

Delaware Geological Survey

FY 2026 Operational Budget Hearing

Joint Finance Committee
February 18, 2025

Outline:

- I. Introduction
- II. DGS Mission
- III. DGS Budget Summary
- IV. Annual Report of Programs and Activities 2021-2022
- V. DGS Staffing and Performance Measures



OUR MISSION

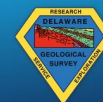
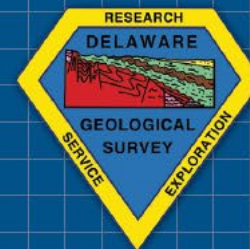
The Delaware Geological Survey's mission is, by statute, geologic and hydrologic research and exploration, and dissemination of information through publication and public service.



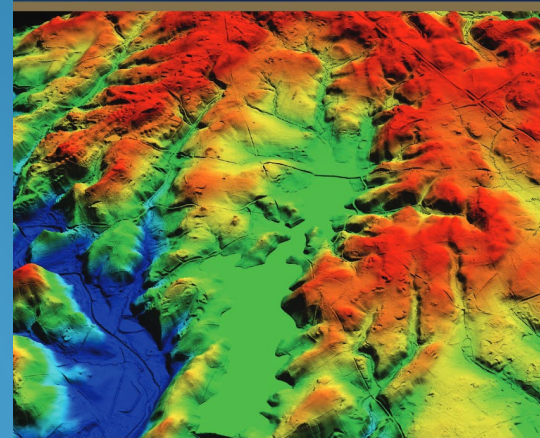
Delaware Geological Survey

DGS Building
257 Academy Street
University of Delaware
Newark, DE 19716-7501

www.dgs.udel.edu



DELAWARE GEOLOGICAL SURVEY
ANNUAL REPORT OF
PROGRAMS & ACTIVITIES



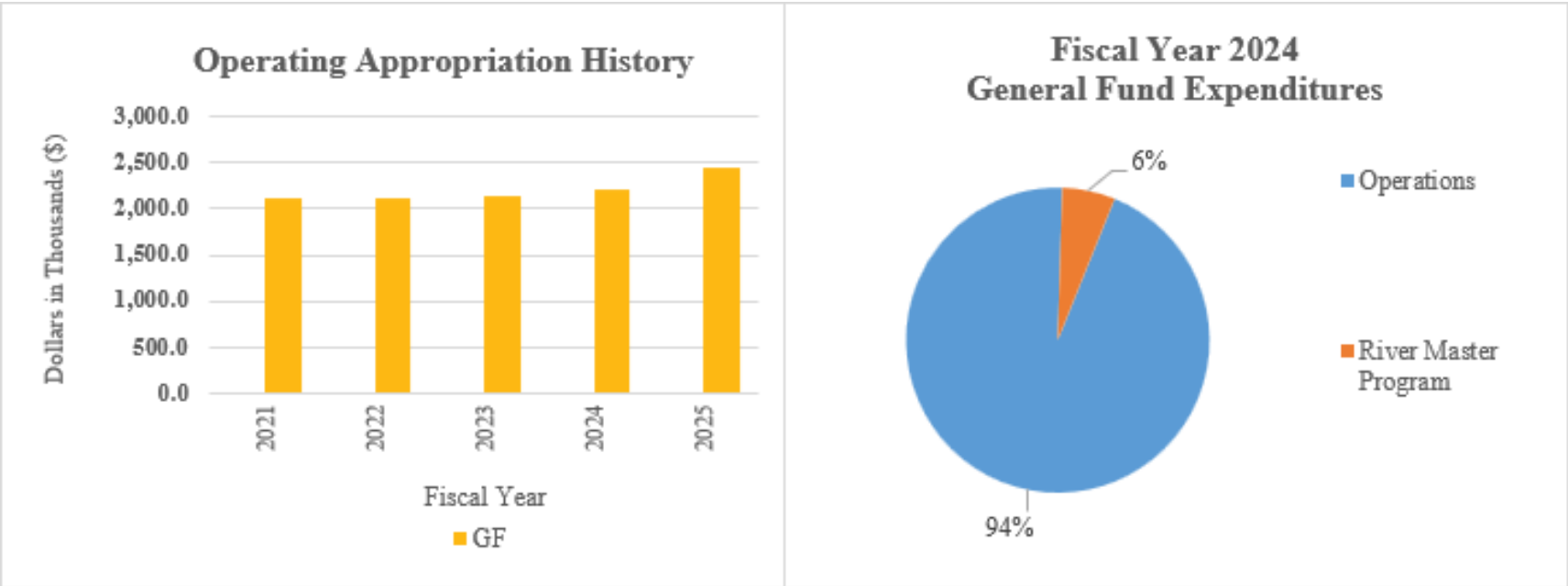
2023-2024

Delaware Geological Survey's Mission:

