First State Geology

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

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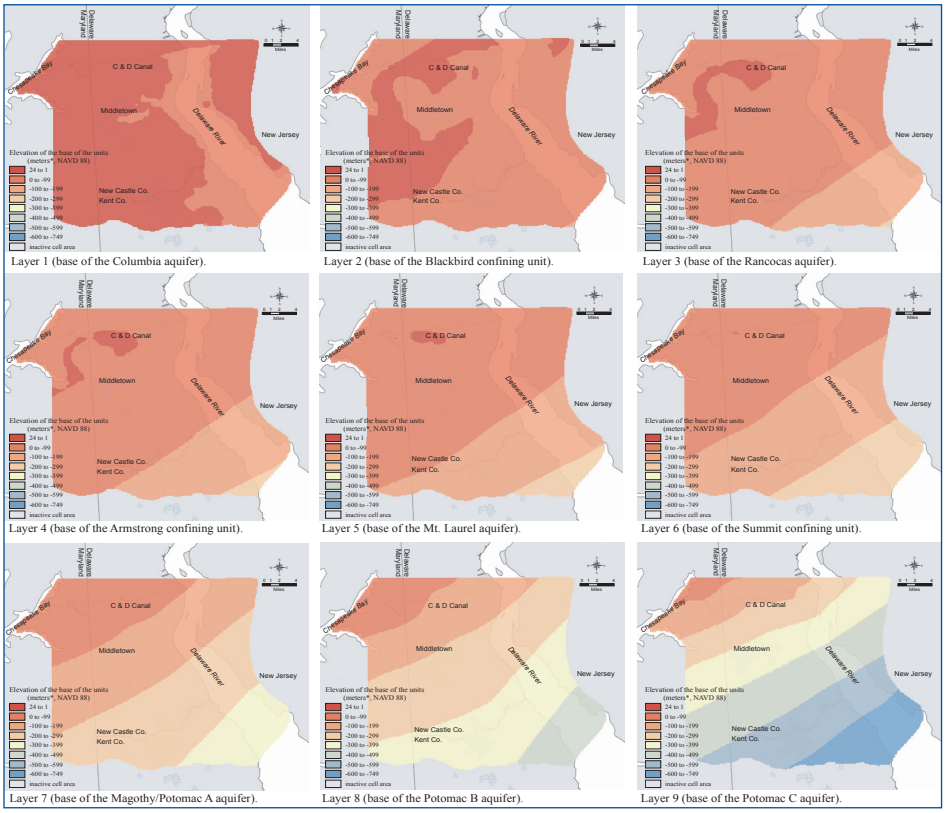
Report of Investigations No. 77: Simulation of Groundwater Flow in Southern New Castle County

By Changming He and A. Scott Andres

To understand the effects of projected increased demands on groundwater to supply water, a finite-difference, steady-state, groundwater flow model was used to simulate groundwater flow in the Coastal Plain sediments of southern New Castle County, Delaware. The model simulates flow in the Columbia (water table), Rancocas, Mt. Laurel, combined Magothy/Potomac A, Potomac B, and Potomac C aquifers, and intervening confining beds. Although the model domain extended north of the Chesapeake and Delaware Canal, south into northern Kent County, east into New Jersey, and west into Maryland, the model focused on the area between the Chesapeake and Delaware Canal, the Delaware River, and the Maryland-Delaware border. Boundary conditions for these areas were derived from modeling studies completed by others over the past 10 years.

The calibrated model successfully simulated groundwater flow directions in the Rancocas and Mt. Laurel aquifers that were expected from the conceptual model. Flow patterns in the Rancocas and Mt. Laurel aquifers are towards local streams, similar to flow directions in the Columbia (water table) aquifer in locations where these aquifers are in close hydraulic connection.

Results of water-budget calculations and predicted head differences between aquifers indicated significant flow between the Rancocas, Mt. Laurel, and Columbia aquifers, especially in updip areas where the confining unit between the aquifers is thin. Farther to the south, where confining units between the Rancocas, Mt. Laurel, and Columbia aquifers are thicker, flow paths and water budget calculations indicated that flow is toward the Delaware River, a regional hydrologic boundary.



Elevations of the aquifers and confining units. Generally speaking, the elevation of the base of a layer is shallowest in the northwest and deepest in the southeast.

The model predicted head patterns in the Magothy/Potomac A, Potomac B, and Potomac C aquifers that are similar to those in previous modeling studies. Pumping in the Magothy/Potomac A aquifer from wells located in southern New Castle County has lowered heads and is directing flow to the pumping center near Delaware City. Pumping from wells in the Potomac B and Potomac C aquifers in New Castle County north of the C&D Canal has lowered heads in these aquifers both north and south of the canal and caused flow to be directed north toward northern New Castle County pumping centers.

Compilation and review of data used for model input revealed major gaps in hydraulic properties, pumping, aquifer and confining bed geometry, and water-level data. The model is a useful tool for understanding hydrologic processes within the study area such as horizontal and vertical flow directions and response of aquifers to pumping, but significant data gaps preclude its use for detailed analysis for water resources management including estimating flow rates between Delaware and adjacent states. The investigation indicated a critical need for additional information required to support planning of future water supplies and wastewater disposal, and management of water-dependent environmental resources. Recommendations for improving our understanding of groundwater availability are presented in the report.

