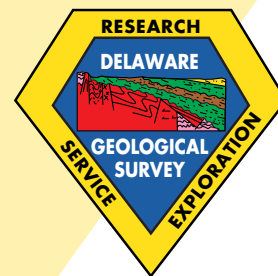


# First State Geology

Current information about Delaware's geology, hydrology, and mineral resources

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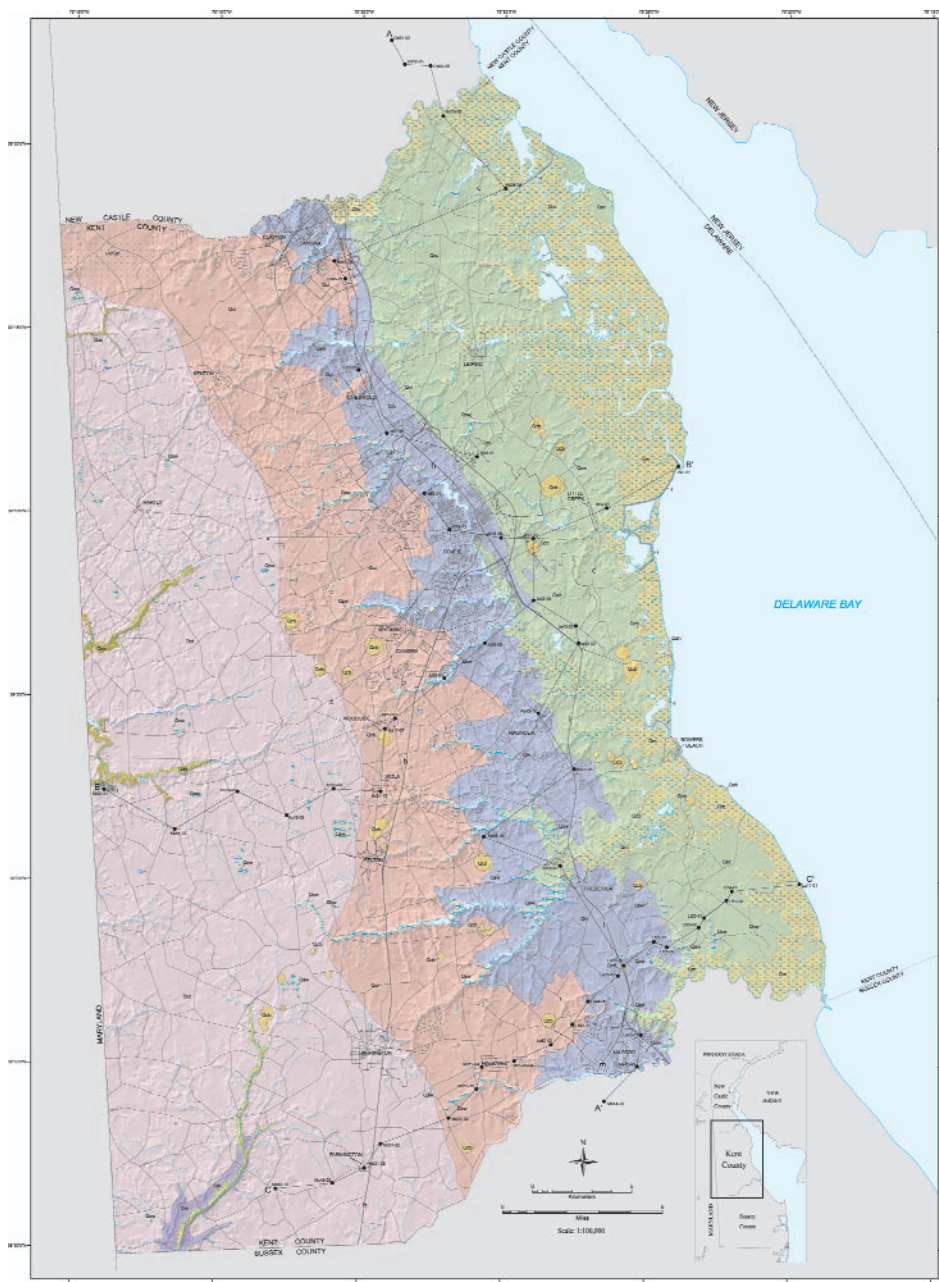
## New Geologic Map of Kent County

By K. W. Ramsey

This summer, the Delaware Geological Survey will release a new geologic map, "Geologic Map of Kent County Delaware" (Geologic Map Series No. 14), which presents the results of research by Kelvin W. Ramsey.

