

Establishment of a Permanent Groundwater Monitoring Site in Calhoun County, South Carolina

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<http://dnr.sc.gov>



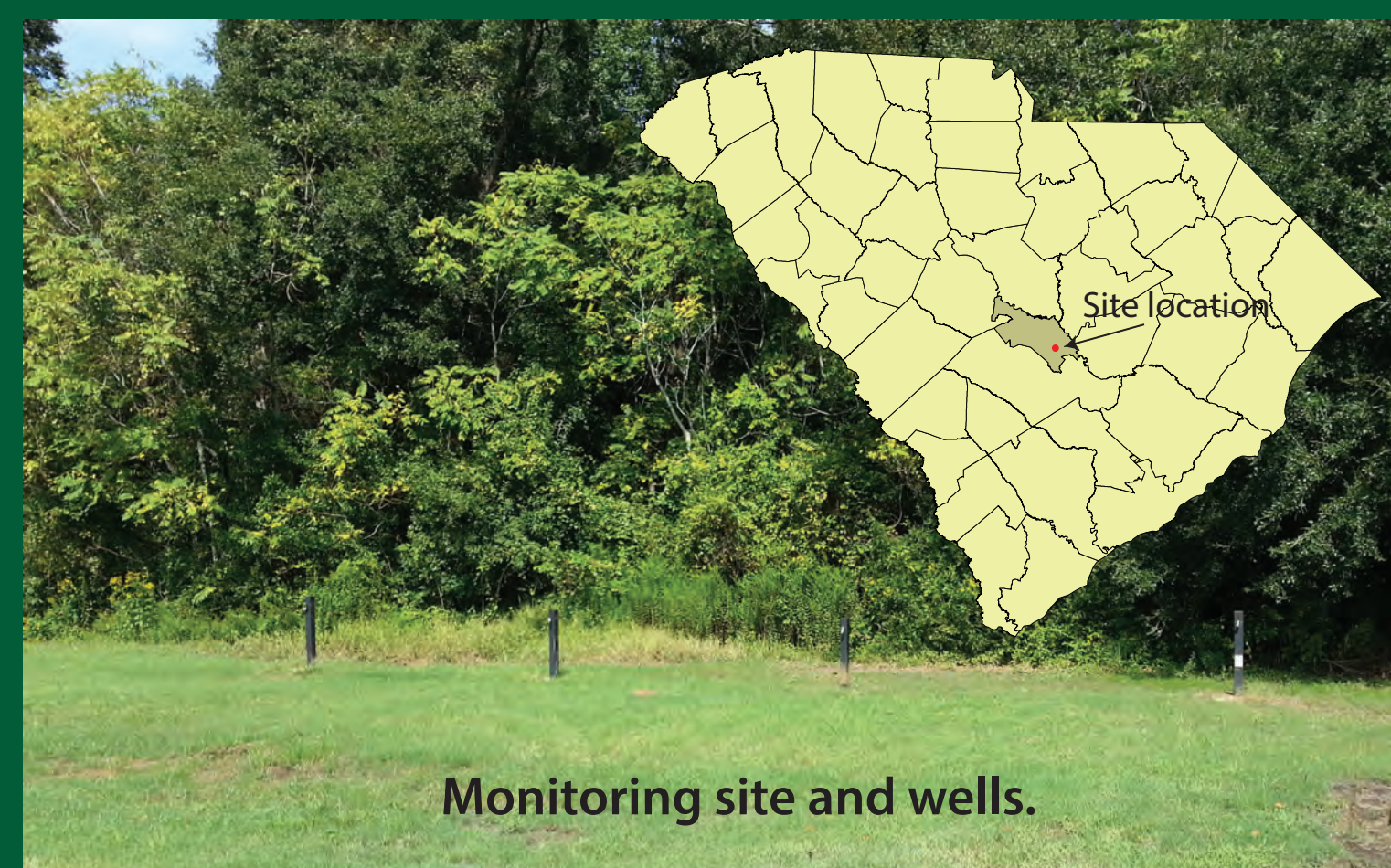
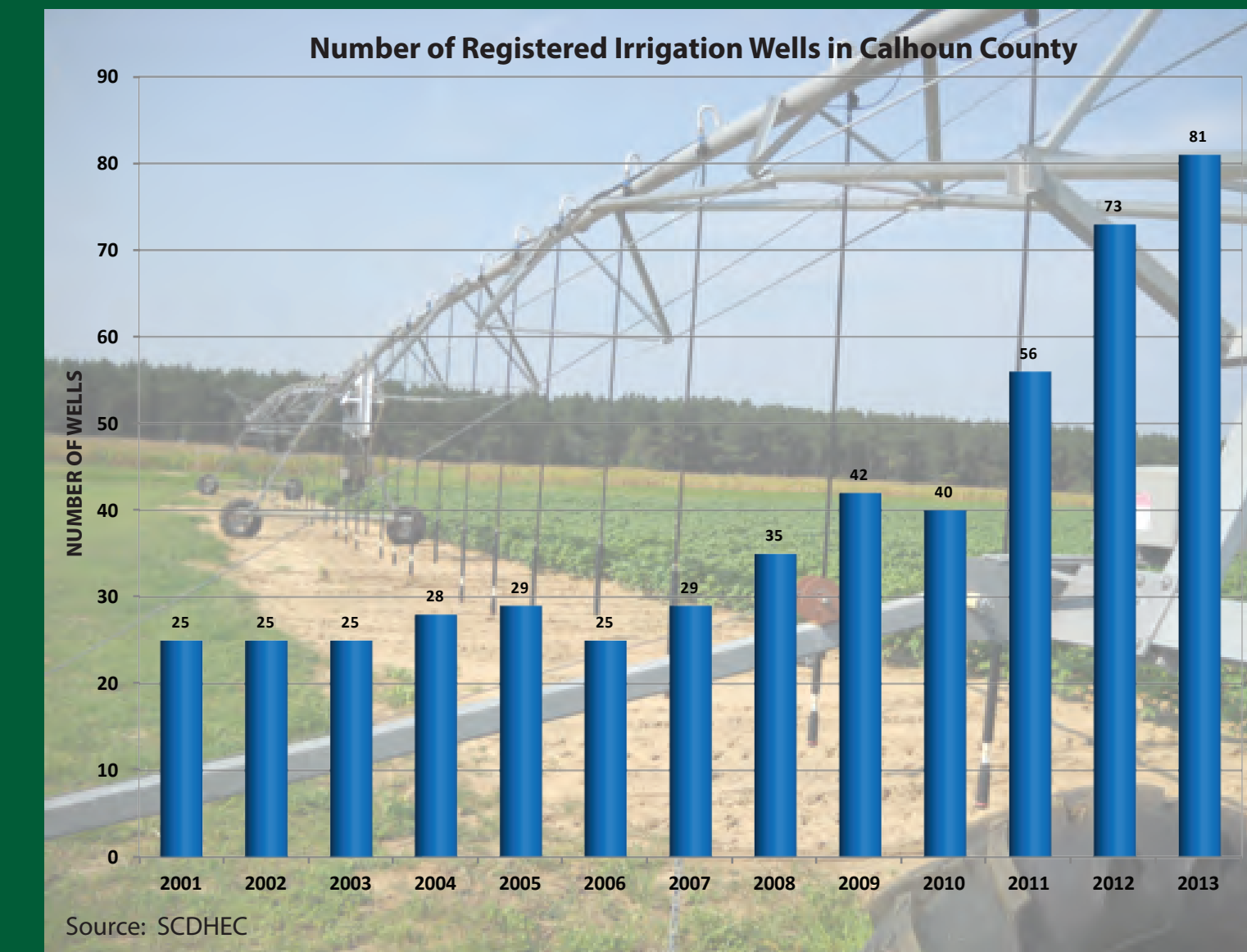
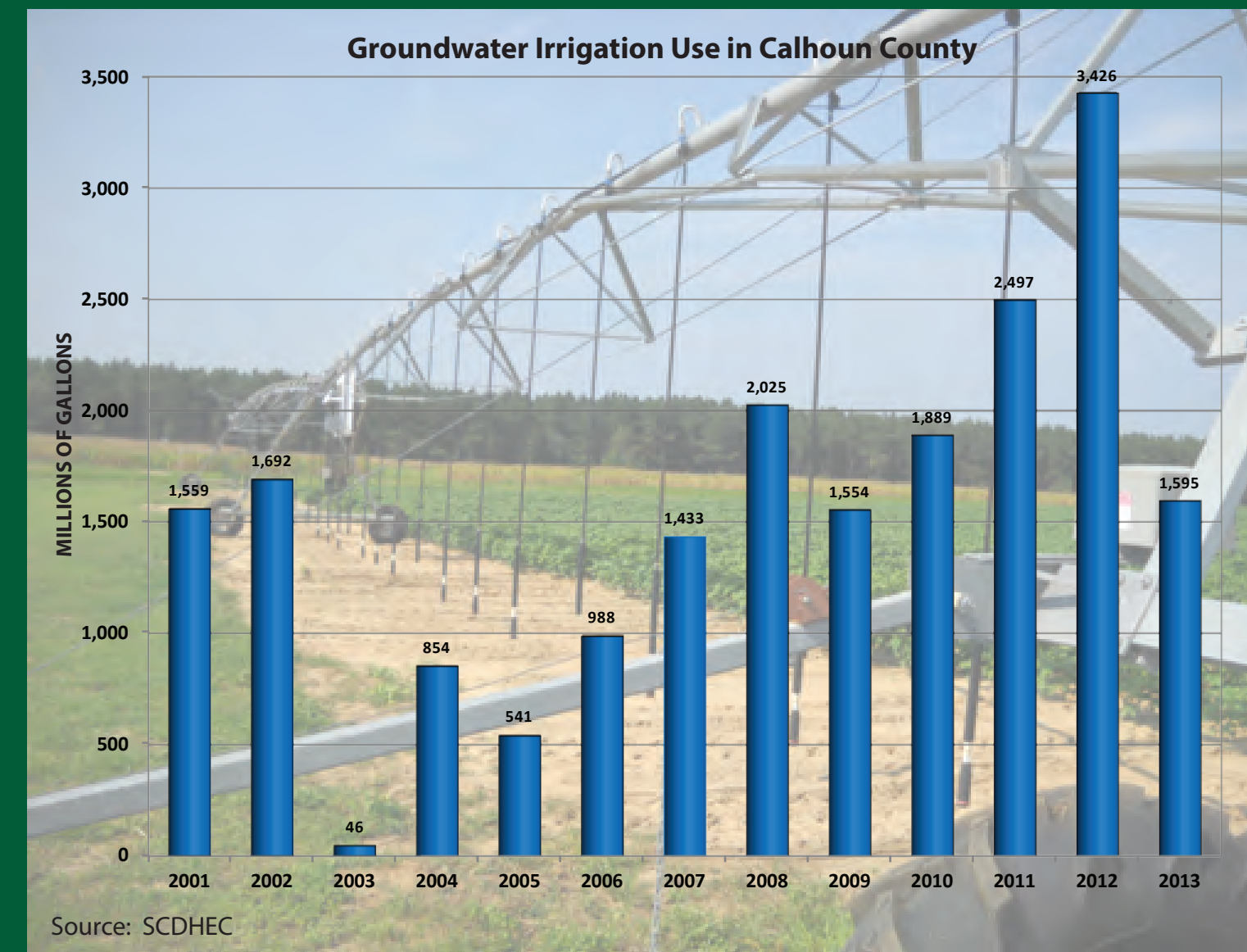
Increased groundwater use for crop irrigation in Calhoun County, South Carolina has raised concern among citizen groups that the increase may be affecting water levels in aquifers that are used for domestic supplies. Irrigation use increased from 1,559 MGY (million gallons per year) in 2001 to 3,426 MGY in 2012, and the number of registered irrigation wells increased from 25 to 73 during this same period (South Carolina Department of Health and Environmental Control). To address this concern, the South Carolina Department of Natural Resources (DNR), in collaboration with Calhoun County, drilled a test hole in the Town of Creston in south-central Calhoun County during the summer of 2013. The test hole was continuously cored to a depth of 1,058 ft (feet) using a wireline coring system operated by the U.S. Geological Survey. A suite of geophysical logs was obtained from the hole after the cores were collected. The logs and cores were used to delineate local aquifer zones and to correlate them to regionally defined aquifers. Sieve analyses were made to determine grain size and sorting.

