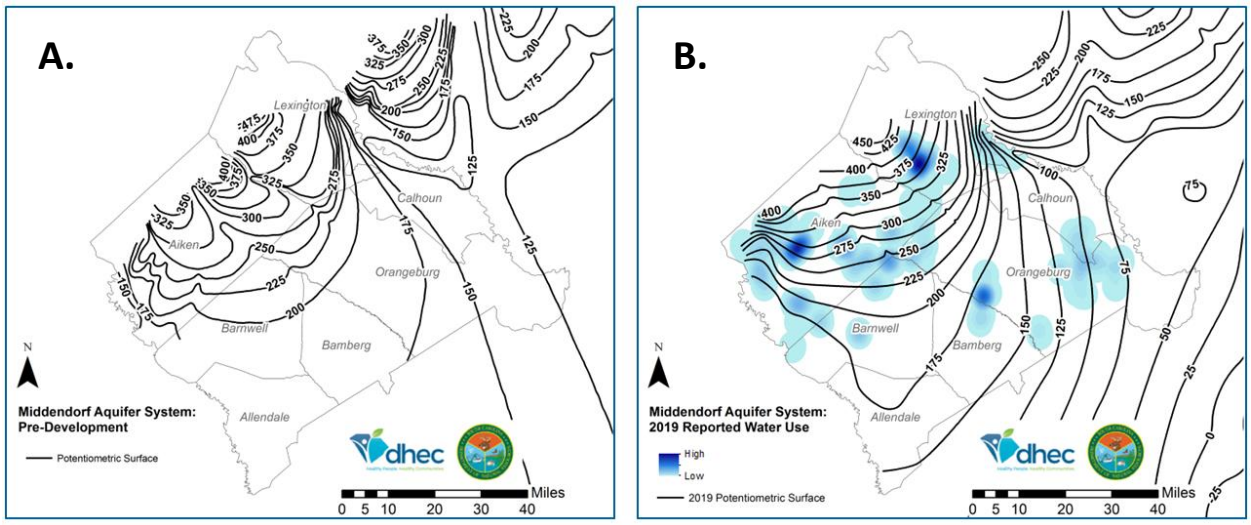

Figure 19. A. Pre-development potentiometric map of the Middendorf Aquifer System in the Western Area (Aucott & Speiran, 1985). B. 2019 potentiometric map of the Middendorf Aquifer System (Czwartacki & Wachob, 2020). Contour lines are in feet relative to MSL.

The pre-development potentiometric surface of the Middendorf Aquifer System indicates that groundwater flowed in a southeasterly direction below the westernmost portion of the Western Area and flowed in a northeasterly direction below Calhoun and eastern Orangeburg Counties. Water levels ranged from 475 feet above MSL below central Lexington County near the Fall Line to 125 feet above MSL below eastern Orangeburg County (Fig. 19, A).

Due to access to recharge, the potentiometric surface of the Middendorf Aquifer System has not been significantly impacted since pre-development in the westernmost portion of the Western Area near the Fall Line; however, by 2019 water levels have declined by as much as 75 feet below eastern Calhoun and Orangeburg Counties (Czwartacki & Wachob, 2020), likely due to groundwater withdrawals in neighboring Clarendon and Sumter Counties. The groundwater flow remains in a southeasterly direction below the westernmost extent of the Western Area and in a northeasterly direction below eastern Bamberg, Calhoun, and Orangeburg Counties (Fig. 19, B).

Groundwater Evaluation

Due to little reliance on the shallower aquifers as a resource, access to recharge, and interactions with surface water in the Western Area, the water levels and potentiometric surfaces of the Floridan and Gordon aquifers have not been significantly impacted since pre-development.

