GROUND-WATER LEVELS
IN
SOUTH CAROLINA

A Compilation of Historical Water-Level Data

by

Karen E. Waters

STATE OF SOUTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES

WATER RESOURCES REPORT

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STATE OF SOUTH CAROLINA
The Honorable Mark Sanford, Governor

South Carolina Department of Natural Resources

Board Members

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ABSTRACT

More than 54 years of data from various sources have been compiled, reviewed, and prepared as hydrographs for this publication. These hydrographs show water-level trends in 282 South Carolina wells, 266 in the Coastal Plain physiographic province and 16 in the Piedmont. For approximately one-third of the wells, data are available for a period of 20 years or more; 14 well records contain data for 40 years or more, and 7 of these wells are in Beaufort County. JAS-1, a well located in southeastern Jasper County, has the longest period of record – more than 50 years.

Wells in several counties have pronounced ground-water level declines or fluctuations. Water levels in the Floridan aquifer in Hampton County show distinct highs in the spring and lows in the fall, probably a result of recharge from precipitation or of local seasonal pumping. Water-level records for the Black Creek aquifer in northern Georgetown County show an average decline of nearly 60 feet since the mid-1970's. Well records for the Black Creek aquifer in Horry County demonstrate the most dramatic decline and recovery over the period of record. Declines as great as 110 feet were recorded through the 1970's and 1980's. Between 1988 and 1992, major public water suppliers in Horry County discontinued well use and began using surface water, thus facilitating regional water-level recoveries as great as 100 feet.

INTRODUCTION

The U.S. Geological Survey (USGS) and the Soil Conservation Service, U. S. Department of Agriculture, first made periodic water-level measurements at 28 wells in the Tiger River valley area in Greenville and Spartanburg Counties during 1932. It was not until 1945, however, that a systematic well-monitoring program was established by the USGS and the South Carolina Research, Planning and Development Board. In this program, water-level measurements were made periodically in 15 wells scattered throughout the Coastal Plain. Beginning in 1946, water-level measurements for the State were published annually as part of a nationwide program. Wells were subsequently added or deleted, and data became refined with time. The USGS now publishes “Water Resources Data for South Carolina” annually and includes data from both surface-water and ground-water monitoring stations.

More than 54 years of data from various sources have been compiled, reviewed, and prepared as hydrographs for this publication. Although data have been published previously in an annual format, never before have records been collected, combined, and presented by county, for the available period of record. In this publication, data from 282 wells, 266 in the Coastal Plain and 16 in the Piedmont, have been compiled and graphed. For about one-third of the 282 wells, data are available for a period of 20 years or more; 14 well records contain data for 40 years or more, and half of these wells are in Beaufort County. The overall period of record for the data presented is from 1938 to 2002, with the longest records represented by well BFT-37 in Beaufort County (1941-1994) and well JAS-1 in Jasper County (1938-1993).

These data provide information needed for monitoring ground-water conditions in South Carolina and planning future management and conservation programs. By observing ground-water fluctuations and trends, changes in aquifer storage can be determined and used as an indication of the status of ground-water conditions, thus better enabling the State to understand, manage, and protect one of its most critical resources.

Physiography

South Carolina covers an area of more than 30,000 square miles and is divided into three physiographic provinces (Fig. 1). A small area along the northwestern boundary of the State lies in the Blue Ridge physiographic province. The Piedmont physiographic province occupies the area between the Blue Ridge province and the Fall Line, and the area between the Fall Line and the Atlantic Ocean constitutes the Coastal Plain physiographic province.

The Blue Ridge and Piedmont provinces are composed of igneous and metamorphic rocks, mostly gneiss, schist, phyllite, and slate. Elevations are as high as 650 ft above sea level at the Fall Line and over 3,500 ft in the Blue Ridge.

The Coastal Plain province consists of variations of sand, clay, and limestone that overlie the Piedmont rocks. Elevations range from mean sea level at the coast to as much as 650 ft at the Fall Line.

Climate

The climate of South Carolina differs significantly among the three physiographic provinces, ranging from humid subtropical along the coast to cool and temperate in the mountains. On average, however, South Carolina has short, rather mild winters and long, hot summers.

Figures 2-4 show the average annual precipitation for each physiographic province from 1935 to 2001, with the exception of the Blue Ridge, where data are available only since 1949. A pink line represents the mean, while yellow and blue lines represent one standard deviation above and below the mean, respectively, and are shown to give the reader an idea of high and low extremes during this time period. The average annual precipitation for the Blue Ridge, Piedmont, and Coastal Plain provinces is 68.6, 47.1, and 47.6 inches, respectively.

Precipitation in the State can vary significantly from year to year and throughout the year. For example, the Blue Ridge province

