

First State Geology

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

Published twice yearly by the Delaware Geological Survey
University of Delaware



Vol. 26, No. 2 • Summer 2008

Rapid Infiltration Basin Systems in Delaware— Current Status

By A. Scott Andres

For a number of reasons, developers of many planned subdivisions are proposing to use rapid infiltration basin systems (RIBS) for waste-water disposal. In January, 2006, DNREC recommended new large-system siting and design criteria that included RIBS. Although RIBS have been used for waste-water disposal and groundwater recharge for many years in arid areas, systematic evaluation of the use of RIBS for waste-water disposal in Delaware has not been done.

There are numerous reasons to be concerned with the use of large-sized RIBS in Delaware. There are several RIBS in the region that have had significant operational problems. The operational problems were expensive to correct and required costly ongoing maintenance. Water contamination from RIBS is a key concern in Delaware because of the use of the shallow Columbia aquifer for water supply and the rapid flow and intimate connection between the Columbia aquifer and bodies of surface water.

For these reasons a multi-pronged, multi-agency study is being conducted to collect the information needed to evaluate the potential benefits and risks associated with using RIBS technology within the state of Delaware. Primary funding for the study is being provided by the Delaware Department of Natural Resources and Environmental Control (DNREC), the DGS, and the University of Delaware Water Resources Center, State Water Resources Institute.

The study team includes DGS staff members A. Scott Andres, Muserref Turkmen, Edward Walther, Changming He, and Steve McCreary; Department of Bioresources Engineering faculty members Stacey Chirnside and William Ritter; and Department of Civil and Environmental Engineering fac-

ulty member Paul Imhoff. Other University personnel who will be participating in the study over the next year include College of Marine and Earth Studies faculty members William Ullman and Holly Michaels and Department of Bioresources Engineering faculty member Ian McCann. To date, there have been a number of undergraduate student participants including Marie Rivers, Janine Howard, Ashley Beers, and Nate Maier. Graduate fellow Maryam Akhavan joined the project team in February 2008.

Study results will allow us to recommend needed waste-water effluent limits and field techniques for permitting and monitoring future proposed RIBS. An assessment of existing tools and methods for simulating RIBS at both site and larger scales is a parallel and equally important effort being conducted at the University of Delaware. Current practices for designing, permitting, and environmental compliance monitoring in Delaware will be improved by evaluating the implications of state and site-specific hydrogeologic conditions on the operation and performance of RIBS.

The project staff has completed a draft report covering assessments of 61 treatment plants that discharge to RIBS in Delaware, New Jersey, Massachusetts, and North Carolina, comparing RIBS

regulations and permitting requirements in multiple states, and documenting results of site visits to RIBS in Delaware and New Jersey. This report is currently under review at DNREC.

Extensive field monitoring efforts are underway at a RIBS facility at Cape Henlopen State Park. Field work includes soil and sediment sampling and analysis, installing and sampling monitoring wells for



Staff members (from left) Hilary Gittings Trethewey, Liz Wolff, and Muserref Turkmen measuring pH and specific conductance of treated waste-water effluent at the Landis Sewage Authority, near Vineland, New Jersey.

water levels and water quality, sampling surface waters, conducting geophysical logging, measuring moisture in the vadose zone, and testing aquifer hydraulics.



RIB at Southwood Acres (Kent County) with treated effluent during infiltration cycle.

New Report Summarizes Research on Deep Cores from Bethany Beach

By Peter P. McLaughlin, Jr.

A new Delaware Geological Survey report summarizes the results of geological investigations conducted on a 1,470-ft-deep research borehole drilled at Bethany Beach, Delaware in May and June, 2000. The objective of the project, a cooperative effort of the Delaware Geological Survey, the Rutgers University Department of Geology, and the U.S Geological Survey, was to obtain a continuous record of the sediments that underlie coastal Sussex County in order to better understand the geological history of the area and the geological characteristics of deep aquifers.