Four aquifers were delineated and are, in descending order: 1) surficial; 2) Gordon (Tertiary sand); 3) Crouch Branch (Black Creek); and 4) McQueen Branch (Middendorf). The surficial aquifer occurs from land surface to 43 ft bls (below land surface). It consists of gravelly, poorly sorted, fine to very coarse quartz sand, interbedded with 0.5–2 ft clay layers towards the top of the aquifer. Gravels compose up to 20 percent of some intervals. The Gordon aquifer occurs from 80–130 ft bls and consists of interbedded quartz sand and clay. Sand beds are moderately sorted and medium to very coarse grained, often containing trace or minor amounts of lignite and muscovite. The Crouch Branch aquifer occurs from 193–385 ft bls and consists of interbedded quartz sand and clay. The sand fraction is moderately to poorly sorted and medium to very coarse grained. Muscovite, pyrite, feldspar, and heavy minerals are present in trace to minor amounts. The lowermost McQueen Branch aquifer occurs from 660–850 ft bls and consists of interbedded quartz sand and clay. Sand beds consist of moderately to poorly sorted, fine to very coarse sand and gravel. Trace to minor amounts of lignite, muscovite, pyrite, and heavy minerals occur. Gravels compose up to 34 percent of some intervals.

Four monitoring wells were completed at the site—one each in the surficial and Gordon, and two in the Crouch Branch. Future work will include the installation of a well in the McQueen Branch aquifer. Automated water-level recorders installed in each well indicate that water levels are about 20 ft bls in the surficial, 60 ft bls in the Gordon, and 80 ft bls in the Crouch Branch. Water levels in both wells completed in the Crouch Branch are nearly identical, indicating hydraulic continuity across fine-grained beds that occur in the middle of the aquifer.

It is believed that most of the irrigation water in the County is being pumped from the Crouch Branch aquifer. Nearby pumping from the Crouch Branch in the summer of 2014 is reflected on the well hydrographs, which show sharp water-level declines of more than 25 ft in both wells completed in the Crouch Branch. No effects from the pumping are observed in wells screened in the overlying Gordon or surficial aquifers, indicating that the Crouch Branch confining unit, which separates the Gordon from the Crouch Branch, is continuous and relatively impermeable in the area. The upper part of the confining unit consists of black clay interbedded with white, fine to coarse sand. The lower part of the confining unit consists of mottled, multi-colored fine to very coarse sand and gravel embedded in a dense clay matrix. The confining unit has been mapped as far west as the Savannah River Site and as far south as Charleston.

The Creston core is stored at the South Carolina Geological Survey in Columbia. The Creston site will serve as a long-term groundwater monitoring site for the State. Water-level data from these wells and others can be found at DNR's webpage: <http://dnr.sc.gov/water/hydro/groundwater/index.html>. The authors wish to thank Alex Butler (SCDHEC) for providing water use data.



The box of cores to the right contains sediments that are part of the Crouch Branch aquifer (aka, Black Creek). The Crouch Branch is widely used in Calhoun County for crop irrigation. It is a productive aquifer, consisting of medium to very coarse quartz sand. Few pumping tests are available, but tests made updip near Fort Motte indicate a transmissivity of about 13,000 ft²/day and a hydraulic conductivity of about 85 ft/day. The aquifer consists of Late Cretaceous (Maastriichtian and Campanian) formations, such as the Peedee and Donoho Creek.

The two boxes of cores to the right contain sediments that are part of the Crouch Branch confining unit. Numbers on the wooden blocks represent the depths of the cores in feet below land surface. The box on the left contains black, organic-rich clay interbedded with white, micaceous quartz sand, lithologies that are typical of the lower-middle Paleocene section. Clay beds often break along silt and fine-sand laminae, giving a poker-chip appearance to the sediments. Trace to minor amounts of lignite, garnet, and pyrite are found in the cores. Sand beds are massive to faintly cross-bedded, moderately sorted, and generally fine to coarse grained. The box to the far right contains what is believed to be the Cretaceous/Tertiary (K/T) contact at 159 ft. Cretaceous sediments consist of very poorly sorted, fine to very coarse sandy clay and clayey sand with minor gravel. Weathered feldspar is common. Sand and gravel grains are often embedded in a dense clay matrix, making the core hard in places. This lithology is indicative of the Sawdust Landing Formation, the uppermost Cretaceous unit found in the State. Sediments from the dashed yellow line to the 159-ft block appear to be reworked as indicated by the irregular bedding structures and very poor sorting. The confining unit is present in nearby cores ORG-393 (Orangeburg), ORG-256 (Wolfton), LEX-844 (Swansea), and SUM-296 (Manchester). Cores from some of the other hydrostratigraphic units are shown below.