In the northwestern portion of the Western Area, close to the Fall Line, groundwater levels and potentiometric surfaces of the deeper aquifers have not been significantly impacted due to access to recharge; however, in the southeastern portion of the Western Area where the aquifers are more distinct, groundwater levels have declined by as much as 14 feet in the Crouch Branch aquifer and Middendorf Aquifer System (including the McQueen Branch and Charleston aquifers) as is evidenced by measurements from SCDNR's groundwater monitoring network (Fig. 14). Groundwater withdrawals in the region have also altered the potentiometric surfaces, causing the pressure surface to decline by as much as 50 feet in the Crouch Branch aquifer (Fig. 18) and as much as 75 feet in the Middendorf Aquifer System (Fig. 19). For the Crouch Branch aquifer, this decline is greatest below the eastern portions of Calhoun and Orangeburg Counties and is attributed to concentrated, high-capacity groundwater withdrawals in conjunction with longer recharge rates of the aquifer in this area. The declines of the pressure surface of the Middendorf Aquifer System are greatest below the eastern portion of Orangeburg County and are attributed to concentrated, high-capacity groundwater pumping in the region, including a potentiometric low that has developed below neighboring Sumter County, and distance from the Fall Line leading to longer recharge rates of the aquifers.

Recommendations

The Crouch Branch aquifer and the Middendorf Aquifer System (including the McQueen Branch and Charleston aquifers) have experienced water level declines below Western Area counties. To both protect the groundwater resources below Western Area counties as well as continue sustainable development of groundwater as a resource, the Department has issued the following recommendations.

Crouch Branch Aquifer and Middendorf Aquifer System

- Staff evaluations of applications for withdrawal increases to existing permits and new groundwater withdrawal permits in areas of concentrated, high-capacity pumping may include a staff conducted groundwater model assessment to determine the potential for the development of pumping cones and potential interference on any neighboring wells.

Western Capacity Use Area

- Encourage the conjunctive use of surface water and groundwater, when available, to meet water demands in the region. Groundwater should be used as a supplemental and/or backup source, if possible.
- In the portions of the Western Area where confining units are present, encourage groundwater withdrawers to discontinue using and properly abandon wells that have been screened across multiple aquifers, and ensure that all future wells are screened in the target aquifer only, with appropriate grouting starting at the plug above the screen interval or the first confining bed immediately above the target aquifer to the top of land surface.
- Cooperative work with SCDNR should continue in preparing the potentiometric surface maps, and future maps should be based on data from individual aquifers to the greatest extent possible to better aid in evaluation of how groundwater withdrawals from capacity use wells (which must be screened into single aquifers) are impacting the local groundwater conditions.
- Work toward educating all South Carolinians on best practices for water conservation must continue in cooperation with all stakeholders.
- Work in conjunction with local, state, and federal partners to expand the groundwater monitoring network in Western Area aquifers by identifying wells scheduled for abandonment that may be incorporated and of benefit to the well network.