To develop a solid understanding of underground geology and ground-water resources, geologists use data obtained by drilling. A specialized drilling method called wireline coring can obtain relatively complete cylindrical samples of subsurface sediments, usually in intervals 5 or 10 feet long and 2-3 inches in diameter. For this project, the goal of the drilling operations was to obtain the first deep, continuous record of underground geology for this part of the Delaware coastal region. A nearly complete record was obtained of sediments ranging from thousands of years old near the surface (Pleistocene) to approximately

30 million years old (Oligocene) at nearly 1,500 ft depth. In addition, wireline geophysical logs were run in the borehole to obtain a continuous record of the electrical (resistivity), nuclear (gamma ray), and acoustical (sonic) characteristics of the formations penetrated by the drilling.

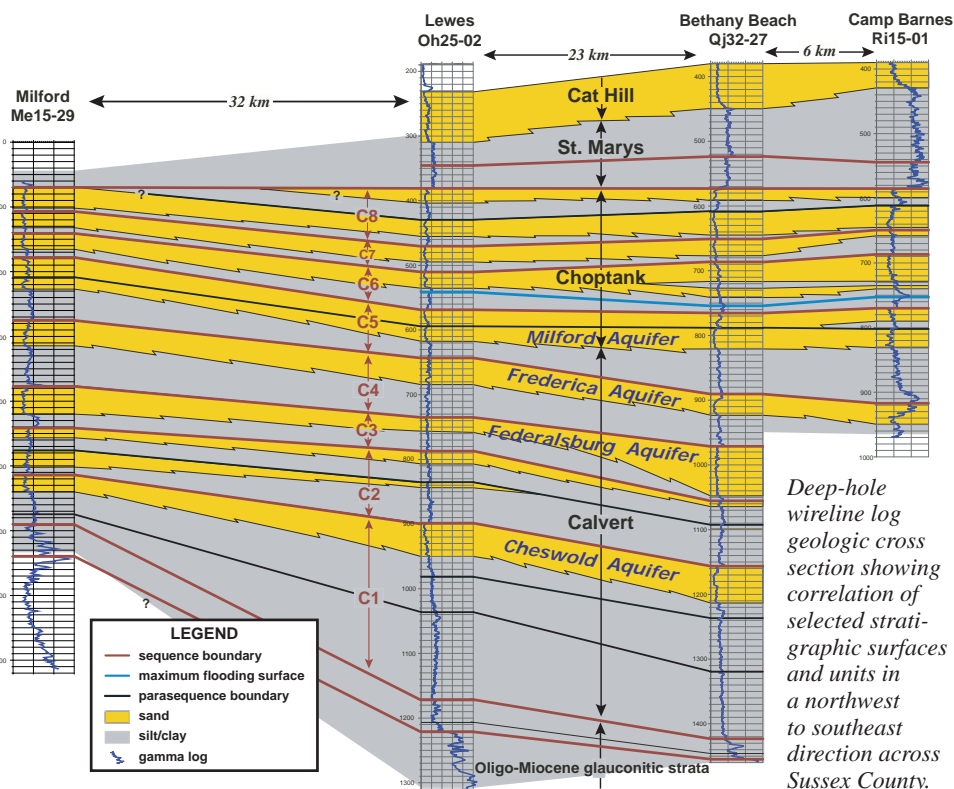
Since this research hole was completed, the project research group has conducted a multidisciplinary suite of analyses of the cores. All cores were redescribed in detail in the laboratory. Subsamples were analyzed for microfossil content (foraminifera, pollen, dinoflagellates, diatoms, radiolaria, calcareous nannofossils) at the DGS and Rutgers to help interpret the age and environment of the sediments. Strontium isotope ratios were determined at Rutgers University to estimate the ages of the formations.

The resulting report includes a detailed characterization of the lithologies, ages, and environments of the formations that underlie Bethany Beach, making it a valuable reference section for the subsurface geology of eastern Sussex County. The cores indicate that the Bethany Beach area evolved through geologic time from an area of muddy, offshore, sea-bottom sediments (30 to 25 million years ago) to progressively shallower-water coastal sediments (25 to approximately 5 million years ago) that record geologically rapid (1 to 2 million years long or less) rises and falls of sea level.