Report of Investigations No. 77 "Simulation of Groundwater Flow in Southern New Castle County, Delaware" is available as a PDF from the DGS website at www.dgs.udel.edu/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.

In Memory of Dr. Johan J. Groot

Former State Geologist and Director of the Delaware Geological Survey, Dr. Johan J. Groot, passed away on September 28, 2009 at the age of 90 in Chestertown, Maryland. He was the first director and

Dr. John J. Groot

state geologist of the second Delaware Geological Survey. The Survey started its investigations in July 1951 at the University of Delaware with Dr. Groot as State Geologist and Lecturer. He later became Professor of Geology and upon his retirement, Professor Emeritus. Under his leadership and guidance, the Department of Geology grew out of the Survey, and in 1956 Dr. Groot was appointed to the chairmanship of the Department of Geology while still serving as state geologist and director. Both the Survey and the Department grew significantly under his leadership. In 1969 the separate positions of state geologist and chairman of the Department of Geology were created when Dr. Groot left the Survey.

Dr. Groot authored or coauthored many Survey publications that provided an initial understanding of the geology, water resources, and natural resources in Delaware. These reports established the importance of the work of the Survey; a science-based, public-service driven organization, and provided the foundation for more detailed investigations as well as a path to the future.

Dr. Groot left the Survey in 1969 and joined the United Nations in Bolivia where he served for five years investigating groundwater resources. He later worked for the FAO on groundwater projects in the Lake Chad Basin and conducted hydrogeological investigations in the Arabian Peninsula. He also consulted in Nigeria, Cameroon, and Niger. Following his retirement from the UN he returned to Newark, Del. and began working at the DGS once again around 1982. He officially retired from the Survey and University of Delaware in January 1992.

He continued to serve the DGS as a volunteer authoring or coauthoring nine additional publications. His work on stratigraphy utilizing pollen contributed significantly to our understanding of the geologic history of Delaware. Dr. Groot's mentoring of junior staff and sharing of ideas and experiences will have a lasting impact on them.

In Memory of Kenneth D. Woodruff

Kenneth D. Woodruff, former associate director of the Delaware Geological Survey, passed away on December 22, 2009 at the age of 73 in Scranton, Pennsylvania.

Ken retired from the DGS in 1992 after more than 25 years of distinguished service, the last 14 as associate director for hydrology and geophysics. His research spanned surface water, groundwater, and geothermal hydrology; gravity, magnetic, seismic, and borehole geophysics; seismic, radon, and pollution hazards; and hydrologic, geologic, and subsurface mapping. He was an administrator, advisor, inventor, and teacher. The scope and volume of Ken's efforts were truly remarkable. The results of his work resulted in more than 30 publications of the DGS alone, as well as in innumerable committee reports, memoranda, and advisories.

Kenneth D. Woodruff

Ken was an outdoor and nature enthusiast who loved fishing, hiking, and bird watching. His abilities, willingness, and modesty earned the respect and gratitude of colleagues and the people of Delaware he served so well.

DGS Unveils New Website and Web-Mapping Services

By John A. Callahan

A new version of the DGS web site and new web-mapping services are available at www.dgs.udel.edu. Many of the new technologies used in the development of the site are consistent with modern web standards. Emphasis was placed on the delivery and retrieval of geologic and hydrologic information considered most useful to our stakeholders. This information is relied upon heavily by other state agencies, federal agencies, private consultants, academic institutions, and the general public, and is presented in numerous formats including reports, digital datasets, online services, and web applications.

The web site is designed to encourage exploring and browsing content rather than the more traditional method of searching for specific terms, although a user can use both methods to locate information. Seemingly disparate information is linked together through a common set of place names and topical keywords, also known as tagging, making it easy for people to "jump" to different parts of the site. Along with keyword tagging, this is done using dynamic menus and interactive exhibits using faceted filtering. The site also maintains a central RSS news feed.

In addition to the web site, DGS released web-mapping services for many of its digital data offerings. Web-map services are a way for users to visualize the data on a map without actually downloading any files. The look and style of the map maintains the symbology as close to the published map version as possible. The site currently serves 14 digital data sets as web-map services, including surficial geologic maps published since January 2001.

All of the DGS map services support the open Web Map Service (WMS) protocol. WMS-based mapping services provide a

standard, well-defined, open architecture and are supported in nearly all GIS packages, such as ArcGIS and Quantum GIS, as well as many spatial data viewers, such as Google Earth.

The new DGS web applications take advantage of several open source software packages. The web site is built upon the Drupal content management system and makes heavy use of the Simile Exhibit tool (e.g., the Publication and Staff web pages). Web-map services are generated by the MapServer mapping engine, a stable and powerful Internet map server.

Prototype Coastal Flood Monitoring System for Delaware

By John A. Callahan

The Delaware coastline has been affected by many great storms in its history, such as the Ash Wednesday storm in March of 1962 and, more recently, the Mother's Day storm on May 12, 2008, which affected communities along the Delaware Bay. These storms have led to loss of life and significant property damage. Much of the damage associated with these and other tropical and extra-tropical weather systems is associated with severe coastal flooding. The added concern of sea-level rise and its effect on the frequency and intensity of coastal flooding events, further emphasizes the need for a modern, dependable coastal flood monitoring system for Delaware's coastal communities.