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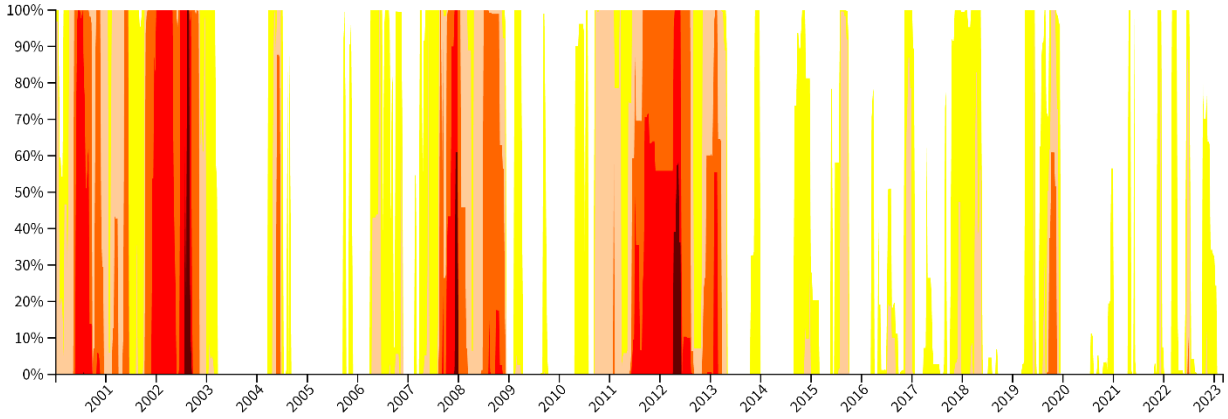
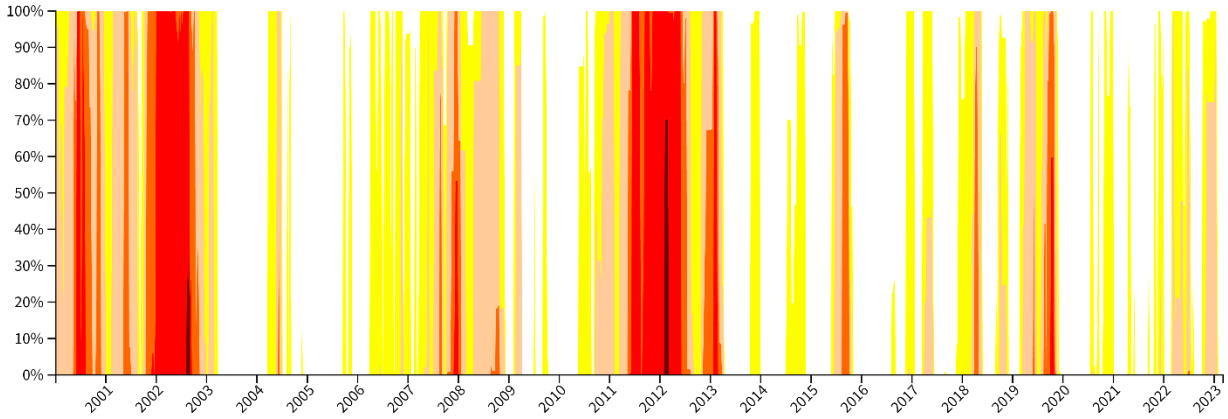
Appendix A: Historic Drought Conditions

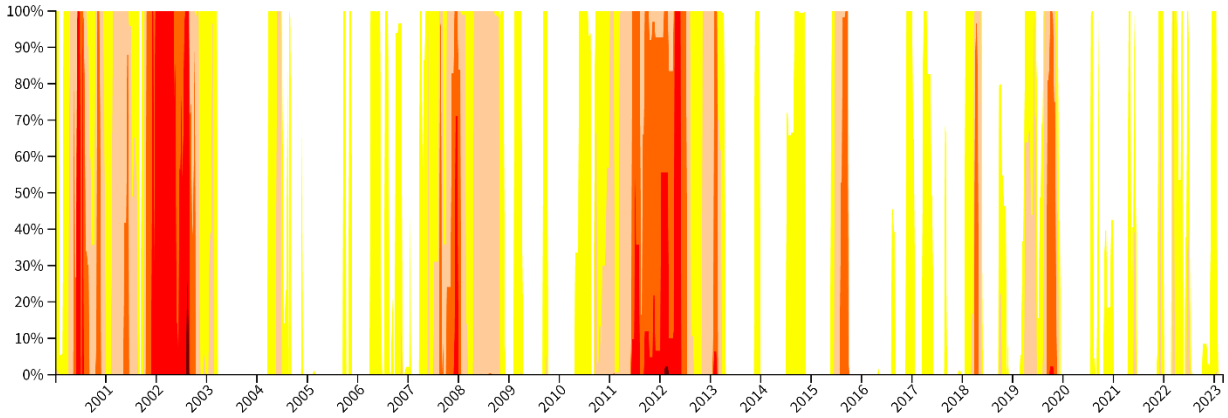
A. Aiken County (SC) Percent Area in U.S. Drought Monitor Categories