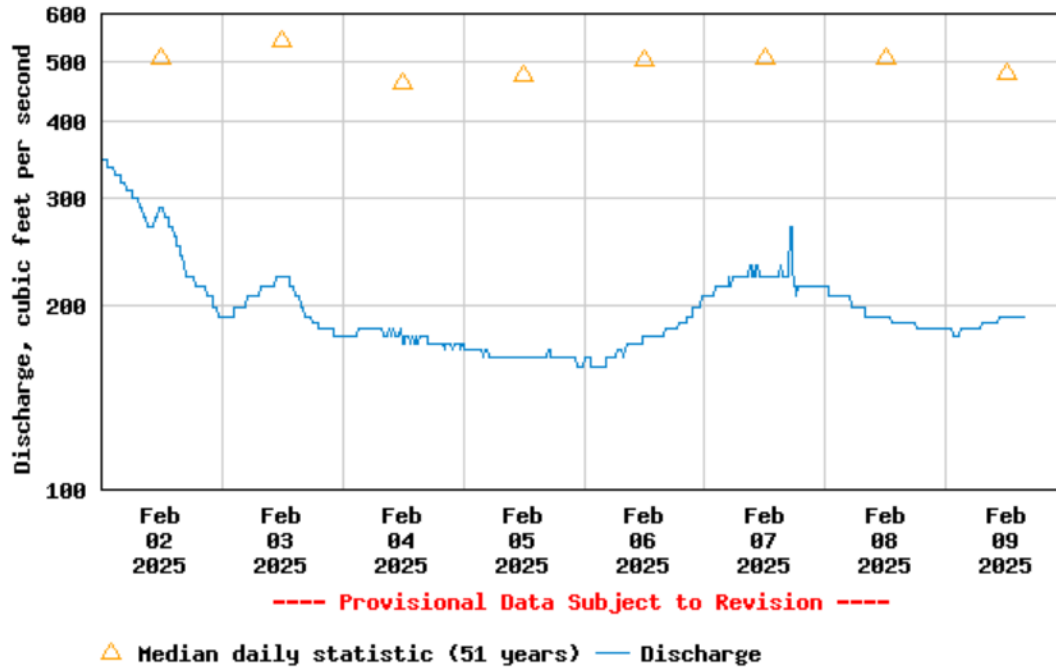
- **Our focus is value-added science for public needs**
- **Program built on 4 primary areas:**
 - (1) **water resources**
 - (2) **geology & mapping**
 - (3) **natural hazards**
 - (4) **information and data dissemination**