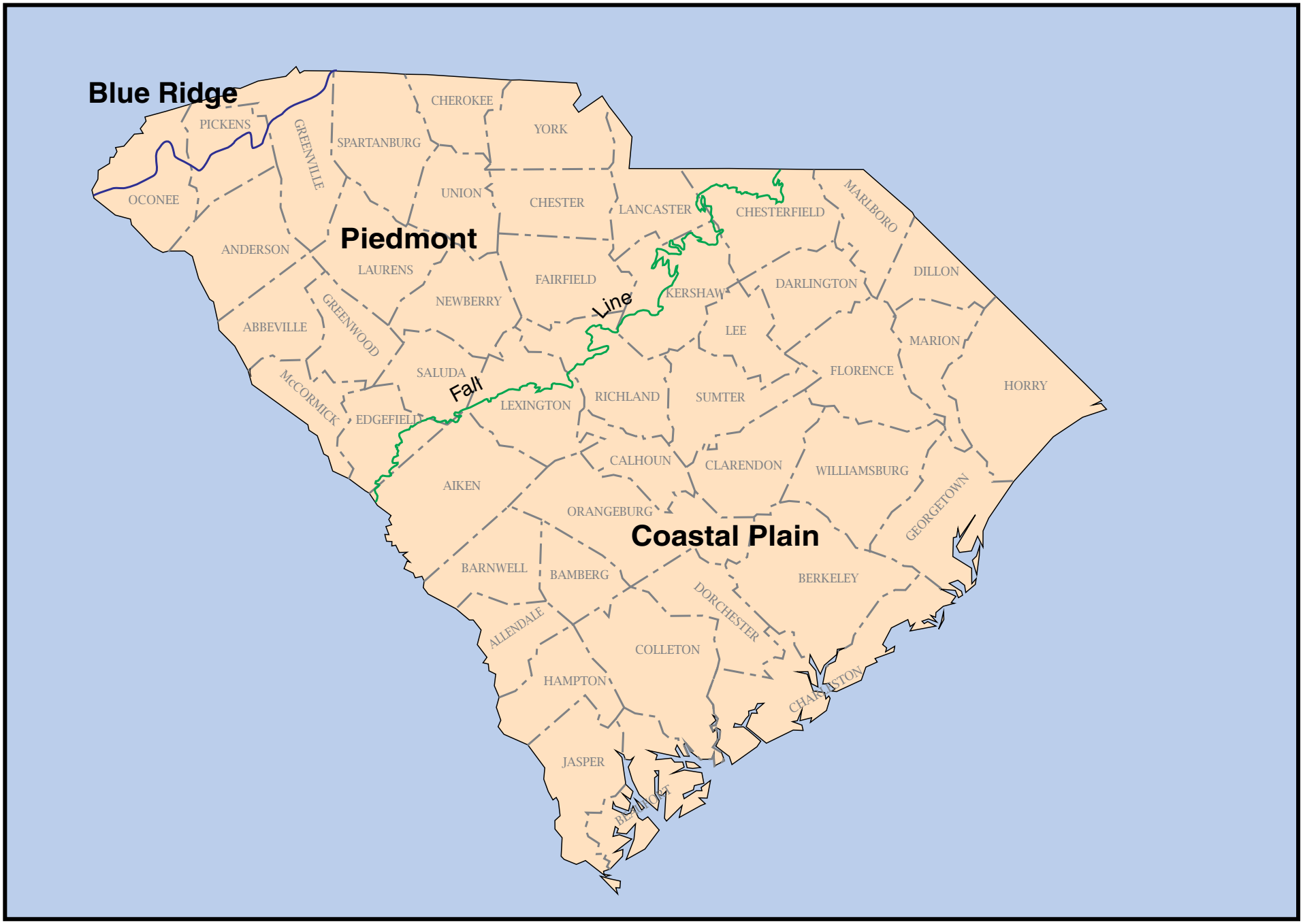

Figure 1. Physiographic provinces of South Carolina.

continued to experience drought conditions during 1987 while the Piedmont and Coastal Plain received additional rainfall from seasonal storms that alleviated any significant rainfall deficits. The years 1925, 1954, 1986, and the period from June 1998 to the present are considered major periods of drought in South Carolina. The droughts of 1925 and 1954 are considered the worst and second-worst, respectively, in the 20th century. Like the present drought (1988 to present), La Niña precipitated the drought of 1954. To date, many of the low-streamflow measurements made throughout the State in 1954 have already been surpassed. The current drought possibly will exceed the second-worst drought on record. (M. E. Brown, State Climatologist, personal commun., 2002).

Previous Investigations

The USGS has published annual reports on ground-water levels in South Carolina since 1942. They include USGS Water-Supply Papers 945, 987, 1024, 1072, 1097, 1127, 1157, 1166, 1192, 1222, 1266, 1322, 1405, 1538, 1803, 1978, and 2171 for the years 1942-1973. Siple (1946 and 1957b) provided useful publications on early investigations of the ground-water resources of South Carolina. Aucott and Speiran (1984) produced water-level estimates for the Coastal Plain aquifers prior to development, as well as completing several investigations related to the potentiometric surfaces of aquifers in the Coastal Plain (1985a and 1985b). Other potentiometric maps include those by Stringfield and Campbell (1993) and Ransom and White (2000).

The South Carolina Department of Natural Resources (SCDNR), Land, Water and Conservation Division, and its predecessor agency, the South Carolina Water Resources Commission, have published several reports concerning water-level measurements and potentiometric maps for local and regional areas of the Coastal Plain. These include Crouch and others (1985 and 1987), Davies (1985), Meadows (1987), Whiting and Park (1990), Gawne (1990 and 1994), Hockensmith (1997 and 2001), and Hockensmith and Waters (1998).

HISTORY OF GROUND-WATER MONITORING IN SOUTH CAROLINA

In 1939, a ground-water monitoring program was begun in Beaufort and Jasper Counties to document the effects of heavy pumping at Savannah, Ga. (USGS Water-Supply Paper 987, 1943). This investigation was led by the USGS in cooperation with the Georgia State Division of Conservation, Department of Mines, Planning, and Geology. Fourteen measurements were obtained in nine wells in Beaufort and Jasper Counties by the end of 1942; however, owing to extreme drought conditions, monitoring was discontinued in 1943 (USGS Water-Supply Paper 987, 1943). These data were not included in the present report because correlation with existing SCDNR observation wells was not possible and because of a lack of essential data such as casing diameter, depth, screen intervals, and exact well locations.

Another ground-water monitoring program began in the Tiger (modern spelling is *Tyger*) River valley area in Greenville and Spartanburg Counties in 1934 and continued until 1942. The USGS, working in cooperation with the Soil Conservation Service of the U.S. Department of Agriculture, made measurements in 28 wells screened in alluvial aquifers. This program was affected by drought, and by 1942 all but three of these wells had gone dry and measurements were discontinued (USGS Water-Supply Paper 945, 1942).

By 1946, the USGS, in cooperation with the South Carolina Research, Planning and Development Board, began a systematic program of ground-water monitoring that included a total of 15 observation wells: 13 in the Coastal Plain and 2 in the Piedmont (USGS Water-Supply Paper 1072, 1946). The well-monitoring program continued, and data were published for various wells in South Carolina from 1946 through 1955 in USGS Water-Supply Papers 1072, 1097, 1127, 1157, 1166, 1192, 1266, 1322, and 1405 as *Water Levels and Artesian Pressures in Observation Wells in the United States in 19**. Part 2, Southeastern States.* In 1955, the name of the publication changed to *Ground-Water Levels in the US, 19**-**. Southeastern States.* By 1973 another change was made, and Water Resources Data were published on an annual basis, specifically for South Carolina. The same format is presently in use. Periodically, other agencies publish water-level data, but none with long periods of records as consistently as the USGS.