This map is the second in a series of three 1:100,000-scale county-wide geologic maps showing the formations found at the land surface. The New Castle County map (Geologic Map Series No. 13) was released in 2006. The purpose of these maps is to provide geologic information on a county-wide scale that can be used for determining the geology of watersheds, recognizing the relationship between geology and regional environmental or land-use issues, identifying potential locations of sand and gravel resources, and providing geologic data for local land-use and regulatory planning decisions. When used in conjunction with subsurface geologic information, these maps aid in locating water supplies for public, domestic, agriculture, and industrial use, mapping ground-water recharge areas, and protecting ground- and surface-water resources.

The geologic map of Kent County was constructed using data collected from drilling and coring the subsurface, examining outcrops, and collecting shallow hand-auger borings. Additional data were collected from drillers' logs, geophysical logs, and samples located in the DGS data repositories. Aerial photographs and soil maps were also used throughout the investigation. Using stratigraphic units previously published on the geologic map of New Castle County and on DGS Geologic Map Series No. 8 (Milford and Mispillion River quadrangles), surficial geologic units were extended south and southeastward into Kent County. Ongoing work in the southern portion of the state suggests that the Beaverdam Formation, previously considered to be restricted to portions of Sussex County,



actually extends over much of central and western Kent County into areas previously mapped as the Columbia Formation.

Accompanying cross sections show the stratigraphic units that lie beneath the surficial units depicted on the map. Many of these subsurface units function as aquifers and are used for public, domestic, irriga-

tion, and industrial water supplies. Descriptions and ages of all the units shown on the map and cross sections are included as well.

The geologic map of Kent County documents a combination of several ongoing projects of the DGS to understand and map the geology of Delaware and was in

part funded by a STATEMAP grant from the Association of American State Geologists and the U.S. Geological Survey.

Geologic Map Series No. 14 will be available to view online or as a downloadable product from the DGS Web page at [www.udel.edu/dgs/publ.htm](http://www.udel.edu/dgs/publ.htm). Printed copies of the publication may be requested by contacting the DGS at (302) 831-2833 or via e-mail at [delgeosurvey@udel.edu](mailto:delgeosurvey@udel.edu).

## Delaware Geological Survey's Statewide Ground-Water Monitoring Network

By A. S. Andres

Ground water is one of Delaware's most important natural resources and is the source of all potable water for areas south of the Chesapeake and Delaware Canal. Proper use, allocation, management, and protection of our ground water require adequate information about the aquifers that supply our water and the physical and chemical characteristics of the water. To obtain this information, the Delaware Geological Survey and other governmental agencies and private compa-

nies regularly install wells, collect well water samples, and measure water levels from wells throughout Delaware.

In recognition of the fact that water levels are one of the most basic and important measurements made in the study of ground water, the Delaware Geological Survey has had a water-level monitoring network in continuous operation since the mid-1950s. The goals of the monitoring network are to (1) systematically collect ground-water level data; (2) analyze trends; and (3) report our findings. Through half a century of conducting basic research on Delaware aquifers and ground water and working with water suppliers, water managers, researchers, and the public, the DGS has developed and maintained a comprehensive network of monitoring wells in which we collect water-level measurements and water samples.

### Data Collection

The DGS regularly monitors water levels in more than 70 wells, which are screened in 11 aquifers and distributed throughout New Castle, Kent, and Sussex counties. Manual measurements are taken monthly and quarterly using either electric tape or an electric sounder (M-scope). Automated measurements are recorded every 15 to 30 minutes by pressure transducer-datalogger systems in 15 of the wells. Data are retrieved quarterly from these instruments and downloaded to an Oracle database. Because of improvements in the temporal resolution of the data and the time savings achieved collecting the data, we plan to increase the number of automated systems by three per year.

