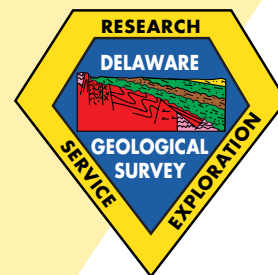


First State Geology

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

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Delaware DataMIL Team Receives Highest USGS Honor

*By Udaily, Office of Public Relations,
University of Delaware*

A team of state and University of Delaware staff has been awarded the 2003 John Wesley Powell award "for noteworthy contributions to the mission and objectives of the U. S. Geological Survey." The group was honored for developing the Delaware Data Mapping and Integration Laboratory (DataMIL).

The award—named for distinguished scientist and early USGS leader John Wesley Powell—is the highest honor possible for those not employed by the USGS.

The DataMIL team includes John Callahan, Tina Callahan, and Dick Sacher of the University's IT User Services/RDMS unit, Sandy Schenck of the Delaware Geological Survey, and Mike Mahaffie of the Delaware Office of State Planning Coordination.

USGS Director Charles G. Groat presented the award at a September 25 ceremony at USGS headquarters in Reston, Virginia.

"(The team has) created the foremost pilot project of the National Map using Internet mapping service technology," Groat said. "The DataMIL team convinced local and state government that the vision of DataMIL and the National Map were the

pathway to improved government service that is beneficial to the state educational system and a useful tool for the public."

DataMIL is an interactive, online "collaboration laboratory" established by the Delaware Geographic Data Committee (DGDC) to make possible continual improvement of the maps and spatial data used by decision-makers at the state, county, local, and federal government levels in Delaware.

Groat commended the recipients for their "distinct achievements, innovation and dedication." He said that, "The First State is truly first in supporting the vision of the National Map, and helping the USGS quickly provide mapping data to the Nation."

The Delaware DataMIL serves the

state's Spatial Data Framework Layers, which when combined produce the National Map for Delaware. The National Map for Delaware serves as the base map upon which state, county, and local agencies track and maintain information. Because agencies use the same base map layers, all the data sets are vertically integrated. These agency-derived maps can be used for planning, natural resource management, and emergency management and response. Also for public use, DataMIL can be used to look at aerial photography, answer questions about a parcel of land, and identify areas suitable for hiking, hunting, and fishing.

For more information about DataMIL see the Winter 2002 issue of *First State Geology* or visit <http://datamil.udel.edu>.



U.S. Geological Survey Director Charles Groat (left) presents the 2003 John Wesley Powell Award to (from left) Mike Mahaffie, Sandy Schenck, Dick Sacher, Tina Callahan, and John Callahan. Photo courtesy of the U.S. Geological Survey.

The DGS Welcomes Steve McCreary

Steve McCreary, a native of Sussex County, Delaware, joined the DGS staff in June as a senior research technician after 17 years of employment in the well drilling industry. He is a licensed well driller in Delaware and Maryland and is primarily responsible for operating and maintaining our CME-55 drill rig, and the DGS ground-water level and ground-water quality monitoring networks.

Steve obtained extensive experience during his 17 years of employment with three large drilling companies in southern

Delaware and eastern Maryland. He has participated in many formal classes and seminars pertaining to drilling methods, drilling fluids, pumps, and electronics related to submersible and vertical turbine pumping systems. He is OSHA certified and very familiar with drilling safety.

We welcome Steve to the DGS and look forward to his invaluable support for, and participation in, our research, service, and exploration efforts related to geologic, hydrologic, and natural hazard investigations that the DGS conducts throughout Delaware.