DGS Appropriation History

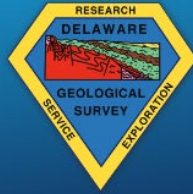


USGS 01481500 BRANDYWINE CREEK AT WILMINGTON, DE

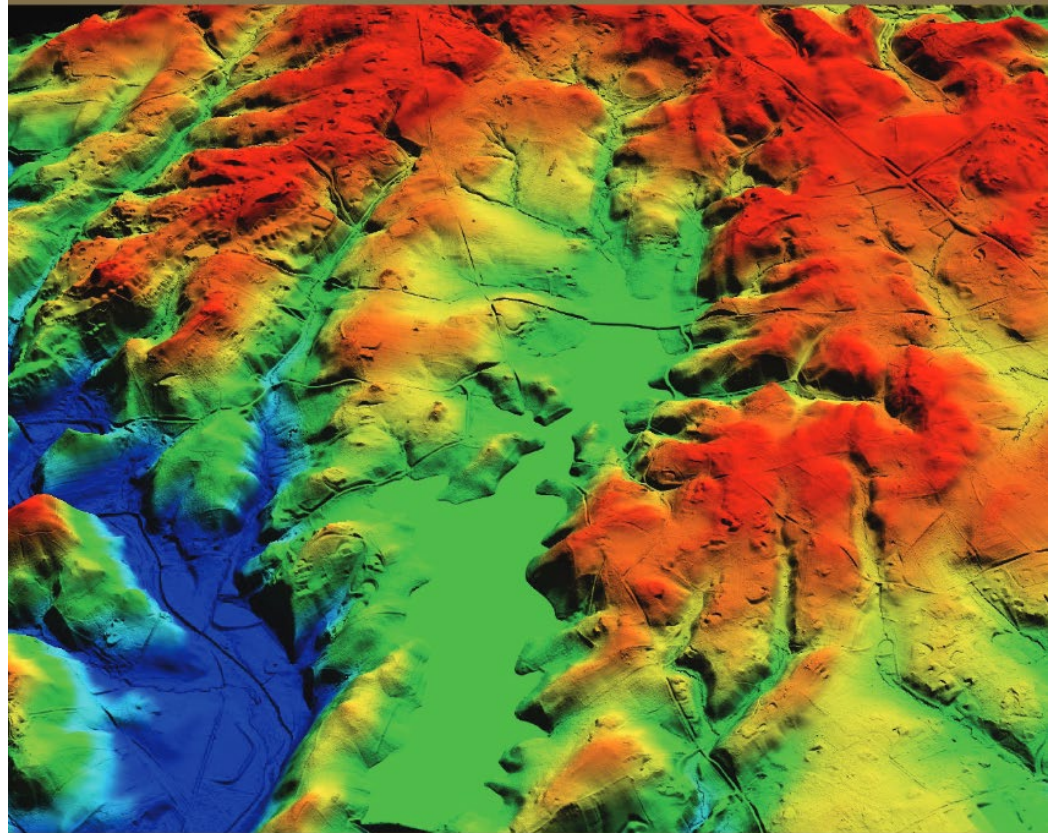


\$40.0K Inflation/Volume adjustment:

- Need to cover state's share to operate the state's stream and tide gages
- Gages are operated through a federal/state cooperative program (USGS/DGS)
- Used for flood warnings, evaluating drought conditions, water management, etc.
- In 2018 state funding to DGS for this program reduced from \$93.2K to \$73.5K
- Over past 4 years, DGS has been operating with ~ \$10.0K shortfall per year
- Partnering agencies have contributed more to make up shortfall
- Expected shortfall for 2025 will be \$30.0K



DELAWARE GEOLOGICAL SURVEY
**ANNUAL REPORT OF
PROGRAMS & ACTIVITIES**



2023-2024

Please refer to
***DGS Annual Report
of Programs & Activities***
for details on the following slides

1. Water Resources

Delaware Groundwater Monitoring Network

Project Contacts: Changming He, Rachel W. McQuiggan, and Thomas E. McKenna

DGS currently monitors groundwater levels and groundwater quality in a network of wells that support multiple uses by the environmental management, engineering, water supply, and science communities

Groundwater Monitoring Network Infrastructure Expansion: Sussex County, Delaware

Project Contacts: Changming He, Rachel W. McQuiggan, David R. Wunsch, Thomas E. McKenna, and Katherine Buell-Fleming

In fall 2023, the DGS began a multi-year project to install new groundwater monitoring infrastructure and collect baseline data in Sussex County, Delaware

Delaware Stream and Tide Gage Program

Project Contact: Stefanie J. Baxter

Ongoing DGS program to advise state and local agencies on stream conditions and flooding on the basis of a cooperative DGS-USGS program to operate stream and tide gages

Stormwater Infiltration BMP Impacts on Groundwater and Infiltration

Project Contacts: Rachel W. McQuiggan and Katherine Buell-Fleming

Evaluating the impacts of winter deicing salt to groundwater, soil chemistry, and infiltration

The Coastal Critical Zone

Project Contact: Rachel W. McQuiggan

Studying coastal processes to understand critical feedbacks related to climate change

Assessing SWI Risk and Vulnerability in Coastal Delaware

Project Contact: Rachel W. McQuiggan

Many coastal regions are at risk of seawater contaminating fresh groundwater resources from saltwater intrusion (SWI)

Assessing Water Quantity in Delaware – Water Tracker

Project Contacts: Kevin Brinson – UD Center for Environmental Monitoring (CEMA), Changming He, and Stefanie J. Baxter

Water-tracking tool under development to quantify water availability across Delaware

2. Geology & Mapping

Middle Atlantic Coastal Plain Stratigraphic Reconciliation Initiative

Project Contact: Peter P. McLaughlin

USGS-funded multistate initiative to establish equivalency of geologic units

Proposed Delaware Subsidence Monitoring Network

Project Contacts: Thomas E. McKenna, Changming He, Daniel L. Warner, and David R. Wunsch