#### Water-Level Monitoring

- Continuous
- Monthly
- ★ Quarterly

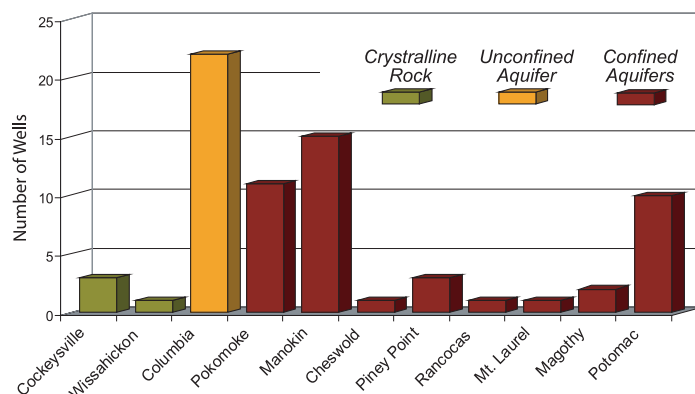
#### Chloride Monitoring

- ▲ Annually

#### Total Number of Wells\*

New Castle	23
Kent	8
Sussex	43

\* All wells are not represented on the figure due to the scale of the image.



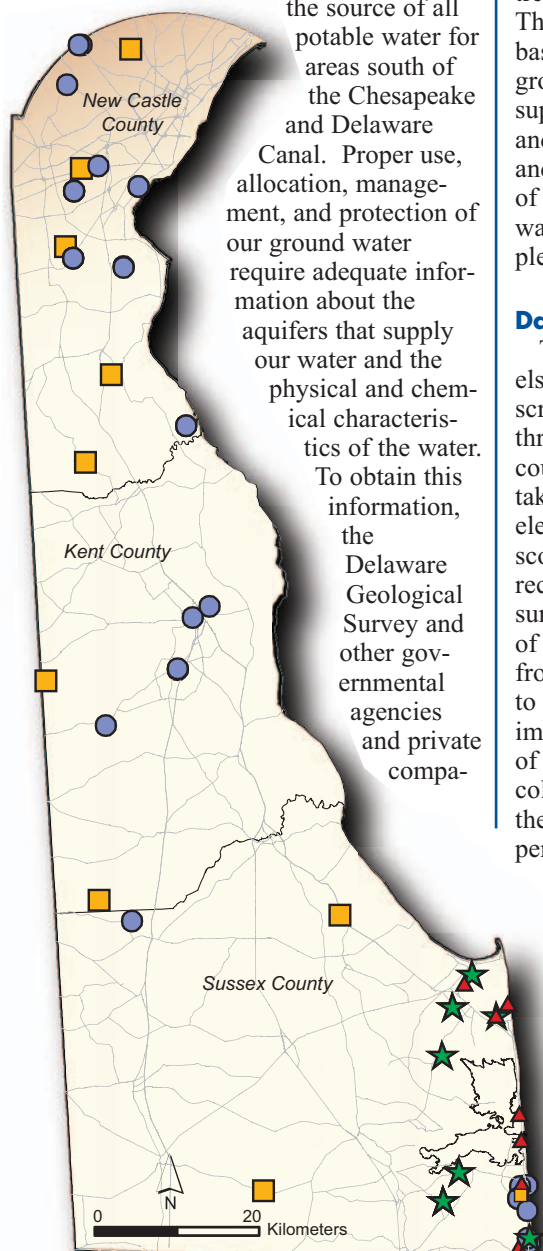
Data collection also involves gleaning previously reported data from publications and archived records. Water-levels from historical well completion reports and driller's notes are valuable pieces of information that are added to the Oracle database. In addition, the DGS routinely retrieves, reviews, and catalogues water-level data collected by the Department of Natural Resources and Environmental Control (DNREC) and the Delaware Department of Agriculture.

Water samples from selected major supply wells located along the Atlantic Coast in eastern Sussex County are collected and analyzed annually for chloride concentrations. A key concern in this area is the potential for degradation of water quality caused by overuse of ground water and subsequent intrusion of salt water. To keep apprised of conditions in this area, ground-water levels are measured at high temporal and spatial frequencies in the vicinities of several major water supply wells. This data collection effort is a part of Delaware's Coastal Aquifer Monitoring Program, conducted in cooperation with DNREC.