With the potential for more damaging coastal storms in the future, the DGS and the Delaware Environmental Observing System (DEOS) developed a coastal flood monitoring system prototype, which was funded by the Delaware Department of Natural Resources and Environmental Control (DNREC) Coastal Programs section, the National Oceanic and Atmospheric Agency (NOAA), and the Delaware Experimental Program to Stimulate Competitive Research (EPSCoR). This system was built for six coastal communities in Kent County, Delaware (Leipsic, Little Creek, Pickering Beach, Kitts Hummock, Bowers Beach, Slaughter Beach).

This current system consists of two components. First, the system ingests water level predictions from the NOAA extra-tropical storm surge model made at Lewes, DE and Reedy Point, DE. These predictions are made for each hour, for 96 hours into the future, and are extended to other locations along Delaware's coastline. If a predicted water level reaches a critical value, subscribers will receive an alert (email and/or text message) notifying them of the height and predicted time of the occurrence.

The second component is a website that displays current and predicted water levels and a Google Maps-based potential flood inundation map for that community. Each subscriber alert contains a link directly to this web site. Options are available to map potential flood inundation levels up to 10 feet (using the NAVD88 vertical datum.). Data and a graph are provided showing future predicted water levels for the full 96 hours. The website also shows any current watches and warnings from the National Weather Service (NWS) and elevation profiles for relevant evacuation routes and primary roads in each of the coastal communities.

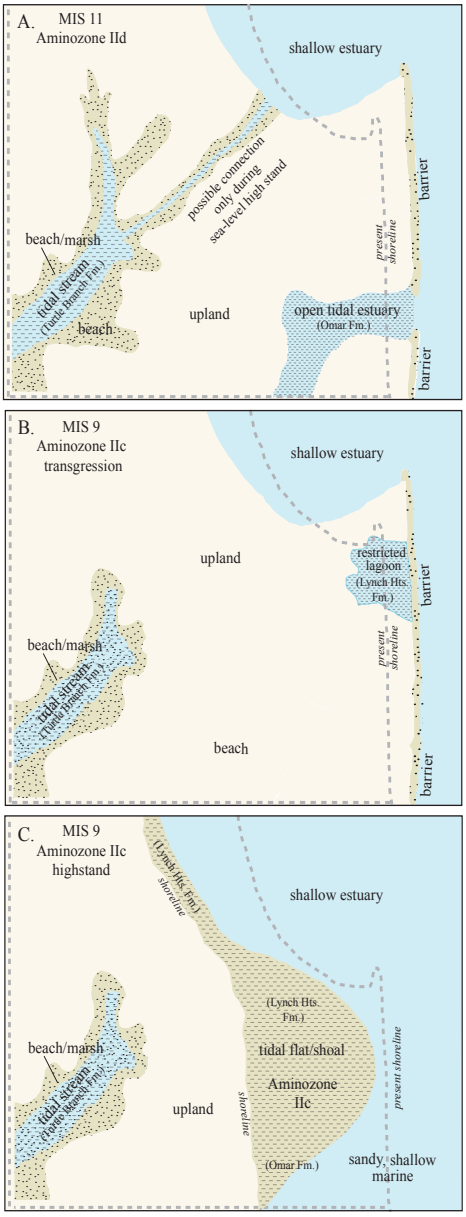
Through this project, Delaware Emergency Management Agency (DEMA) and other emergency management personnel throughout Kent County can be notified up to 4 days in advance of potential critically high water levels along the coastline.

Report on the Interglacial Sediments in Southern Delaware

By Kelvin W. Ramsey

The geologic history of southern Delaware has been related to the advancing and retreating of glaciers and the corresponeding fall and rise of sea level during the middle to late Pleistocene. DGS Report of Investigations No. 76, "Stratigraphy, Correlation, and Depositional Environments of the Middle to Late Pleistocene Interglacial Deposits of Southern Delaware" summarizes the geology of southern Delaware associated with sea-level rise (interglacials). Much like the recent rise of sea level over the last 10,000 years, the coastline of Delaware during the middle to late Pleistocene moved landward, and sediments were deposited in stream, swamp, marsh, coastline, and offshore environments.

Two formations, the Lynch Heights and the Scotts Corners, make up the Delaware Bay Group, which was deposited on the margins of ancestral Delaware Bay. Three formations, the Omar, Ironshire, and Sinepuxent, make up the Assawoman Bay Group, which was deposited in lagoons and along the coastline of the Atlantic



Conceptual models of deposition during (A) MIS 11 (older Lynch Heights, Omar, and Turtle Branch Formations); (B) MIS9 transgression (younger Lynch Heights, Omar, and Turtle Branch Formations; and (C) MIS 9 high stand (younger Lynch Heights, Omar, and Turtle Branch Formations). Transgressive environments (B) were much like that of today with lagoon and estuarine environments along the ancestral Atlantic Coast, shallow estuarine environments along the ancestral Delaware Bay coast, and tidal stream environments along the ancestral Nanticoke River tributary to an ancestral Chesapeake Bay. High-stand environments (A,C) included a sandy shoreline along the ancestral Atlantic and Delaware Bay coastlines, a shallow tidal connection between the shallow Delaware Bay estuary and the Nanticoke estuary and sandy shorelines along the Nanticoke tidal stream. The lagoons along the Atlantic and Delaware Bay shorelines (A,B) were completely filled with sediment and transgressed by the shoreline (C). Dashed line represents the present Delaware/Maryland state boundary and the Atlantic Coast.