To identify the wells, the original numbering system consisted of a number assigned in the order in which the well was catalogued and a name, usually the well owner. Latitude and longitude were introduced in the 1951 report, and by 1959 the USGS had changed its well identification format by combining the latitude, the letter N for North, the longitude and a number that represented the well as it was catalogued. Local numbers continued to be used. In 1969, both the letter N and the catalogue number were discontinued. The principal well-numbering system became the latitude and longitude along with the local well number, currently in use. Well names and identification numbers did not always stay the same, resulting in some confusion; consequently, not all of the USGS historical well data could be used in this report.

AQUIFER NOMENCLATURE

With the exception of the 16 wells located in the Piedmont province, aquifer nomenclature was determined by using the geohydrologic framework of Aucott, Davis, and Speiran (1987).

Six aquifer systems were defined and are summarized below:

1. The surficial aquifer, also considered the water-table aquifer, is generally less than 40 ft thick and is located in the lower Coastal Plain. It overlies the Floridan aquifer in the southern counties and the Black Creek aquifer in the southeastern counties.

2. The Floridan aquifer can be as thick as 1,400 ft, and it consists of parts of the Cooper, Ocala, and Santee Formations. This aquifer is found only in southern and southwestern areas of the Coastal Plain and overlies the lower part of the Tertiary sand aquifer.

3. The Tertiary sand aquifer is as much as 1,400 ft in thickness and consists of an upper and lower section. The upper section is the updip sand equivalent of the limestone that composes the Floridan system. It includes the Barnwell, McBean, and Congaree Formations and lies between the Fall Line and the updip limit of the Floridan aquifer. The lower section is composed of early Eocene and Paleocene sediments and underlies the upper section of the Tertiary sand aquifer and all of the Floridan aquifer. It covers the majority of the Coastal Plain and overlies the Black Creek formation.

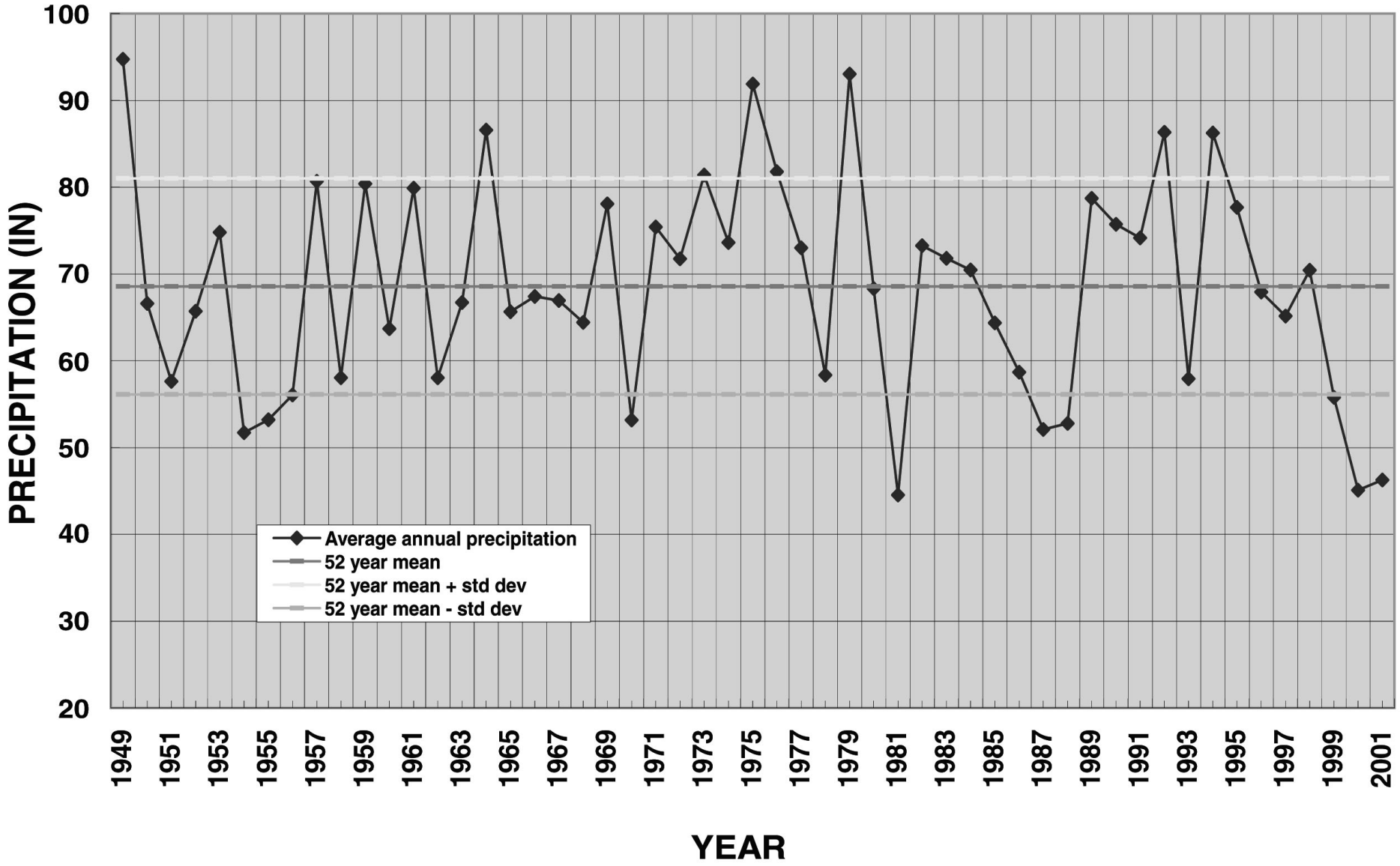

Figure 2. Average annual precipitation for the Blue Ridge province.