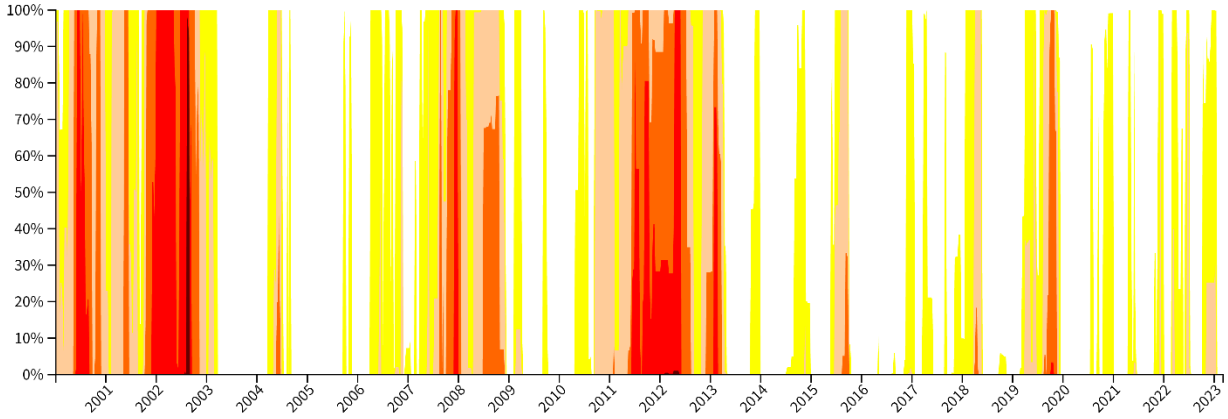
B. Allendale County (SC) Percent Area in U.S. Drought Monitor Categories



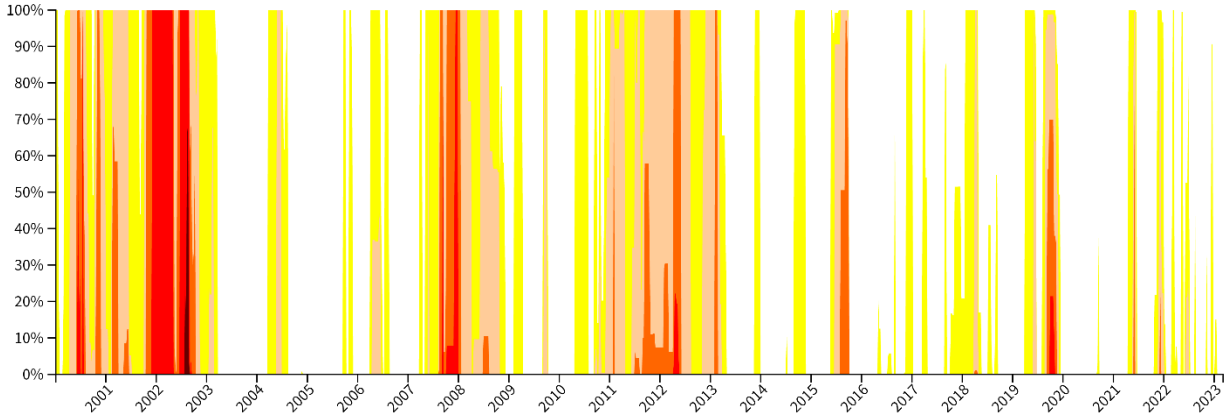
C. Bamberg County (SC) Percent Area in U.S. Drought Monitor Categories