Quantifying and mapping land subsidence along Delaware Bay

Assessing 21st Century Beach Sand Supply and Demand along the Mid-Atlantic Coast

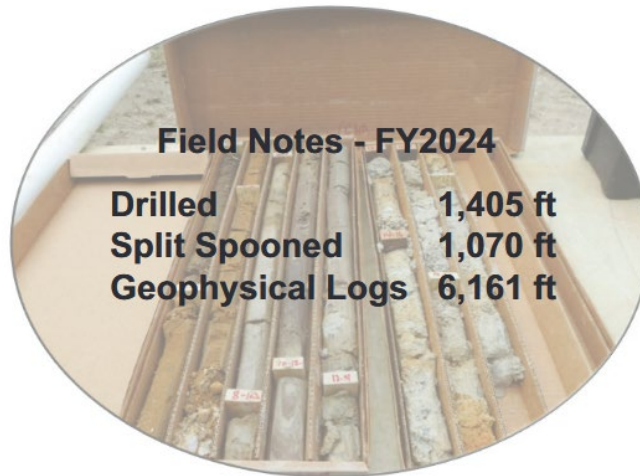
Project Contacts: Daniel L. Warner and David R. Wunsch

Modeling 21st century beach sand supply and demand on Delaware and Maryland's Atlantic coastline

Delaware Geologic Mapping Program

Project Contact: Jaime L. Tomlinson

Mapping the surficial geology of Delaware through the STATEMAP federal cost-share program

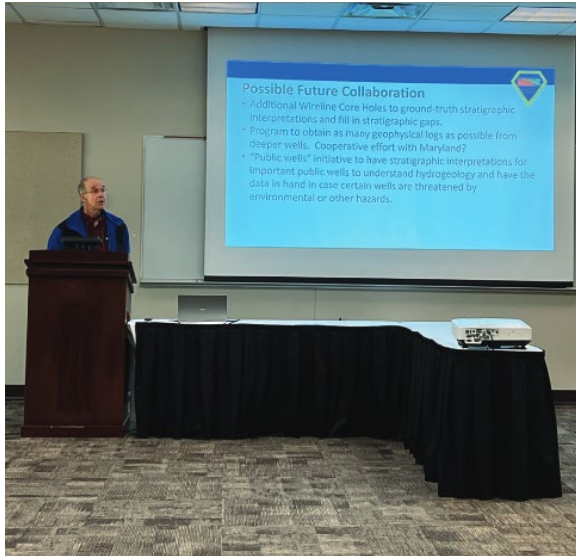


Borehole Log Data Preservation Project

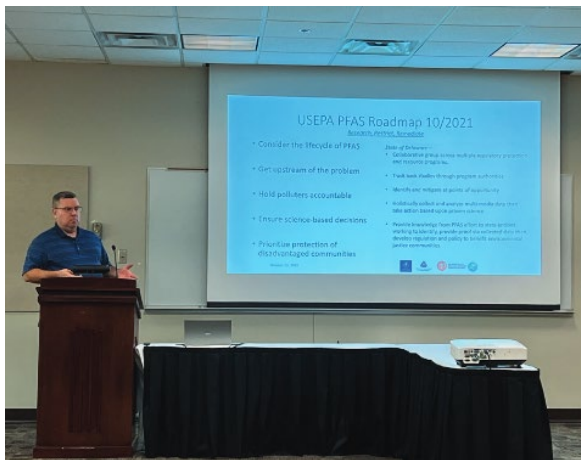
Project Contact: Peter P. McLaughlin

Two NGGDPP funded projects help the DGS preserve lithology log and geophysical log data for future studies

DGS and DNREC Hold Second Professional Retreat



"Meeting with the professional staff from DNREC provided valuable feedback for DGS scientists to help guide our research programs in order to provide optimal benefits for DNREC personnel that use our data and expertise on a regular basis" remarked DGS Director David Wunsch.



"DNREC and DGS have had an excellent long-standing relationship that has enabled us to better understand and manage the natural resources of our State. The sharing of information between our programs and the collaboration of our collective staff greatly strengthens both organizations. The recently established DGS/DNREC retreat provide us with the opportunity to continue these efforts and strengthen those relationships, particularly as both agencies bring on new staff" noted Steve Smailer, Director of the DNREC Division of Water.