The results of this project also document the sequence stratigraphy of the strata in this hole, a way of packaging sediments that reflects changes in sea level and subsidence, thus helping geologists to clarify the origins of and geologic controls on deposition of these formations. In most of the Miocene (25 to 5 million year old) sediments, sequence boundaries can be located based on changes from shallowing to deepening environmental patterns, with the shallowing-upward packages tending to be thicker. Many of the sequence boundaries show evidence of exposure or non-deposition at an unconformity, reflecting sea-level falls that left former sea-bottom sediments exposed as dry land.

Most importantly for local residents, the improved understanding of subsurface geology and correlations help us better understand the deep confined aquifers of coastal Sussex County. Sand units are identified in the deep (>700 ft) part of the hole that correspond to the Cheswold, Federalsburg, Frederica, and Milford confined aquifers, (water-bearing formations) all of which are important ground-water sources used for public, domestic, agricultural, and industrial supplies further north in northern Sussex County and Kent County. In the shallower part of the hole (<500 ft), sand units are identified that are locally referred to as the Manokin and Pocomoke aquifers that provide most water used in the areas between Fenwick Island and Indian River Inlet. The geological characteristics of these intervals suggest that the deeper four aquifer intervals are more laterally continuous near-shore sand bodies and that the shallower Manokin and Pocomoke aquifers are more complex units that occur in an interval of interfingering nearshore to estuarine deposits.

The results of this work are being released as DGS Report of Investigations No. 75, "Stratigraphy and Correlation of the Oligocene to Pleistocene Section at Bethany Beach, Delaware" by Peter P. McLaughlin (DGS), Kenneth G. Miller and James V. Browning (Rutgers University), Kelvin W. Ramsey, Richard N. Benson and Jaime L. Tomlinson (DGS), and Peter J. Sugarman of the New Jersey Geological Survey. This report is available as a pdf from the DGS web site at <http://www.dgs.udel.edu/publications>. Printed copies will be available in the fall. Additional information can be found by contacting the Survey at (302) 831-2833 or via email at delgeo-survey@udel.edu.



DGS Welcomes John A. Callahan

By William S. Schenck

John A. Callahan, of Newark, Delaware, joined the DGS staff in February as a GIS Web Application Specialist/Research Associate III and is responsible for the continued development of the web-associated services of the Delaware Data Mapping and Integration Laboratory (DataMIL) and DGS web and data-specific applications.

John's previous employment included work as Applications Scientist at Earth Satellite Corporation, GIS Consultant/Applications Developer for Environmental Systems Research Institute, and most recently as Information Resource Consultant III at the University of Delaware Research and Data Management Services.

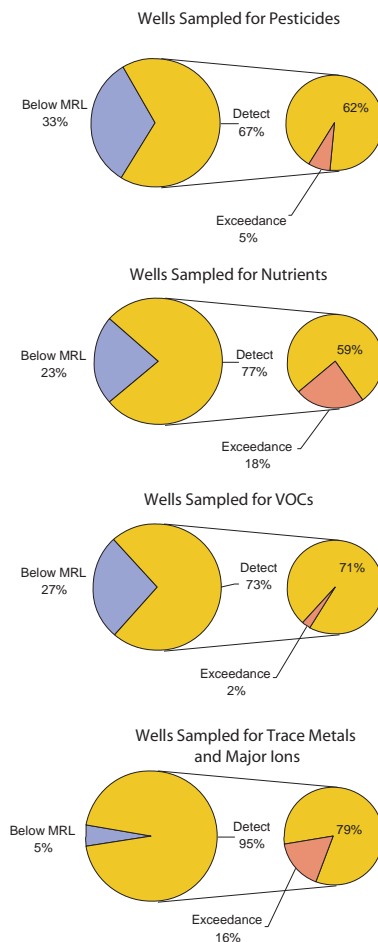
John received B.S degrees in Mathematics and Physics from Temple University in 1994 and is currently finishing his Master of Science in Geography here at the University of Delaware. John is actively involved with the GIS communities within the University and the state and his interests include GIS, spatial analysis and remote sensing, climatology and physical geography, environmental science, internet applications, and the content management and software development for those applications.