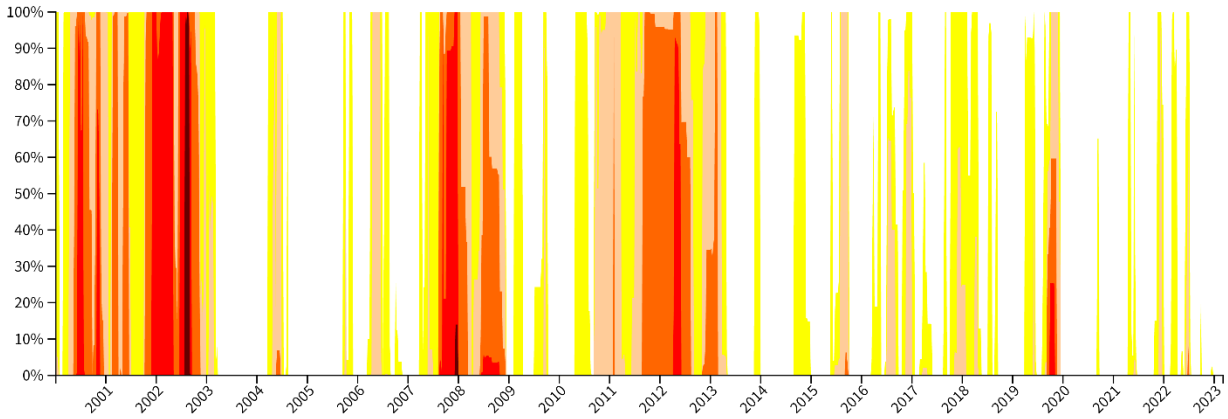
D. Barnwell County (SC) Percent Area in U.S. Drought Monitor Categories



E. Calhoun County (SC) Percent Area in U.S. Drought Monitor Categories



F. Lexington County (SC) Percent Area in U.S. Drought Monitor Categories



G. Orangeburg County (SC) Percent Area in U.S. Drought Monitor Categories

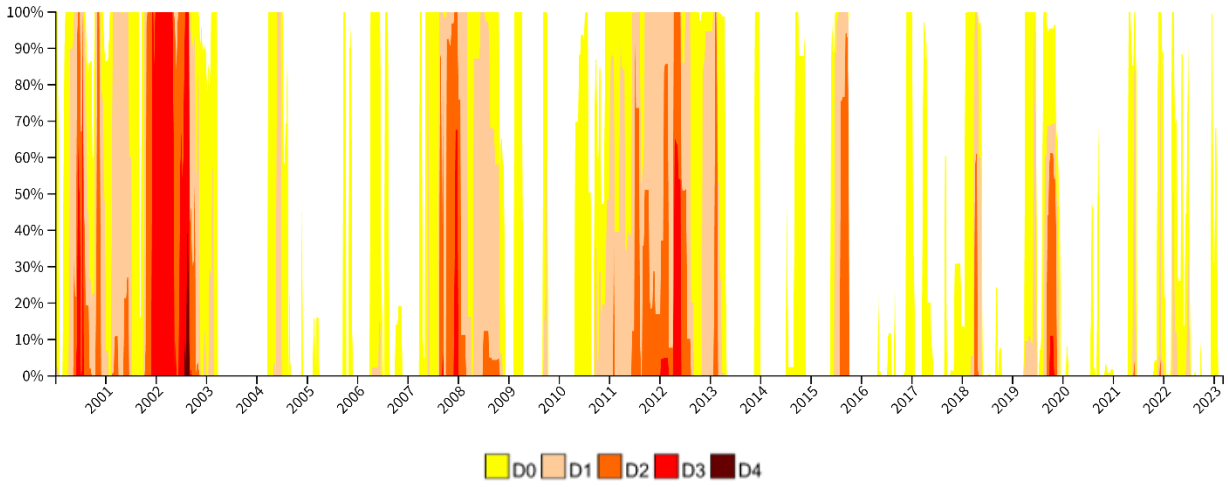


Figure A1, A-G. Severity and percent drought coverage for Western Area counties. D0 represents abnormally dry periods and D4 represents periods of exceptional drought. https://www.drought.gov/; accessed March 23, 2023.