3. Natural Hazards

DGS Natural Hazards Emergency Response Program

Project Contacts: Stefanie J. Baxter and David R. Wunsch

Coordination of DGS activities related to assessing natural hazards and risks associated with earthquakes, floods, and storms, and providing support to emergency managers

April 5, 2024 Earthquake near Tewksbury, New Jersey

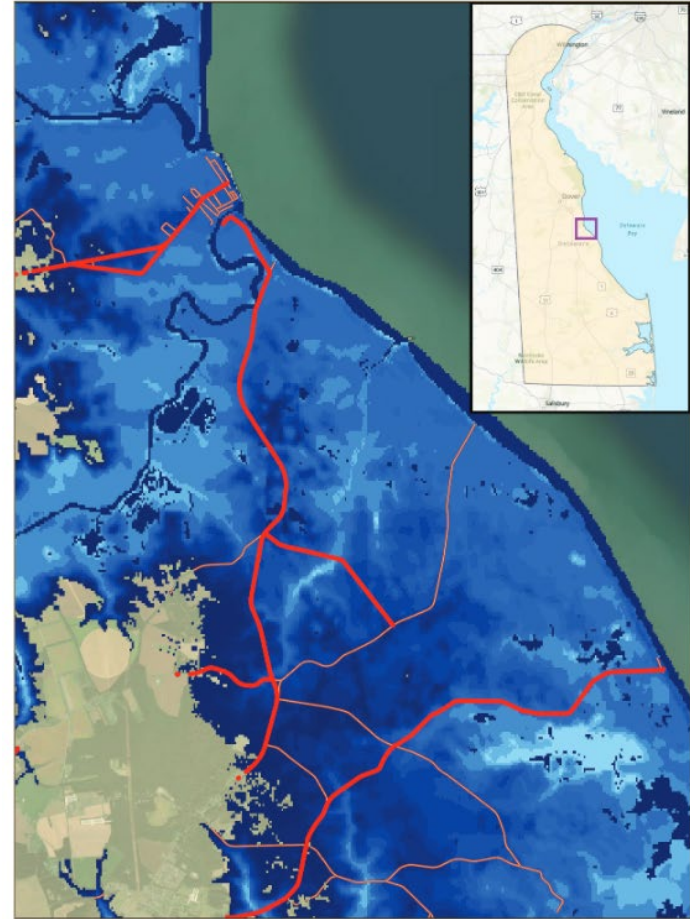
Project Contact: Stefanie J. Baxter

DGS Seismic Network used to help inform scientists of earthquake epicenter

Assessing transportation impacts of nuisance and major coastal flooding in Kent County, Delaware

Project Contact: Daniel L. Warner

DGS is part of a collaborative effort to help inform coastal resilience strategies in Kent County



Road segments affected by a simulated Category 1 Hurricane surge with 0.5 m of sea-level rise, which will likely be reached in the next 30 to 50 years. Affected roads are marked in orange, while critical roads are marked in dark red. Roads are classified as "critical" if they are the sole or primary access road to a community, a major thoroughfare, or the primary access to emergency services.

DGS Education Outreach and Community Engagement

The DGS provides opportunities to enhance STEM (Science, Technology, Engineering, and Mathematics) education programs in the state. We also participate in forums where we can engage with members of the public to answer questions and make educational as well as other earth science materials available.



DGS Coast Day display showing how different natural environments move through geologic time.

UD's College of the Earth, Ocean, and Environment (CEOE) hosts their annual Coast Day at the Lewes Campus in southern Delaware each fall. The DGS has engaged the coastal community at Coast Day for over 20 years. Visitors interact with the DGS staff, prompted by poster displays, rocks, cores, and hands-on activities for children. New and rotating exhibits are displayed. Our exhibits focus on geology, water resources, and natural hazards. Activities for children have included searching for fossils, painting with natural clay minerals, and a Pet Rock Petting Zoo. Visitors are provided with samples of the state mineral (Sillimanite) and the state fossil (Belemnite).



DGS display featuring the bedrock geologic map of the Delaware Piedmont with samples of the bedrock units.

Students from UD's Dr. Michelle Chrapa's Sedimentology and Stratigraphy class were introduced to DGS's drilling equipment during a demonstration at the University of Delaware's farm property. For over 10 years, DGS staff have been providing students in the geology class a "hands-on" opportunity to observe the drilling rig operations and the extraction of geologic core. Students were then mentored by DGS geoscientists in how to describe the core in the field. Core samples were also collected by the students for further examination and interpretation in the classroom.