We welcome John to the DGS and look forward to his invaluable support for our research, service, and exploration efforts related to geologic, hydrologic, and natural hazard investigations that the DGS conducts throughout Delaware and making those data readily accessible for everyone's use through the DGS web site.

DGS Issues Report on Domestic Well Water-Quality Survey

By A. Scott Andres

The DGS released a new technical report entitled Results of the Domestic Well Water-Quality Study. This report was prepared by DGS staff members Vincent Pellerito, Mark Neimeister, Elizabeth Wolff, and A. Scott Andres and was conducted at the request of the Environmental Subcommittee of the Delaware Cancer Consortium and Delaware Division of Public Health. There was a sense of a public concern that domestic well water may be a contributing cause of the higher incidence rates of certain types of cancers in Delaware. Furthermore, a common perception has been that



Summary charts of detection and exceedance proportions for sampled wells in terms of contaminant classes. Below MRL refers to non-detections as they represent analyses of contaminants that were not detected above the laboratory minimum reporting limit. Nutrient analysis results include nitrate-nitrogen, nitrite-nitrogen, nitrite plus nitrate-nitrogen and ammonia.

Delaware ground water is of questionable quality because of a high concentration of polluting industries, agricultural pesticide use, and inadequate public sewage treatment facilities.

Open File Report No. 48 documents the technical aspects of an intensive survey, review, and analysis of existing groundwater quality data of samples collected from shallow (<100 ft deep) domestic and small (serving <100 customers) public wells, which were obtained by a number of state and federal agencies. Known and potential sources of ground-water contamination were catalogued and categorized. The risks the sites pose to water-supply wells were ranked through the use of a conservative contaminant transport model. A small number of domestic wells (1 to 2 percent) are located in areas of significant risk; however because wells in these risk zones have been sampled during DNREC-mandated studies, it is unlikely that residents in these areas are consuming contaminated water.

Contaminants were frequently found at concentrations much below maximum contaminant levels or health-based screening levels. The exceedance rate is similar to that found in national surveys. The detection rate of volatile organic compounds (VOCs) in Delaware is higher than in national surveys. The types of contaminants found in wells are consistent with the land use and land cover of the areas contributing water to the wells. For example, VOCs are most commonly associated with urban/suburban land use, and pesticides and nitrates are most commonly associated with agricultural land use. This also is consistent with national trends.

The report provides information that will be useful in guiding anticipated growth and economic development and developing and protecting water resources. The report is part of the Delaware Geological Survey's ongoing mission to understand hydrologic systems and to advise, inform, and educate Delawareans about the results of such investigations for use in such topics as water resources, agriculture, economic development, land-use planning, environmental protection, mineral resources, and recreation.

Open File Report No. 48 is available as a pdf from the DGS web site at <http://www.dgs.udel.edu/publications>. Additional information can be found by contacting the Survey at (302) 831-2833 or via email at delgeosurvey@udel.edu.

DGS Joins College of Marine and Earth Studies at UD

Excerpted from UDaily, July 1, 2008

DGS, which was created in 1951 by an act of the General Assembly, is a state agency that has been administratively assigned to the University of Delaware since its inception. On July 1, it became formally affiliated with the College of Marine and Earth Studies (CMES).

DGS will retain its autonomy, but the new arrangement will build on an already strong relationship with CMES. DGS scientists have teamed up with faculty across the college for numerous projects. Additionally, several DGS employees have secondary appointments with the Department of Geological Sciences.

The new formal partnership will create opportunities for additional collaborative work between DGS and CMES researchers.