Record Flooding on Red Clay Creek

By J. H. Talley

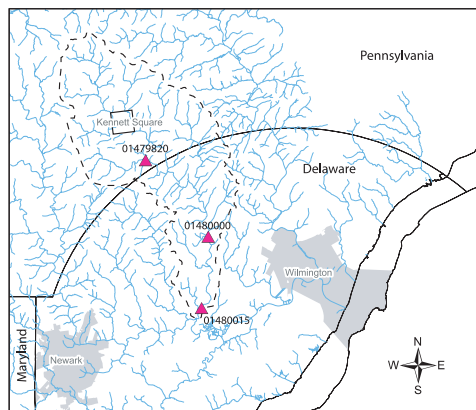
The remnants of Tropical Storm Henri dumped more than 10 inches of rain in a five-hour period (4:00 a.m. – 9:00 a.m.) on September 15, 2003, in the relatively small upper Red Clay Creek drainage basin in nearby Chester County, Pennsylvania according to interpretation of Dopplar radar by the Office of the State Climatologist. Rain fell at the rate of about 2 inches per hour between 4:00 a.m. and 7:00 a.m. and about 3 inches fell between 7:00 a.m. and 8:00 a.m. The rainfall exceeded the 24-hour

Peak stages and discharges for previous flood of record (Hurricane Floyd) and flood of September 15, 2003.

GAGING STATION (Location shown in Figure 1)				PREVIOUS FLOOD OF RECORD			FLOOD OF SEPT. 15, 2003		
Number	Name	Drainage Area (mi ²)	Period of Record	Date	Stage (ft)	Peak Discharge (ft ³ /s)	Stage (ft)	Peak Discharge (ft ³ /s)	Recurrence Interval (years)
01479820	Red Clay near Kennett Square	28.3	1988-03	9/16/99	10.04	4,680	14.98	21,000	~500
01480000	Red Clay at Wooddale	47.0	1943-03	9/16/99	13.93	7,650	17.61	32,000	>500
01480015	Red Clay near Stanton	52.4	1988-03	9/16/99	23.54	8,260	25.52	34,500	200-500*

Peak discharge data and recurrence interval estimates for September 15, 2003 were provided by USGS and are subject to revision.

*The analysis was based on a relatively short period of 15 annual peaks from 1989 to 2003.



Location of streamgages mentioned in this article. Station numbers are identified in accompanying table. Red Clay Creek drainage basin outlined by dashes.

100-year return period value of 8 inches as well as the 3-hour 100-year value of 4 inches. More than 7 inches were recorded near Hockessin. The intense rainfall of short duration occurred during a time when the ground was already saturated and resulted in record flash flooding and unprecedented damage in the Red Clay Creek drainage basin from southeastern Pennsylvania to the confluence of Red Clay and White Clay creeks at Stanton, Delaware.

Record high stages and instantaneous peak discharges were recorded on all three streamgages along Red Clay Creek. Peak-flow data for the storm of September 15, 2003, and



Damaged railroad along Rt. 82

peak-flow data for the highest previous flood (Hurricane Floyd) are presented above.

The peak discharge on Red Clay Creek near Kennett Square was 21,000 ft³/s or 9.4 million gallons per minute surpassing the previous record of 4,680 ft³/s by 16,300 ft³/s. The peak discharge at Wooddale was 32,000 ft³/s or 14.4 million gallons per minute eclipsing the old record of 7,650 ft³/sec by 24,350 ft³/sec. The peak at Stanton was 34,500 ft³/s or 15.5 million gallons per minute surpassing the previous record by more than 26,000 ft³/s. The peak flows at all three stations were more than 4 times greater than the previous records. For comparative purposes, the average daily flow on Red Clay Creek at Wooddale in September is only about 30 ft³/s or 13,500 gallons per minute.



Washed out section of Faulkland Rd.

The peak discharge at Wooddale was calculated to have a recurrence interval of more than 500 years. The recurrence interval is the average time, in years, between occurrences of a given flow. Although a particular peak stream discharge may have an average frequency of occurrence of a number of years (10, 20, 100), that discharge may occur in any year. For example, a discharge having an average occurrence of 100 years may occur in any year and may possibly occur in two consecutive years; however, in any one year there is only a 1 percent chance of the 100-year discharge occurring.