Ocean. Two additional formations, the Turtle Branch (newly named and described in RI76) and the Kent Island, make up the Nanticoke River Group, which was deposited in stream and estuarine environments along the ancestral Nanticoke River Valley and its tributaries.

Four major periods of deposition that are recorded globally as Marine Isotope Stages (MIS) have been identified in these interglacial sediments. These are MIS 11 (367-440 kyrs BP) and 9 (297-347 kyrs BP) for the Lynch Heights, Omar, and Turtle Branch Formations and MIS 5e (113-128 kyrs BP) for a portion of the Scotts Corners, and the Ironshire and Kent Island Formations, and MIS 5a (71-85 kyrs BP) for a portion of the Scotts Corners Formation and the Sinepuxent Formation. Dating these units is based on amino acid racemization of shell material by Dr. John Wehmiller of the Department of Geological Sciences at the University of Delaware and relative stratigraphic position of the interglacial deposits.

Understanding of the Pleistocene formations provides models of coastline migration during times of sea level rise that can be applied to predicting coastline change related to the present rise of sea level. Ancient shorelines were landward of those at present when sea level was higher than that of today, and coastal environments migrated with the shoreline as sea level rose. In some cases, ancient lagoons were completely filled with sediment, and the shoreline migrated landward creating an open coast with shoreline bluffs now recognized as scarps (breaks in land surface topography) miles inland from the present coastline.

Report of Investigations 76 is available as a PDF from the DGS website at www.dgs.udel.edu/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.

DataMIL Gets a New Look

By John A. Callahan

The Delaware DataMIL (Data Mapping and Integration Laboratory) is a statewide online mapping and data distribution application for the State of Delaware (www.datamil.delaware.gov). DataMIL was released in April 2002 and since has primarily focused on serving as the official topographic maps for the State of Delaware, and mapping and distributing datasets of the Delaware Spatial Data Framework. The Delaware Spatial Data Framework consists of the essential digital spatial datasets (also called "base map" data) most commonly used for all types of mapping within the State, and include data such as roads, rivers and streams, land use, elevation contours, and aerial photography. These are used on a daily basis by state, county, and local agencies as well as by planners, developers, realtors, environmental and engineering consultants, and the general public.

DGS has significantly revised DataMIL to make it easier for users to find and download datasets they need. Most importantly, every dataset in the DataMIL Catalog has complete metadata, which describes the purpose of the data, spatial extents and coordinate system, horizontal or vertical accuracy notes, and more. The Catalog can easily be searched by major categories, location, and full text search. Within the Catalog, most datasets can be previewed before download. A "Preview Data in Map" button opens a dynamic map region with the chosen layers displayed. By adding multiple layers to this map, it may seem similar to the MapLab; however, its intent is for previewing and does not allow interaction with the features within each layer.

GIS-ready data files can also be downloaded for nearly all data in DataMIL. For most vector-based datasets (points, lines, and polygons), shapefiles covering the entire state can be downloaded next to each metadata entry. For larger raster-based datasets, such as aerial photography, the "Tiled Data Distribution" feature must be used. This feature allows users to download smaller subsections (1.7 x 1.7 km^2 tiles) through a Google Maps interface for easier data management and faster downloading times.

Remaining unchanged are the topographic map availability and the MapLab. Topographic maps are available, generated from the latest Delaware Framework data, for download as PDF files for each USGS quadrangle throughout the state. The MapLab allows users to visualize all of the datasets of the Delaware Framework as individual layers on the same map. These continue to be the very popular components of DataMIL.

In addition to full metadata descriptions, data download, and map display for all Delaware Framework layers, each dataset can be accessed via web map services. Mapping services are made available in both ArcIMS and OGC WMS (Web Map Service) formats. Instructions on how to access these web services are available on the DataMIL web site.