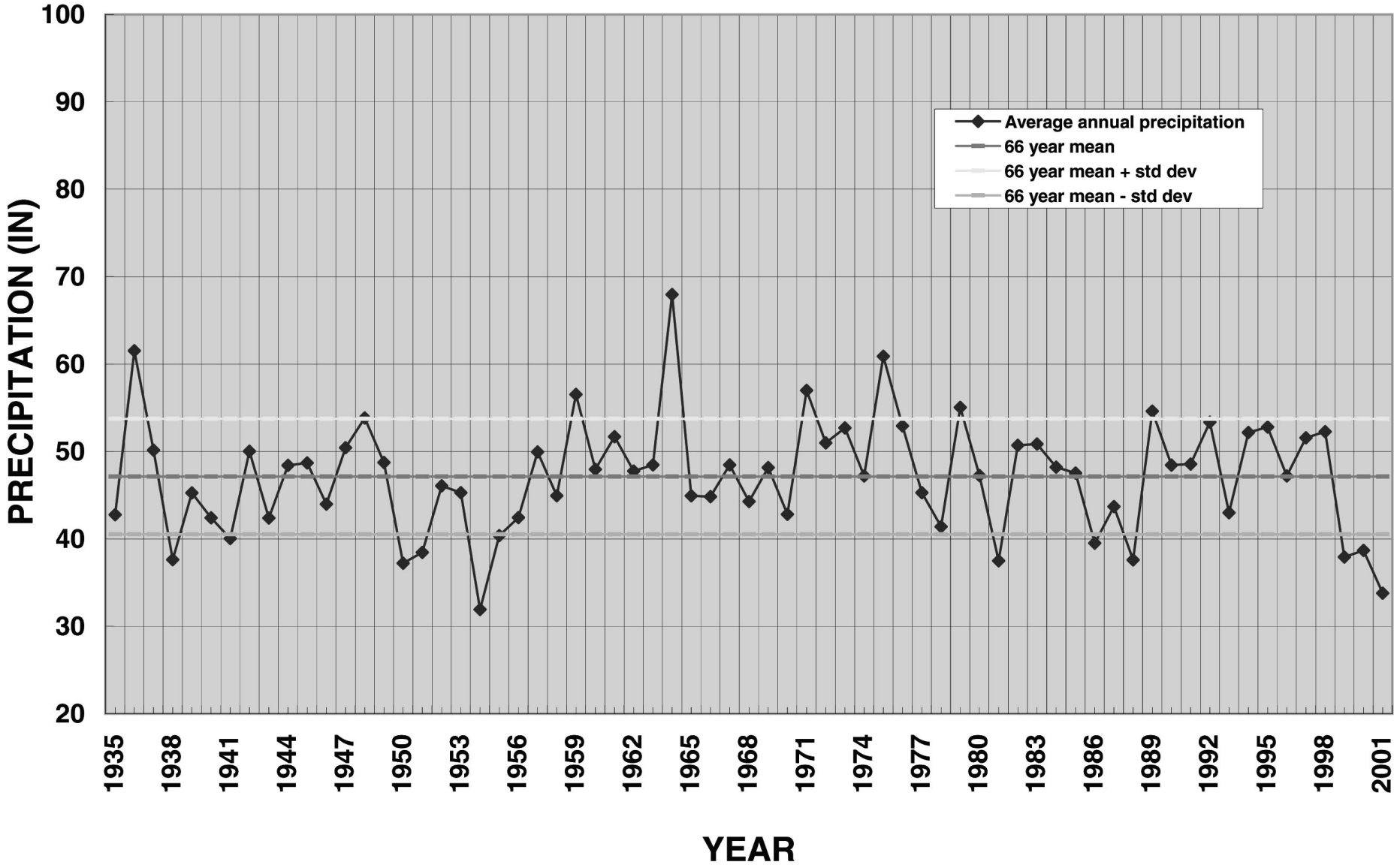

Figure 3. Average annual precipitation for the Piedmont province.