The intense rate of rain caused the Red Clay Creek at Wooddale to rise about 10 feet

in three hours between 7:45 a.m. and 10:45 a.m. The water level rose at a rate of about 1 foot every 10 minutes between 9:00 a.m. and 10:00 a.m. The unprecedented height of the water resulted in Red Clay Creek exceeding the limits of the mapped 100-year floodplain. The volume and velocity of the water caused extensive damage to houses, buildings, railroads, roads, and bridges along the entire length of the creek.

The New Castle County Department of Land Use estimated that damage to the dwellings and structures they inspected from this 500-year event exceeded \$43 million. Damage estimates to the Wilmington and Western Railroad between Marshallton and Hockessin were more the \$6 million. Numerous roads, bridges, and bridge approaches also suffered severe damage; however, damage estimates for these structures are not yet available.

Workshop Illustrates Offshore Sand Research

By K. K. McKenna

The Delaware Geological Survey hosted and cosponsored the U.S. Minerals Management Service (MMS) Mid-Atlantic Cooperative Offshore Sand Workshop on October 23, 2003, at the University of Delaware. The MMS designed, developed, and implemented its federal/state partnership Offshore Sand and Gravel Program with several coastal states in 1992, not only to identify potential sand and gravel resources in federal waters for use by the public and private industry, but also to conduct environmental investigations of habitat use by finfish, shellfish, and bottom-dwelling organisms in areas where potential sand resources have been identified. Fourteen coastal states participate in the national program.

The one-day workshop provided a forum for mid-Atlantic states with existing cooperative programs, along with federal agencies and consultants to present and discuss recent research regarding offshore sediment resources, results of environmental studies related to habitat, and to share ideas and methodologies for integrating the research



Interim Director and State Geologist John Talley (left) and Delaware Offshore Sand Team Coordinator Kelvin Ramsey (center) accept a certificate marking the tenth year of the MMS-Delaware Offshore Sand Cooperative Program from Renee Orr, Chief, Leasing Division at the Mid-Atlantic State's OCS Sand Workshop.

conducted by the various state and federal agencies. The workshop also enabled states with new projects to become more familiar with the cooperative program.

Seven coastal states represented by federal and state agencies, geological surveys, and universities participated in the workshop. Kim McKenna, DGS project geologist, discussed the process of using stack-unit mapping and geographic information systems to identify potential offshore beach-quality sand borrow areas. The MMS program has enabled DGS researchers to identify 16 areas offshore Delaware that contain nearly 105 million cubic yards of beach-quality sand. Tony Pratt, acting administrator of DNREC's Shoreline and Waterway Management Section, spoke about Delaware's sand needs to maintain beaches, problems with obtaining sand, and the social value of maintaining beaches for such things as shoreline protection and recreation. Other presentations focused on seismic studies of offshore sand ridges, upcoming federally sponsored beach nourishment projects, the U.S. Geological Survey's usSEABED data program, and ongoing environmental investigations.

DGS Fossil Dig at Coast Day

By L. T. Wang

On October 5, 2003, the Delaware Geological Survey hosted "Fossil Dig for Kids" at Coast Day, an annual event sponsored by the University of Delaware Sea Grant College Program and Graduate College of Marine Studies held at the Hugh R. Sharp Campus in Lewes, Delaware. Children learned how to identify *Gryphaea* (oyster) from the Cretaceous Period, and scallops and marine mammal bones from the Miocene Epoch by digging through a sandbox filled with several Delaware and Maryland marine fossils.

Over 200 copies of Special Publication 22

(The Hurricane of October 21-24, 1878 by K.W. Ramsey and M.K. Reilly) and Hydrologic Map 12 (Ground-Water Recharge Potential, Sussex County, Delaware by A.S. Andres) were distributed. There were several requests for the recently published Geologic Map 12 (Geologic Map of the Lewes and Cape Henlopen Quadrangles, Delaware by K.W. Ramsey). Several hundred copies of Special Publication 26 (Historical Coastline Changes of Cape Henlopen, Delaware) were distributed at Coast Day for the third year in a row.

Special thanks to A. Scott Andres, Andrew Klingbeil, Matt Martin, Jon Malmstedt, Steve McCreary, Mark Neimeister, and John Watson for their contributions to a successful event.