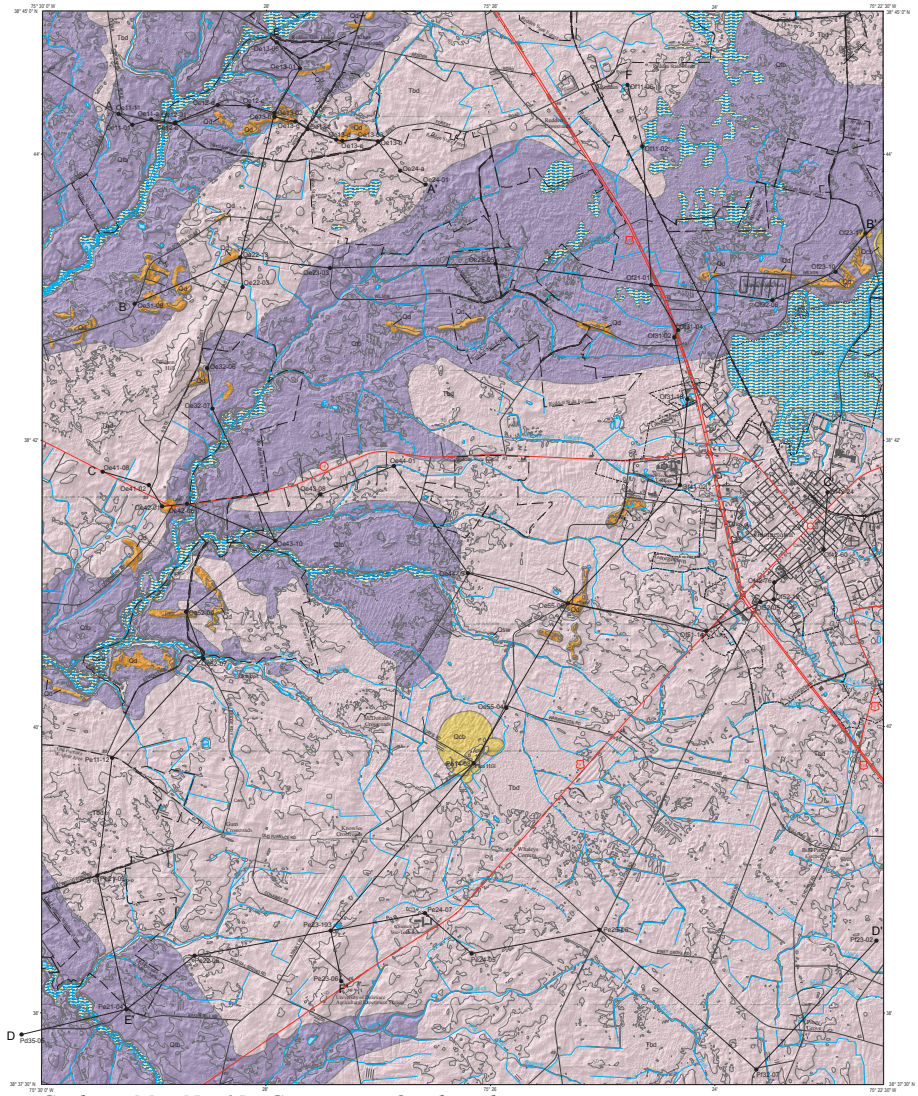
The new revision of DataMIL takes advantage of some free and open source (FOSS) web technologies. The DataMIL Catalog is built upon GeoNetwork (http://geonetwork-opensource.org/) and includes the built-in search functionality, GeoRSS feed, and dynamic mapping. All of the data downloads are compressed and archived using the 7-zip program - a program that is very similar to the popular Windows-based WinZip program, is multi-platform (Mac, Windows, Linux), and free. More information on GeoNetwork and 7-zip can be found on the DataMIL website.

Geologic Map No. 15: Georgetown Quadrangle

By Kelvin W. Ramsey

The geologic history of the surficial geologic units of the Georgetown Quadrangle is primarily that of deposition of the Beaverdam Formation and its subsequent modification by erosion and deposition of younger stratigraphic units. The age of the Beaverdam Formation is uncertain due to the lack of age-definitive fossils within the unit. Stratigraphic relationships in Delaware indicate that it is no older than late Miocene and no younger than early Pleistocene. Regional correlations based on similarities of depositional style, stratigraphic position, and sediment textures suggest that it is likely late Pliocene in age (3.5 - 2.6 million years ago); correlative with the Bacons Castle Formation of Virginia.

The land surface expression of the Beaverdam Formation in the Georgetown Quadrangle ranges from about 40 ft in elevation near stream valleys to about 50 ft in elevation away from the streams. Local variations in elevation of ±4 ft give the land surface a slightly hummocky appearance. The primary exception is a feature in the northwest section of the quadrangle called Wilson Hill, which rises about 14 ft above the surrounding landscape. Isolated high spots (hills) of Beaverdam Formation also have been observed east of Georgetown and west of Selbyville (Selbyville Quadrangle). No clear explanation of their origin is apparent.



Geologic Map No. 15 - Georgetown Quadrangle

The Turtle Branch Formation is found along the major stream valleys that cross the Georgetown Quadrangle. Its contact with the Beaverdam Formation at the land surface is marked by a subtle scarp with the surface of the Turtle Branch Formation being less than 40 ft and the surface of the Beaverdam Formation greater than 40 ft. There are many places, however, where there is no break in topography between the two units. The two units are readily differentiated by the recognition of the well-sorted, clean sands of the Turtle Branch Formation contrasted with the poorly sorted, silty to clayey sands of the Beaverdam Formation. At the contact between the two formations, the sands of the Turtle Branch Formation are siltier than elsewhere in the unit. The land surface of the Turtle Branch Formation is relatively flat, ranging from 34 ft near the edge of stream valleys to about 40 ft near its contact with the Beaverdam Formation. In the area of Redden State Forest east of Rt. 113, the otherwise flat surface of the Turtle Branch Formation ranges up to 45 ft in elevation and is interspersed with low areas that contain upland swamps.

Modern deposition in the map area is represented by swamp deposits along the present streams and on the uplands. Along Deep Creek, the stream swamps are now perched and drying out due to ditching, which has lowered the local water table by more than 10 ft, and much of the organic material has been or is being oxidized leaving behind a white to red silt or sand. Upland swamps consist of organic-rich sand and silty muck formed in areas where the water table is high and ponding has allowed accumulation and preservation of organic material. These upland swamps are best developed in Redden State Forest east of Rt. 113 and north of Georgetown in the vicinity of Savannah Ditch. Upland swamp deposits are mapped on lithology and distribution of swamps as delineated in the U.S. Geological Survey hydrography database. They do not necessarily conform to wetlands mapped on vegetation, soils, or other criteria.