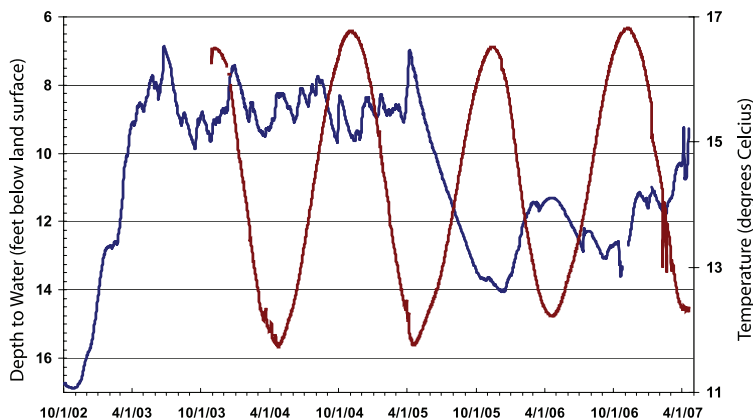
### Distribution of Ground-Water Data

These measurements have a wide variety of applications. For instance, the depth to the water table is a limiting factor in constructing buildings and roads, designing and locating land-based wastewater disposal systems, and for irrigating crops. Ground-water elevations are used to calculate ground-water flow directions and rates and to support more comprehensive interpretations of availability and sustainability of water supplies, rates and directions of contaminant transport, water use and disposal permits, and to project future ground-water conditions.

The DGS received over 100 requests from state agencies, consultants, and the public for ground-water data in the past year, and the number of requests per year has steadily grown. This number does not include ground-water data directly retrieved from the DGS website. Drought







This hydrograph shows fluctuations in the water table (with scale on left axis) observed between October 2, 2002 and April 17, 2007 in well Db24-18, located near Newark, Delaware. A graph of water temperature (with scale on right axis) begins in October 2003. A key feature shown on this chart is the 9-foot rise of the water table following the end of the drought in 2002. Also note the gradual decline of water temperatures beginning in early December of each year in response to recharge of cold water to the water table. Water temperatures began rising again in the latter half of April of 2004, 2005, and 2006 and continue to rise during summer months in response to subsequent recharge events and warmer air temperatures.

or flood conditions increase the number of these requests. In addition to responding to direct requests, we also distribute information through the monthly series *Summary of Water Conditions in Delaware* and through presentations at meetings of Delaware's Water Supply Coordinating Council and the Governor's Drought Advisory Committee.

While reviewing the types of data requested over the years the DGS identified several commonly recurring questions and developed several publications and Internet-based self-service basic data and interpretive products. These include:

(1) A table listing wells having 100 or more water-level observations or wells having 20 more years of record and more than 75 water-level measurements.

Additional information provided includes the northing, easting, and altitude of each well, the aquifer screened, and the date the well was drilled. Data accessible on this webpage (<http://www.udel.edu/dgs/Hydrology/histgw.html>) are a subset of DGS holdings and are updated quarterly. A data link for the well of interest provides access to a comma delimited text file of all available water-level data for that well. Hydrographs are available as PDF files for a subset of wells that have water-level recorders.

(2) A table listing wells with 4 or more water-level measurements, which are accessible at [http://www.udel.edu/dgs/Hydrology/historical/wl\\_rpt3.csv](http://www.udel.edu/dgs/Hydrology/historical/wl_rpt3.csv). Additional information provided includes the northing, easting, and altitude of each well, the top and bottom of the screened interval, the number of observations, the aquifer screened, and the period of record. Also included are the minimum, average, and maximum water levels. This list is formatted for easy import to geographic information systems (GIS).

(3) A file containing tabulations of monthly minimums, quartiles, averages, maximums, and period of record values

for wells with 20 or more years of record.

The tables are formatted for performing statistical analysis and for producing charts and are accessible at [http://www.udel.edu/dgs/Hydrology/historical/wl\\_stats2.html](http://www.udel.edu/dgs/Hydrology/historical/wl_stats2.html).

(4) Digital water-table data for New Castle, Kent, and Sussex counties, and the thickness, elevation of the base, and transmissivity of the unconfined aquifer in eastern Sussex county. These digital products (DP05-04, DP05-03, DP05-01, and DP06-01, respectively) are available as GIS-ready map layers and can be accessed at <http://www.udel.edu/dgs/Publications/pubform.html>.

Recent surveys of our stakeholders have revealed that most data users want to have more information available through Internet-based self service means and many users want some sort of map interface to access the data and additional tools to display the data. As a result, the DGS is developing the map interface for data retrieval and new tools to improve data display capabilities.

DGS staff members also have begun developing additional capabilities to link our monitoring well network to other climate and environmental data distribution sites, most notably DEOS, the Delaware Environmental Observation System (<http://www.deos.udel.edu/>). To date, two DEOS stations have been equipped with monitoring wells. The water-level data from those wells will soon be available through DEOS.