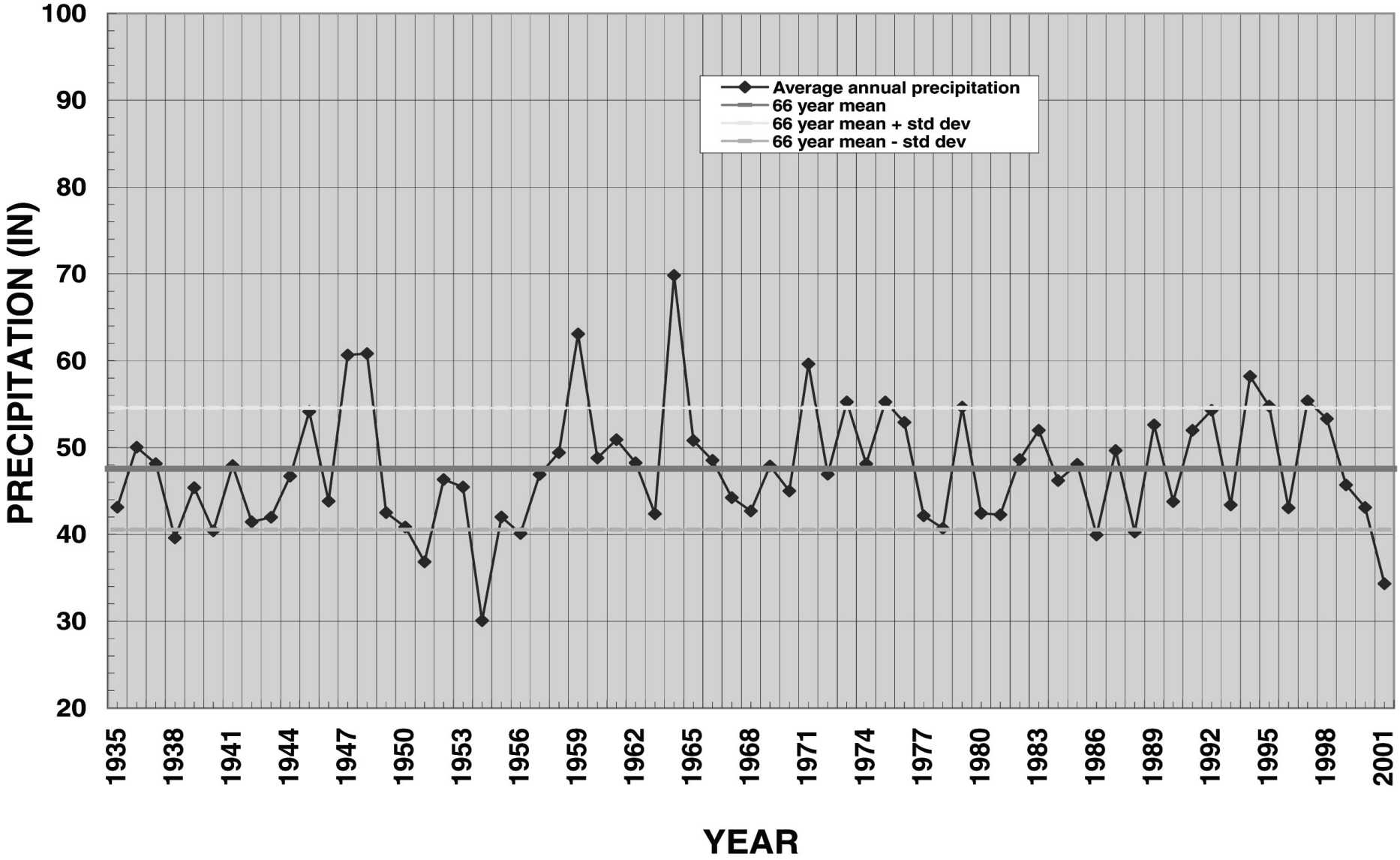

Figure 4. Average annual precipitation for the Coastal Plain province.

4. The Black Creek aquifer has a thickness of 1,000 ft or less and comprises the Black Creek Formation and parts of the overlying and underlying units. This aquifer extends along the entire lower Coastal Plain and crops out in the eastern section of the upper Coastal Plain. The Black Creek aquifer overlies the Middendorf aquifer.

5. The Middendorf aquifer can be as thick as 800 ft and comprises the Middendorf Formation. This aquifer occurs throughout the Coastal Plain and crops out adjacent to the Fall Line. It overlies the Cape Fear aquifer in the middle and lower Coastal Plain and crystalline bedrock in the upper Coastal Plain.

6. The Cape Fear aquifer is not well defined, and information is sparse regarding its thickness and areal extent, but a range in thickness of 0 to 800 ft is indicated. The aquifer involves only the Cape Fear Formation, and there is no known outcrop. This aquifer overlies Pre-Cretaceous igneous and metamorphic rocks.

DATA COLLECTION AND COMPILATION

Nearly half of the 282 wells whose hydrographs are presented in this report have, for some period of their record, continuous daily measurements; the remaining wells have intermittent measurements. The spatial distribution of data is irregular, abundant in some counties and missing in others. For counties with numerous observation wells, the ones in this report were selected on the basis of length of record, number of measurements, location, and aquifer. Figures 5 through 7 show locations of wells. The selected wells had either one full year of continuous data or at least four intermittent measurements over a minimum period of three years. Also, a maximum of two wells per aquifer were chosen to represent numerous wells located within the same 1-minute degree of latitude and longitude. Water-level measurements were compiled and presented as depth to water from land surface and as elevation of water level above or below mean sea level (estimated where land surface elevation had to be obtained from topographic maps.)

Data were collected from various sources, such as State agencies and miscellaneous publications; however, the majority of measurements were obtained from SCDNR and USGS files and publications.

WATER USE

Although South Carolina relies heavily on surface water as a source of public supply, 99 mgd (million gallons per day) were obtained from wells in 2000. This is about 18 percent of the total used for public supply. More than half of the 300 largest municipalities and water authorities rely on wells. In addition, ground water provides about 64 mgd for rural domestic use, 57 mgd for industrial use, 190 mgd for crop irrigation, and 25 mgd for golf-course irrigation (oral comm., J.E. Castro, 2002).

Ground water has always been an important source of water for South Carolina. In the mid-1940's, it supplied 115 of the State's 166 public water-supply systems. About 98 percent of the rural population obtained water from wells and, although no specific figure was provided for industrial use, Siple (1946) inferred that a large portion of that supply came from ground water. In the year 2000, ground water was the only source of water supply for one-third of the State's population.

EXPLANATION OF HYDROGRAPHS

Hydrographs are presented by county. For each well the following are given: identification numbers, location, aquifer name, well construction, period of record, and extremes of record. The well-numbering system includes a three-character abbreviation for the county name followed by a number that represents the chronological order in which the well record was obtained; for example, AIK-183. In addition, SCDNR uses a grid-location system in which each grid division corresponds to 5 minutes of latitude and longitude. An upper-case letter signifies the latitude grid and a number signifies the longitude grid. (See Figs. 5-7.) To further pinpoint the well, the 5-minute grid is divided into 1-minute grids represented by the lower-case letters a through y. Wells in that 1-minute grid are numbered consecutively as their records are obtained. The grid number for AIK-183 would be 41V-x3.

The measurement datum for each well is based on the National Geodetic Vertical Datum of 1929 and has either been surveyed, in which case it will be shown as a precise measurement (as 12.12 ft), or estimated from a topographic map (as 12 ft). Maps used to determine elevations are USGS topographic quadrangles with a scale of 1:24,000 and contour intervals of 5, 10, or 20 ft or of 1.5 meters.

For each well, the header information is followed by two graphs. The first graph plots the period of record for each well, using the first and last days of the calendar years in which the measurements were made. The second graph plots data on a standard horizontal scale starting in 1940 and ending in 2010. Where feasible, a 20-ft scale with 5-ft intervals was used for the vertical axis. For both graphs, water levels are relative to land surface on the left vertical scale and relative to sea level on the right vertical scale. Several wells have water levels above land surface.