The purpose of the map is to provide geologic information that can be used for determining such things as the geology of watersheds, recognition of the relationship between geology and regional environmental or land-use issues to support land-use and regulatory decision making, and identification of potential locations of sand and gravel resources. When used in conjunction with subsurface geologic information, the map can be used to aid in locating water supplies for public, domestic, agricultural, and industrial use, mapping groundwater recharge areas, and protecting ground- and surface-water resources in a rapidly growing area in Sussex County.

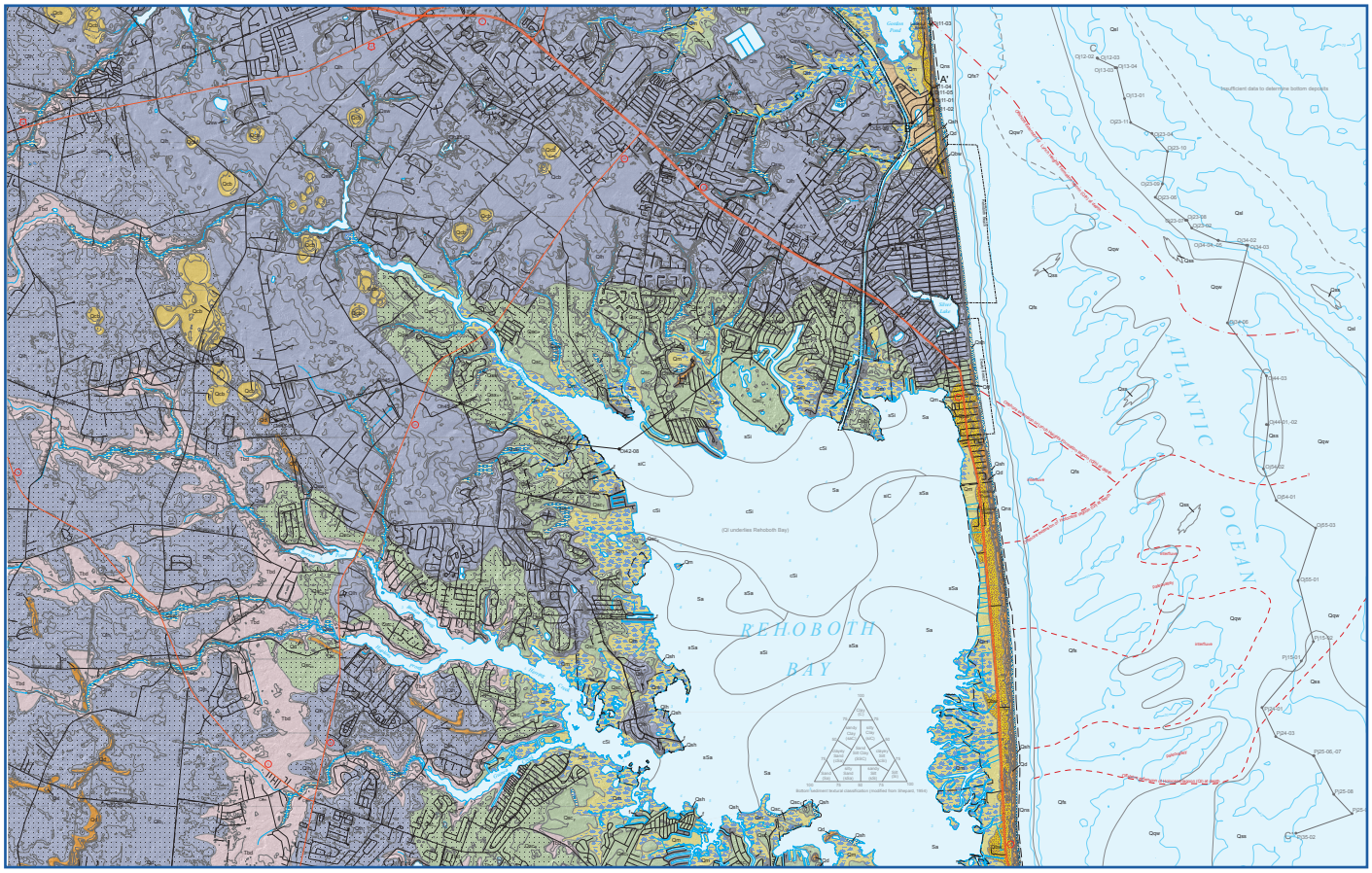
This geologic map is the result of funding by the Delaware Geological Survey and a grant from the Statemap Program of the U.S. Geological Survey and the Association of American State Geologists, and is available to view online or as a downloadable product from the DGS website at www.dgs.udel.edu/publications. Printed copies may be requested by contacting the DGS at (302) 831-2833 or via email at delgeosurvey@udel.edu.

Geologic Map No 16: Fairmount and Rehoboth Beach Quadrangles

By Kelvin W. Ramsey

Geologic Map Series No. 16 Geologic Map of the Fairmount and Rehoboth Beach Quadrangles is unique for a DGS map in that it includes both onshore and offshore geology. Onshore, the map shows the distribution of the Pliocene Beaverdam Formation and the Pleistocene Lynch Heights and Scotts Corners Formations. Bottom sediment textures are shown for Rehoboth Bay. Offshore in the Atlantic, geologic units are mapped out to about 4 miles and include a portion of Hen and Chickens Shoal.