John Malmstedt (right) helps children identify fossils at Coast Day.

New DGS Report on Lewes-Rehoboth Beach Area

By A. S. Andres

The DGS released a new publication on water resources for the Lewes-Rehoboth Beach area of Delaware. Report of Investigations No. 65 is entitled "Wellhead Protection Area Delineations for the Lewes-Rehoboth Beach Area, Delaware." The publication presents the results of research by A. Scott Andres, Cheryl A. Duffy, and Evan M. Costas.

In Delaware, wellhead protection areas (WHPAs) are the land areas through which water enters the ground and moves to water supply wells within a 5-year time frame. The WHPAs were delineated with digital ground-water flow simulation and geographic information systems software that incorporated complex aquifer and boundary geometries, spatially variable recharge, particle tracking, and sensitivity analyses. The resultant WHPAs for nine wellfields for the Lewes-Rehoboth Beach area cover 1.4 square miles.

The results of this work are crucial to the development, management, and protection of ground-water resources used for public water supplies by the City of Lewes, City of Rehoboth Beach, and Tidewater Utilities in this environmentally sensitive area that is

undergoing rapid development.

The project was developed in cooperation with the Delaware Department of Natural Resources and Environmental Control, Division of Water Resources, and supports their Source Water Protection Program. Source water protection plans provide state, county, and local officials, and utility operators with information to assess contamination risks to their wells and to develop means to minimize those risks.

The report is available as a downloadable product from the DGS Web site at www.udel.edu/dgs under Publications. Printed copies may be requested by contacting the Survey at (302) 831-2833, via email at delgeosurvey@udel.edu, or by visiting the DGS office at the University of Delaware.

Earthquake near Newark

By S. J. Baxter

On August 13, seismographs located at the DGS recorded a small earthquake in the Newark area. The magnitude 1.7 event occurred at 5:46 p.m. EDT. The earthquake is the first to occur in Delaware since four small earthquakes occurred in the Wilmington area in 1998. The Survey received several phone calls or "felt reports" primarily from people on Main Street in Newark at the time of the event. Most reported hearing a loud, sharp bang; a few others reported hearing a boom or rumble.

On August 26, the DGS recorded a regional earthquake on two of our seismographs located in northern New Castle County. According to Lamont-Doherty Earth Observatory of Columbia University, the 3.5-magnitude event occurred at 2:24:18 p.m. EDT. The epicenter was located approximately 65 miles north of Wilmington, Delaware, and about 17 miles east of Allentown, Pennsylvania. Slight damage was reported in both Riegelsville, Pennsylvania and Milford, New Jersey. One Delaware resident called the DGS and reported feeling the tremor.

The DGS operates a five-station seismograph network in Delaware. Three stations are located in northern New Castle County, and one each in Kent and Sussex counties. Most earthquakes in northern Delaware have been too small to be felt but are recorded by sensitive seismometers. The largest instrumentally recorded event was a 3.8 magnitude earthquake in Wilmington on February 28, 1973.

If you would like to learn more about earthquakes, the DGS has two publications available on their website. They are Open File Report No. 42, "Catalog of Earthquakes in Delaware," and Special Publication No. 23, "Earthquake Basics." These publications can be downloaded from the DGS website at <http://www.udel.edu/dgs> under Publications.

The DGS Welcomes Three Limited Term Staff

The DGS welcomes three limited term researchers: Andrew D. Klingbeil, Matthew J. Martin, and John C. Watson.

Andrew is a limited term researcher with interests in coastal and marine geology, hydrogeology, and GIS. His work will focus on investigating the hydrologic properties and geometry of the surficial (Columbia) aquifer in eastern Sussex County, Delaware, to aid modelers in the delineation of wellhead protection areas for public supply wells. Project goals include a final report that will include a GIS-ready, 30-meter digital elevation model (DEM) depicting the base of the Columbia aquifer and a 90-meter grid of its transmissivity estimated from field measurements.