Two types of water-level data are illustrated on the hydrographs: 1) those that were recorded on a continuous basis by use of automatic recorders, and 2) those that were measured intermittently with steel or electric tapes. A solid line represents data recorded continuously and a hollow circle connected by a solid line represents intermittent measurements.

SIGNIFICANT FINDINGS

In this data set, 26 wells (9 percent) are open to the Middendorf aquifer. Historically, substantial water-level declines have been observed in Middendorf wells in Berkeley, Charleston, and Florence Counties. Some of the greatest declines are listed below:

- BRK-431, near Moncks Corner, had a decline of nearly 40 ft from 1989 to 2000.
- CHN-14, in downtown Charleston, had a decline of nearly 80 ft from 1990 to 2000.
- FLO-128 and FLO-129, near the Great Pee Dee River, have 18- and 13-year records, respectively, and had water-level declines of 37 and 21ft. Hockensmith and Waters (1998) discussed, in detail, the historical trends of this aquifer.

Of the wells in this report, 68 (24 percent) are open to the Black Creek aquifer. Charleston, Georgetown, Horry, and Florence Counties have had the most significant historical water-level declines. Wells CHN-64, in downtown Charleston, and CHN-182, on the northeastern boundary of the county at Hampton Plantation, had consistent declines of more than 30 ft for the periods of 1990 to 1992 and 1986 to 2001, respectively. Most of the observation wells in Georgetown County have undergone water-level declines of 13 to 100 ft, with the longest record being 30 years. Wells located

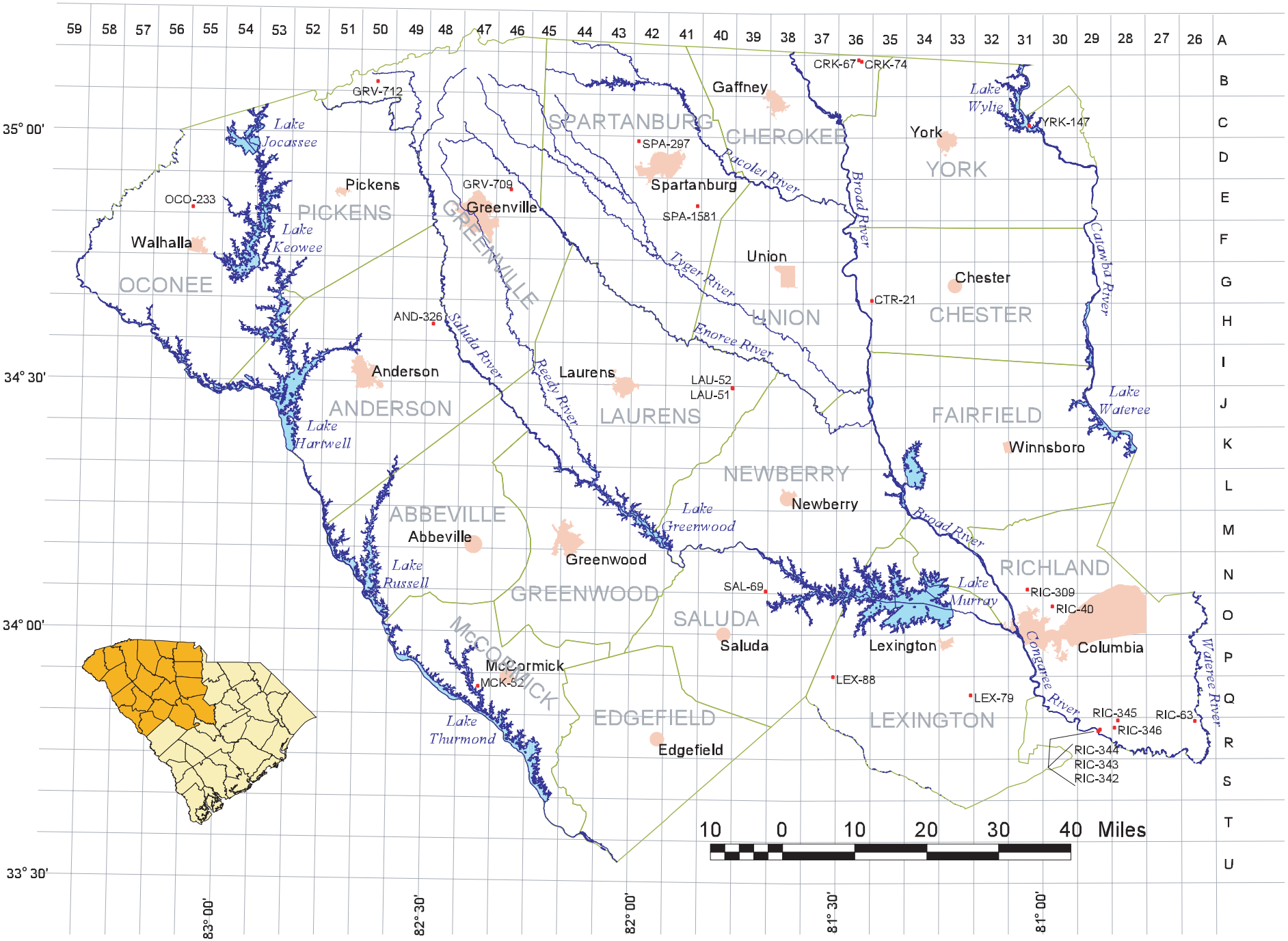

Figure 5. Locations of observation wells in northwestern South Carolina.