The geologic history of the stratigraphic units found at the land surface begins with the deposition of the sands of the Beaverdam Formation in a fluvial to estuarine system. Throughout the Pleistocene, the Beaverdam Formation has been modified by erosion and deposition related to the changes in sea level associated with the advances and retreats of northern hemisphere glaciers. During the high stands of sea level when the glaciers were at their minima, estuarine deposition much like



Geologic Map No. 16 - Fairmount and Rehoboth Beach Quadrangles

that of the modern Rehoboth Bay occurred and is mapped as the Lynch Heights and Scotts Corners Formations. A lagoonal body of mud in the Lynch Heights Formation has been mapped north of the present Rehoboth Bay that extends from east of Cape Henlopen High School to underneath the town of Rehoboth Beach and offshore west of Hen and Chickens Shoal.

Modern deposition includes Rehoboth Bay and its tributaries, the barrier coastline, the southernmost portion of Cape Henlopen, and offshore. The succession of deposits related to Rehoboth Bay goes from freshwater swamp deposits in the upper reaches of the tributaries, which grade into the tidal streams, marshes, and lagoonal deposits.

Ninety-nine vibracores, most of which are 20 ft in depth below the sea floor, were used to map offshore deposits These deposits are the result of the rise of sea level during the latest Pleistocene to Holocene and are associated with the migration of the shoreline as sea level rose and deposits associated with the modern marine setting.

The extension of the margins of the paleovalleys filled with Lynch Heights Formation and Holocene lagoon deposits are shown offshore by red dashed lines. These lagoonal deposits are found beneath the surficial Holocene lithologic units. Interfluve areas within and between paleovalleys are topographic highs of Beaverdam Formation. The lagoonal bodies are differentiated from each other by the Holocene deposits being more sand than clay, and the Lynch Heights lagoon being compact silty clay.

This geologic map is the result of funding by the Delaware Geological Survey and a grant from the Statemap Program of the U.S. Geological Survey and the Association of American State Geologists. The offshore Atlantic geology is the result of core data obtained from the U.S. Army Corps of Engineers, Philadelphia District and the Delaware Department of Natural Resources and Environmental Control, and by funding from the Bureau of Ocean Energy Management, Regulation and Enforcement of the U.S. Department of the Interior.

Geologic Map Series No. 16 is available to view online or as a downloadable product from the DGS website at www.dgs.udel.edu/publications. Printed copies may be requested by contacting the DGS at (302) 831-2833 or via email at delgeosurvey@udel.edu.

Publications

Report of Investigations

No. 76, Stratigraphy, Correlation, and Depositional Environments of the Middle to Late Pleistocene Interglacial Deposits of Southern Delaware, **Kelvin W. Ramsey**, 43 p.

No. 77, Simulation of Groundwater Flow in Southern New Castle County, Delaware, **Changming He** and **A. Scott Andres**, 12 p., 2 plates.

Geologic Map Series

No. 15, Geologic Map of the Georgetown Quadrangle, Delaware, **Kelvin W. Ramsey**, scale 1:24:000.

No. 16, Geologic Map of the Fairmount and Rehoboth Beach Quadrangles, Delaware, **Kelvin W. Ramsey**, scale 1:24,000.

Staff Notes

Presentations

The following posters and presentations were presented by DGS staff at the University of Delaware's Geospatial Research Day held in the Trabant University Center, Newark, DE, Nov. 19, 2009: **A. Scott Andres**, "Visualization of Published DGS Hydro- and Geologic Geospatial Products;" **John C. Callahan**,

"The New Delaware DataMIL Demo," and "Opening Geospatial Information;" **Thomas E. McKenna**, "Watching the Tide Come In - Environmental Thermography and Hydrology," and "Thermal Infrared Imaging as a Tool for Investigating Natural Processes;" **William S. Schenck**, "DataMIL Topographic Maps;" **Edward F. Walther**, "Screening Areas for Rapid Infiltration Basin Systems Suitability through GIS Processing;" and **Lillian T. Wang**, "Geologic Map of Kent County, Delaware," and "Surficial Geologic Mapping of Delaware in GIS."

A. Scott Andres, "Agricultural Water Use in Delaware" and "Rapid Infiltration Basin Systems Research Introduction," Rural Water Association and Delaware Clean Water Advisory Council, Milford, DE, Nov. 18, 2009; with **Thomas E. McKenna**, and **Changming He**, "Integration of Groundwater Monitoring into Delaware's Water Resources Programs," 15th annual Maryland Water Monitoring Council Conference, North Linthicum, MD, Dec. 3, 2009; "Land Application of Wastewater" and participated in a panel discussion of land-use effects on water resources a forum sponsored by the Sussex County League of Women Voters, Georgetown, DE, Jan. 13, 2010; "Groundwater Resources and Ag Water Use in Delaware," irrigation session during Delaware Ag Week, Harrington, DE, Jan. 20, 2010; and with **Edward F. Walther**, "Development and Application of a GIS Screening Tool for Assessing Suitability of Land for Rapid Infiltration Basin Systems," **Andres** also participated in a panel discussion co-sponsored by the U.S. Subcommittee on Groundwater, "National Groundwater Monitoring Network: Listening Session," National Ground Water Association Summit, Denver, CO, Apr. 12-15, 2010. Also with **Edward F. Walther,** "Soil-Aquifer-Treatment in the mid-Atlantic - Is it Disposal or Reuse?" and M. Akhavan and P. T. Imhoff, "Disposing Treated Wastewater in Rapid Infiltration Basins: Simulations to Optimize Soil-Aquifer-Treatment," Sixth International Conference on Sustainable Water Environment, University of Delaware, July, 2010; invited presentation "Groundwater Quality in Delaware - Environmental Problems and Potential Solutions," University of Delaware CANR – Joint Workshop in the Agricultural and Environmental Sciences, University of Delaware College of Agriculture and Natural Resources, University of Pennsylvania New Bolton Center, and China Agricultural University College of Resources and Environmental Sciences, Aug. 19, 2010; "Modeling Hydrologic and Geochemical Aspects of Rapid Infiltrations Basins," with M. Akhavan, P. T. Imhoff, S. Finsterle, C. Gu, and F. Maggi, AGU Annual Meeting, San Francisco, CA, Dec. 15, 2010; "Submarine Groundwater Discharge to a Coastal Lagoon," Spring Seminar Series, Dept. of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA, Feb 4, 2011.