Matthew is a limited term project geologist with interests in GIS, hydrologic mapping and medical geography. Matt's work at the DGS is focused on completing a water-table elevation model for the Inland Bays watershed in Sussex County and application of those methodologies and procedures to mapping the water table for the entire state of Delaware. The primary goal of this project is to produce more accurate and cost effective water-table elevation maps, in the form of 30-meter resolution DEM of the water table under dry, normal, and wet conditions for engineering, hydrogeologic, environmental management, and regulatory applications.

John is also a limited term project geologist with interests in GIS, geologic mapping, and GPS. John was hired by the DGS to provide GIS and mapping support to the State Geologic Mapping Project. His primary responsibilities are to query data and examine site locations to find the best possible sites to drill for geologic data and samples. He uses GPS equipment to accurately record the location of each drill site, and helps record the data

in the Oracle database. The data John helps collect are used to map the surficial geology of Delaware.

Publications

Recent DGS Publications

Report of Investigations

No. 65, Wellhead Protection Area Delineations for the Lewes-Rehoboth Beach Area, Delaware, A. Scott Andres, Cheryl A. Duffy, and Evan M. Costas.

Staff Notes

Presentations

A. Scott Andres, "Transport of P and N in Four Small Coastal Plain Watersheds of Delaware", SERA-17-Phosphorus Working Group annual meeting, June 26; "Groundwater Recharge Mapping for Protection of Water Resources," Delaware Policy Forum Conference on Land Use Change and Water Quality, University of Delaware, October 2; "State of Delaware Initiatives in Internet Ground-Water Data," with J. H. Callahan of Research Data Management Services, National Ground Water Association annual conference, December 9.

Richard N. Benson, "Gulf of California Radiolaria on the Web," 10th meeting of International Association of Radiolarian Paleontologists, University of Lausanne, September 8-12.

Peter P. McLaughlin, Jr., "Life as a Geologist at a Geological Survey," Department of Geological Sciences, Rutgers University, October 2; participated in a workshop sponsored by the U. S. Geological Survey and the International Continental Drilling Program, "Deep Drilling in the Central Crater of the Chesapeake Bay Impact Structure," September 22-24, and presented a poster, "Neogene Sequences from the East-

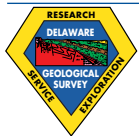
Central Delmarva Peninsula: Results from Drilling at Bethany Beach, Delaware," with K. G. Miller and J. V. Browning of Rutgers University, and **R. N. Benson**; organized and convened a technical session, "Micropaleontology and Palynology of the Atlantic and Gulf Coastal Plains of North America," 2003 joint meeting of the American Association of Stratigraphic Palynologists, Canadian Association of Palynologists, and the North American Micropaleontological Section of SEPM, October 5, and presented two papers, "Application of biostratigraphy to aquifer geology problems: A review of the Cretaceous and Miocene of Delaware and New Jersey, Middle Atlantic Coastal Plain, USA," with P. J. Sugarman, K. G. Miller, **R. N. Benson**, J. V. Browning, and G. J. Brenner; and "Cretaceous to Neogene chronology of sequences in the middle Atlantic Coastal Plain: new constraints from down dip drilling," K. G. Miller, P. J. Sugarman, J. V. Browning, **P. P. McLaughlin**, R. K. Olsson, and S. F. Pekar.

Thomas E. McKenna, "Thermal Imaging of Ground-Water Discharge in Delaware's Inland Bays," College of Marine Studies Oceanography Seminar, University of Delaware, September 23.

Service and Awards

Congratulations to **Lillian T. Wang** and **Peter P. McLaughlin, Jr.**, for 5 years of service at the Delaware Geological Survey.

Congratulations to **William S. Schenck**, Richard Sacher, Christina Callahan, and John Callahan, IT User Services/RDMS unit at the University of Delaware; and Mike Mahaffie, Delaware Office of State Planning Coordination, recipients of the John Wesley Powell Award from the U. S. Geological Survey on September 25 at a ceremony at USGS headquarters in Reston, Virginia (see accompanying story).



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