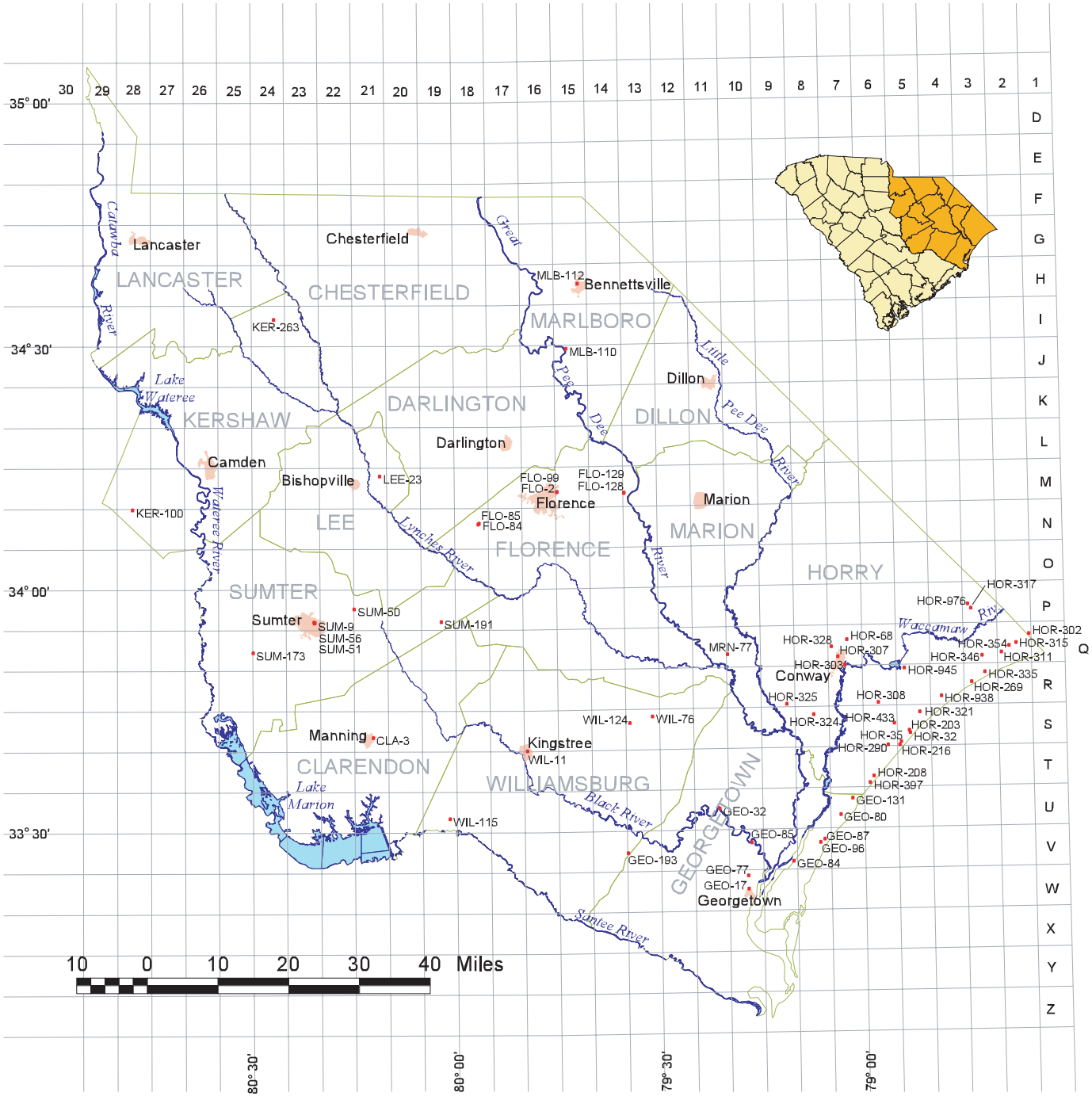

Figure 6. Locations of observation wells in northeastern South Carolina.