We also work with our federal counterparts, the U.S. Geological Survey, and other state agencies, including DNREC and the Department of Agriculture to coordinate the work of our respective agencies. Recently, DGS Senior Scientist, A. Scott Andres, was nominated by the National Ground Water Association and appointed a member of the Subcommittee on Ground Water

(SOGW), a part of the National Advisory Committee on Water Information. Scott will be representing the 50 states as co-chair of the Data Standards and Data Management workgroup of SOGW. Participation on this subcommittee will keep Delaware current with national programs that measure, manage, and distribute ground-water information.

## Publications

### Recent DGS Publications Geologic Map Series

No. 14, Geology of Kent County, Delaware: **Kelvin W. Ramsey**, scale 1:100,000.

### Open File Reports

No. 46, Storm-water and Baseflow Sampling in the Nanticoke River Watershed: Preliminary Report of Findings 2002-2004: **A. Scott Andres**, William J. Ullman, and Karen B Savidge, 20 p.

No. 47, Digital Watershed and Bay Boundaries for Rehoboth Bay, Indian River Bay, and Indian River, **Thomas E. McKenna**, **A. Scott Andres**, and Kerrilynn P. Lepp, 8 p.

## Staff Notes

### Presentations

Members of the Delaware Geological Survey were invited speakers at the 2007 Delaware Water Science Seminar, April 25, in Dover: **A. Scott Andres**, "3D Geologic Mapping at the DGS;" **Thomas E. McKenna**, "Remote Sensing of Temperature to Characterize Ground-Water/Surface-Water Interaction in Delaware;" and **Peter P. McLaughlin, Jr.**, "Geology of the Confined Aquifers of

Kent County: Stratigraphy, Mapping, and Hydrogeological Implications” and “Geology of the Potomac Aquifer of Northern New Castle County: Keys to Improving Hydrogeological Characterization.”

**A. Scott Andres**, “Results of the Domestic Well Water-Quality Survey,” Delaware Cancer Consortium, Wilmington, Feb. 20; and with David Legates, **William S. Schenck**, **Miriam L. Pomilio**, and **Bradley L. Strittmatter**, “Internet-based Hydrologic Data Distribution at the University of Delaware,” National Ground Water Association Ground Water Summit, April 30.

**P. Steven McCreary**, “Proper Well Construction and Management,” Master Well Owner Network Workshop, Dover, June 2.

**John H. Talley**, “Ground-Water Availability, Trends in Water Demands Associated with Irrigation and Public Water Supply through 2030, and Potential Conflicts that May Arise from Competing Demands for Water,” invited speaker at Friends of Agriculture Breakfast, Dover, March 16.

**Lillian T. Wang**, “Surficial Geologic Mapping of Delaware in GIS,” TUGis conference, Towson, March 19-20 and at

Delaware GIS 2007 conference, Dover, May 2; “Geocollaboration: Collaborative Methods for Working with Geospatial Data,” TUGis conference.

## Service and Awards

**A. Scott Andres** was nominated by the National Ground Water Association and appointed a member of the Subcommittee on Ground Water (SOGW), a part of the National Advisory Committee on Water Information. Scott will be representing the 50 states as co-chair of the Data Standards and Data Management work-group of SOGW. The National Advisory Committee on Water Information represents the interests of water-information users and professionals in advising the Federal Government on Federal water-information programs and their effectiveness in meeting the Nation’s water-information needs.

Congratulations to **Steven V. Bertsche** for 15 years of service at the University of Delaware.

**A. Scott Andres**, **Richard N. Benson**, **Peter P. McLaughlin, Jr.**, and **Thomas E. McKenna** were members of the Northern New Castle County Ground-Water Modeling Team that received the External Partnering Award from the U.S.

Army Corps of Engineers, Philadelphia District, for their work on a multi-year ground-water modeling study that provided a more comprehensive understanding of the Potomac aquifer system.

**Miriam L. Pomilio** presented “Geographic Information Systems, Lessons for Educators,” at the Delaware Instructional Technology Conference, April 18-19.

**Kelvin W. Ramsey** participated in a panel discussion on “Sea-Level Rise Impacts on Ecosystems and Coastal Communities,” Delaware Coastal Issues Workshop, Dover, June 25.

**William S. Schenck** presented a public lecture on the Geology of White Clay Creek State Park, March 23; participated as a subject matter expert for the Delaware Board of Professional Geologists at the National Association of State Boards of Geology Council of Examiners, Minneapolis, March 29–April 1; presented “Rocks, Minerals, and Geologists” to Chester County Cub Scout Summer Camp, June 20.

**John H. Talley** represented Delaware at the Outer Continental Shelf Policy Committee meeting, Annapolis, Feb 20-22.



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