Appendix B: SCDNR Groundwater Monitoring Network

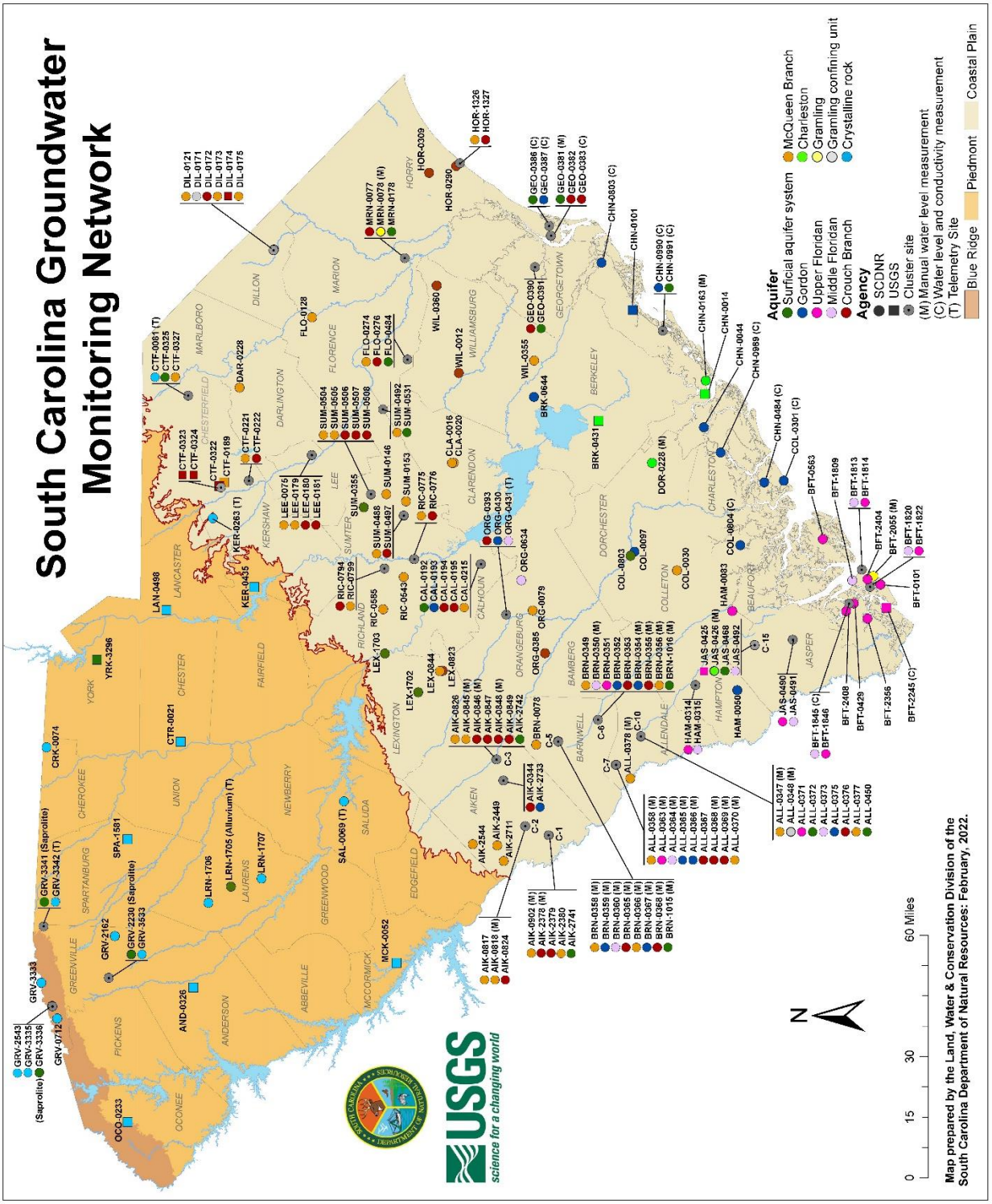


Figure B1. Map of wells included in the SCDNR Groundwater Monitoring Network. https://hydrology.SCDNR.sc.gov/; accessed March 6, 2023.