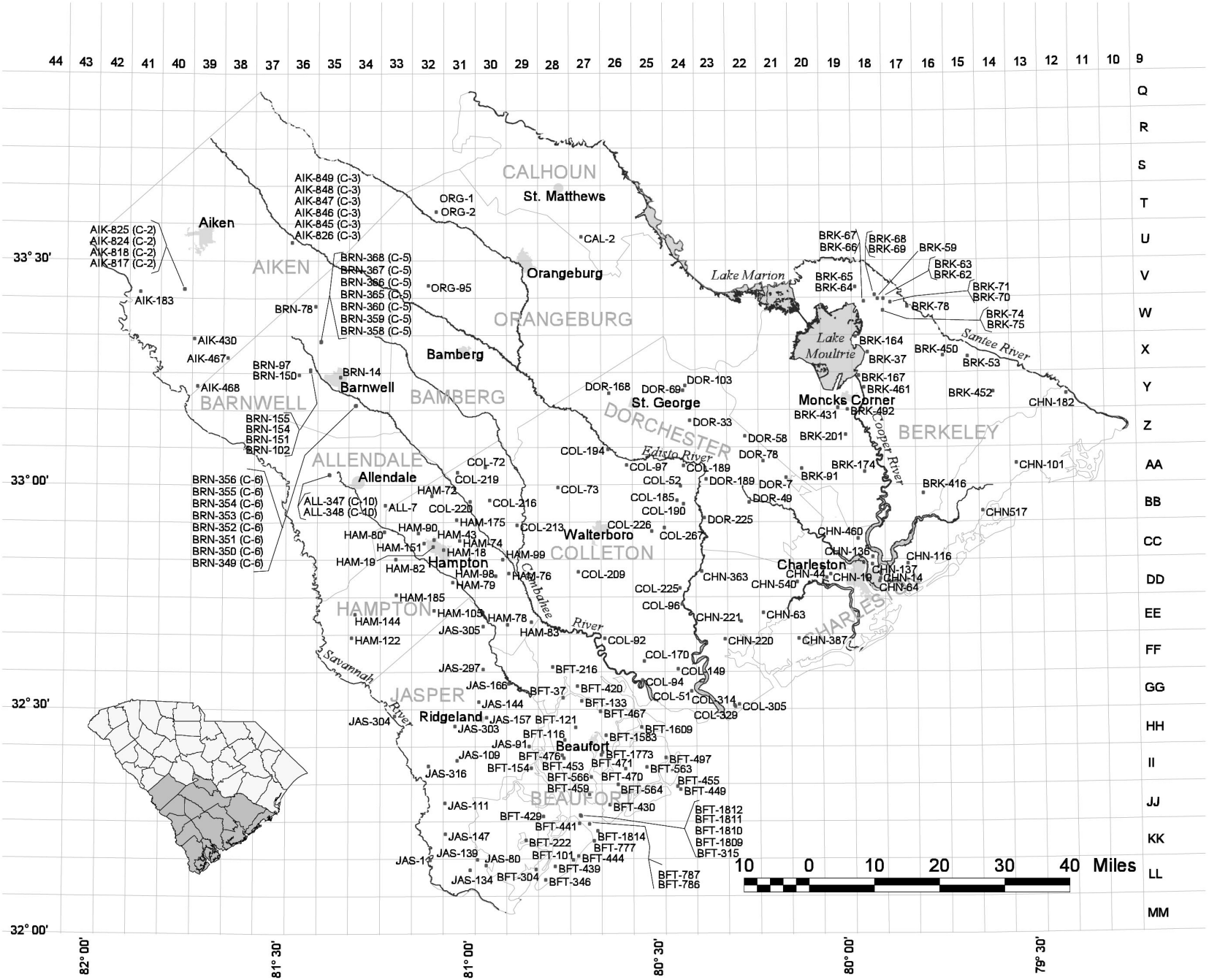

Figure 7. Locations of observation wells in southern South Carolina.

near Litchfield and Murrells Inlet had significant declines with an average of nearly 60 ft since the mid-1970's. GEO-193, near the town of Andrews, had the greatest water-level decline, 101 ft from 1988 to 2001. During the last 5 years, however, the water level in this well has risen about 40 ft.

Most of Horry County discontinued using ground water and began using surface water between 1988 and 1992 because of substantial water-level declines in the Black Creek aquifer. During the 1970's and 1980's, water levels showed seasonal pumping effects and overall declines of 50-110 ft (Hockensmith, 1997). Throughout the 1990's, many wells showed regional recovery of the aquifer, with water levels rising as much as 100 feet (where data were available). One well, HOR-321, near the center of the cone of depression, shows both the decline and subsequent recovery.

A well in Marion County, MRN-77, near Brittons Neck Fire Tower, showed a steady decline in water levels of more than 30 ft from 1982 to 2000.

About half of the wells in this publication are open to the Tertiary sand and Floridan aquifers. Seasonal fluctuations are evident in most wells, as are tidal fluctuations in the coastal counties. Water levels in the Floridan aquifer in Hampton County show distinct highs in the spring and lows in the fall, probably a result of recharge from precipitation or effects of local seasonal pumping. Most of the well data show no dramatic declines for the deeper aquifers; however, slight declines were observed in Beaufort County where water levels in some wells fell 20 ft or less. Over the past 15-20 years, wells monitored in Charleston County had an average decline of 13 ft. A more comprehensive summary of historical trends regarding this aquifer has recently been published by Hockensmith (2001).

There are 24 observation wells in the surficial aquifer. Water-levels in these wells are subject to precipitation fluctuations, seasonal evaporative and transpiration demands, and surface- water stage effects. Often these wells can be used as local drought- index wells.

Sixteen observation wells are located in the Piedmont and Blue Ridge provinces. They range in depth from 80 to 800 ft. These wells obtain their water from fractures that penetrate the crystalline rocks, but the water levels often reflect seasonal fluctuations.

In summary, historical data for 282 wells have been collected and compiled in graphical form to provide an overall picture of the status of ground-water levels in South Carolina. Although not spatially exhaustive, these data are fairly comprehensive and may be used by South Carolina natural-resource stewards to manage and protect this vital resource.

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WELLS FOR WHICH HYDROGRAPHS ARE PRESENTED

COUNTY NO.	LATITUDE	LONGITUDE	GRID NO.	PERIOD	AQUIFER	PAGE NO.
AIKEN						
AIK-183	332555	815315	41V-x3	1952-1998	Middendorf	19
AIK-430	331940	814435	39X-e1	1952-2000	Middendorf	20
AIK-467	331705	813915	38X-o1	1951-1981	Tertiary sand	21
AIK-468	331320	814405	39Y-f1	1953-1973	Tertiary sand	22
AIK-817	332615	814612	40V-s2	1988-2000	Middendorf	23
AIK-818	332615	814612	40V-s3	1988-2000	Middendorf	24
AIK-824	332616	814615	40V-s5	1993-2000	Black Creek	25
AIK-825	332616	814614	40V-s6	1989-2000	Black Creek	26
AIK-826	333230	812905	36U-01	1989-2000	Middendorf	27
AIK-845	333232	812908	36U-o2	1993-2000	Middendorf	28
AIK-846	333232	812908	36U-o3	1993-2000	Black Creek	29
AIK-847	333232	812908	36U-o4	1993-2000	Black Creek	30
AIK-848	333232	812908	36U-o5	1993-2000	Black Creek	31
AIK-849	333232	812908	36U-o6	1993-2000	Tertiary sand	32
ALLENDALE						
ALL-7	325725	811410	33BB-o8	1946-1966	Tertiary sand	33
ALL-347	330128	812302	35AA-q2	1993-1995	Middendorf	34
ALL-348	330130	812304	35AA-q3	1993-1995	Cape Fear	35
ANDERSON						
AND-326	343714	822856	48H-n2	1993-2000	Piedmont rock	36
BARNWELL						
BRN-14	331431	812121	35Y-b11	1948-1968	Tertiary sand	37
BRN-78	332358	812520	36W-j1	1981-1992	Middendorf	38
BRN-97	331449	812753	36Y-c4	1977-1979	Black Creek	39
BRN-102	331531	812606	36X-x17	1977-1985	Black Creek	40
BRN-150	331449	812753	36Y-c11	1977-1979	Tertiary sand	41
BRN-151	331519	812606	36X-v1	1977-1985	Tertiary sand	42
BRN-154	331531	812606	36X-v2	1977-1985	Tertiary sand	43
BRN-155	331531	812606	36X-v3	1979-1985	Tertiary sand	44
BRN-349	331044	811851	34Y-x1	1988-2000	Middendorf	45
BRN-350	331044	811851	34Y-x2	1988-2000	Tertiary sand	46
BRN-351	331044	811851	34Y-x3	1988-2000	Tertiary sand	47
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