Publications Open File Reports

No. 48, Results of the Domestic Well Water-Quality Study: Vincent Pellerito, Mark P. Neimeister, Elizabeth Wolff, and **A. Scott Andres**, 50 p.

No. 49, Ground-Water Availability in Southern New Castle County: Bailey L. Dugan, Mark P. Neimeister, and **A. Scott Andres**, 19 p. and 3 plates.

Staff Notes Presentations

A. Scott Andres, "Evaluation of Rapid Infiltration Basin Systems (RIBS) for Delaware," Source Water Assessment and Protection Program, Citizens Technical Advisory Committee, Dover, March 26; also moderator and organizer for session "Towards a National Ground Water Monitoring Network," at the National Ground Water Association Annual Summit, Memphis, March 31-April 4; with William Ullman, College of Marine and Earth Studies, "N and P Transport: Processes in a Mid-Atlantic Coastal Plain Watershed," and, with Charles Job, U.S. EPA, "Progress Report from the Advisory Committee on Water Information, Subcommittee on Ground Water, Data Standards, Data Management Work Group," National Water Quality Monitoring Conference, in Atlantic City, May 20; with **Thomas E. McKenna**, and **Changming He**, "Monitoring Water Resources and Water Availability Planning for Sustainable Future Water

Supplies South of the C&D Canal," Governor's Water Supply Coordinating Council, Dover, June 12.

John A. Callahan, "Introduction to Drupal," Delaware Web Developers Group, Feb 20; "DataMIL: A Look Forward Toward Community Bulding," Delaware Geographic Data Committee, April 4; "Campus Mapping Initiative," University of Delaware Delaware Web Developers Group, June 26; "Introduction to Quantum GIS," UD administrative offices OCM and OEVP, June 18; "The New UD Drupal User Community Web Site," UDrupal Delaware Web Developers Group, July 3.

Peter P. McLaughlin, Jr. and **Jaime L. Tomlinson**, "Sussex County Ground-Water Availability Study," Source Water Assessment & Protection Program, Citizens Technical Advisory Council, Dover, Mar. 26.

John H. Talley, "Summary of Water Conditions in Delaware," at the Delaware State Golf Association, Dover, Feb. 19, and represented Delaware at the Outer Continental Shelf Policy Committee Meeting, Herndon, Mar. 5-6. Talley chairs the OCS Hard Minerals Subcommittee; "Historical Exploration for Energy Resources in Delaware," at the Southeast U.S. Mesozoic Basins Energy Resources Potential Workshop, Charlottesville, May 13-14.

Lillian T. Wang, "Publishing Surficial Geologic Maps of Delaware," Delaware GIS 2008: A Spatial Network Conference, Dover, April 23.

Service and Awards

Congratulations to **Karen D'Amato** for 20 years of service at the Delaware Geological Survey and the University of Delaware, and to **Kelvin W. Ramsey** and **P. Steven McCreary** for 20 years and 5 years of service, respectively, at the Delaware Geological Survey.

John A. Callahan, wrote and administered the exam for the Delaware Science Olympiad Remote Sensing Event, Division C, Delaware State University, March 15; worked with the UD Disaster Research Center to complete their online mapping tool: Puerto Rico Disaster Decision Support (DDS) Tool; served on the UD Content Management System (CMS) Committee; developed and currently runs the UDrupal web site to aid on the adoption of CMS technologies by UD; and is currently acting as a consultant to Office of Communication and Marketing (OCM) on the new UD web site development.

P. Steven McCreary helped organize and with **Charles T. Smith** actively participated in the Maryland-Delaware Children's Water Festival, Delaware Technical and Community College, Terry Campus, May 8.

William S. Schenck represented the Delaware Board of Geology at the National Association of State Boards of Geology, Cody, April 3-4.



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Newark, DE 19716-7501

First State Geology is published by the Delaware Geological Survey, a State agency established by an Act of the Delaware General Assembly in 1951 and organized as a unit of the University of Delaware.

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