John A. Callahan, "Development of a GIS Database in a Marine Spatial Planning Context for Offshore Wind Power for Delaware;" with **A. Scott Andres**, "A Web-based Mapping System for the Delivery of Hydrogeologic Data for Delaware;" and with Daniel J. Leathers, David R. Legates, **John H. Talley**, Kevin R. Brinson, and Linden S. Wolf, "A Prototype Coastal Flood Monitoring System for Delaware," Fourth Delaware Estuary Science and Environmental Summit, Cape May, NJ, Jan. 30-Feb. 2, 2011.

Thomas E. McKenna, "A Simple Model for Evaluating Tidal Inundation of Wetlands in the Murderkill Estuary (Kent County, Delaware)," Fourth Delaware Estuary Science and Environmental Summit, Cape May, NJ, Jan. 30-Feb. 2, 2011.

Peter P. McLaughlin, Invited speaker, "More Than Turning On The Tap: Understanding the Groundwater of Southern Delaware and the Hidden Geology That Holds It," University of Delaware Annual Land and Sea Lecture Series, UD Virden Center, Lewes, DE, Mar. 26, 2010.

Kelvin W. Ramsey, "Pliocene and Quaternary Stratigraphy of Delaware: Implications for Correlation of Atlantic Coastal Plain Deposits with the Marine MIS Record" Southeastern and Northeastern Sections of the Geological Society of America,. Baltimore, MD, Mar. 15, 2010.

William S. Schenck, "National LiDAR Applications and Benefits: A Perspective from the States," American Geographers annual meeting, Washington, DC, Apr. 14, 2010.

John H. Talley, "Groundwater Availability, Trends in Water Use, and Potential Conflicts," Pickle Packers International spring meeting, Philadelphia, PA, Apr. 15, 2010.

Service and Awards

Congratulations to **Steven V. Bertsche**, **John A. Callahan**, and **Laura K. Wisk** for 21, 15, and 11 years of service, respectively, at the Delaware Geological Survey and the University of Delaware, and to **A. Scott Andres** for (26), **Stefanie J. Baxter** (15), **Peter P. McLaughlin** (11), **Lillian T. Wang** (11), and **Miriam L. Pomilio** (5) years of service at the Delaware Geological Survey.

John A. Callahan, **Karen L. D'Amato**, **Thomas E. McKenna**, and **Peter P. McLaughlin** represented the DGS at the University of Delaware's Coast Day, Lewes, DE, Oct. 3, 2010.

John A. Callahan co-organized the University of Delaware's Geospatial Research Day held in the Trabant University Center, Newark, DE, Nov. 19, 2009; wrote and proctored the exam for Delaware high school students for the Delaware Science Olympiad, Remote Sensing Event**,** Delaware State University, Dover, DE, Mar. 6, 2010.

Miriam L. Pomilio was in charge of registration and the K-12 student contest for the Delaware GIS 2010 conference held at the Sheraton Conference Center in Dover, DE, Mar. 29-30, 2010; helped organize GIS Day, a statewide event, Dover Air Mobility Command Museum, Dover Air Force Base, Dover, DE, Nov. 18, 2010.

William S. Schenck attended the National States Geographic Information Council (NSGIC) meeting in Annapolis, Md., Mar. 3-8, 2010; participated as a subject matter expert on the Association of State Boards of Geology (ASBOG) fall council of Examiners Workshop and served as the Delaware Board of Geology voting delegate at the annual business meeting, St. Louis, MO, Nov. 4-7, 2010; led a Piedmont geology fieldtrip for the A.I. DuPont High School earth science class along the Wilmington Western Railroad, Wilmington, DE, Nov. 17, 2010.

John H. Talley serves on the Delaware Bay Shore Work Group convened by DNREC Secretary Collin P. O'Mara and co-chaired by Senators Brian J. Bushweller and F. Gary Simpson. John also serves on the Bureau of Ocean Energy Management, Regulation, and Enforcement's Delaware Renewable Energy Uses of the Outer Continental Shelf (OCS) Task Force.

Lillian T. Wang co-chaired the conference planning subcommittee and was webmaster for the Delaware GIS 2010 conference held at the Sheraton Conference Center in Dover, DE, Mar. 29-30, 2010.

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