Senior Research Technician and licensed driller, Steve McCreary, explains how the drill rig and drilling tools work.



Senior Scientist, Pete McLaughlin, showing the students how to describe core materials while in the field.

4. Information and Data Dissemination

Online Open Data Access

Project Contact: Lillian T. Wang

DGS research data available online and via web mapping services

Online XML and Mapping Applications

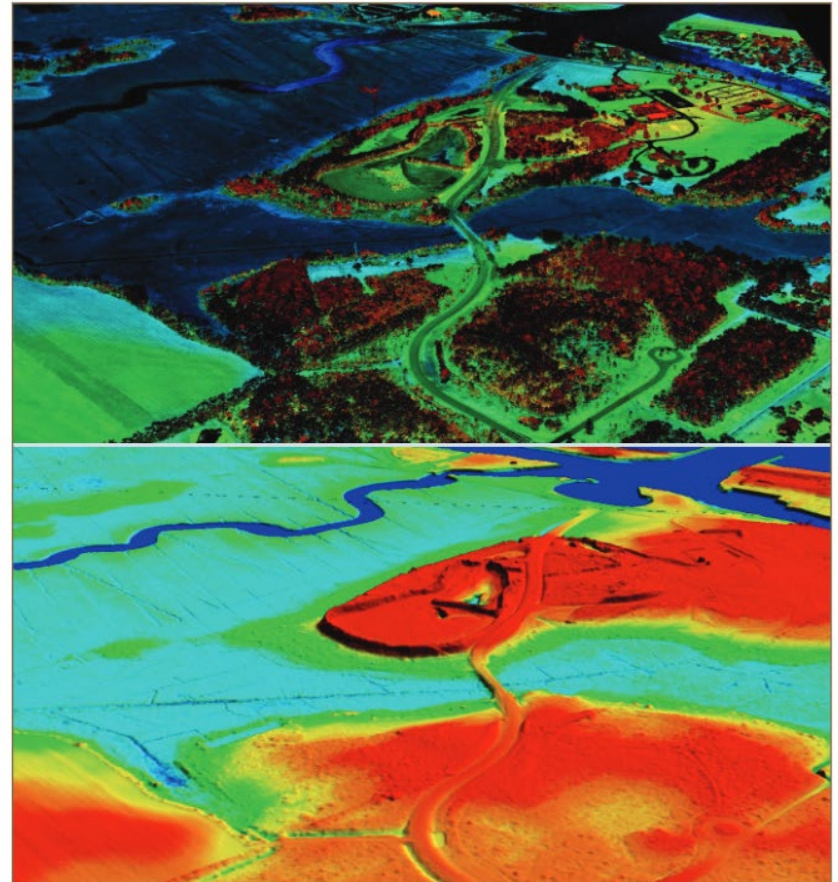
Project Contacts: Changming He and Daniel L. Warner

Delivering DGS data to state agencies and the public using web-based technologies

Statewide LiDAR and 3D Hydrography

Project Contacts: Daniel L. Warner and David R. Wunsch

New Quality Level 1 LiDAR being flown in Delaware to produce a new DEM and surface hydrography dataset



Example of a LiDAR point cloud (top) that captures ground, vegetation, structures, boats, and even birds. The point cloud is filtered and interpolated to produce a digital elevation model (bottom) that provides a smooth surface of local topography. Note that these data are vertically exaggerated 5x to make it easier to distinguish major features.

PUBLICATIONS

DGS PUBLICATIONS COMPLETED

GEOLOGIC MAPS

GM 27 Geologic Map of the Elkton, St. Georges, and Delaware City Quadrangles, Delaware, **Tomlinson, J.L.** and **Ramsey, K.W.**

GM 28 Geologic Map of the Frederica and Bennetts Pier Quadrangles, Delaware, **Tomlinson, J.L.** and **Ramsey, K.W.**

OPEN FILE REPORTS

OFR 56 Early Mesozoic Rift Basins in Delaware: A Review of their Occurrence and an Assessment of their Carbon Potential, KunleDare, M.A., 2024, 39 p.

DGS PUBLICATIONS IN PROGRESS

REPORT OF INVESTIGATIONS

RI 86 Kent County Groundwater Monitoring Project: Hydrogeology and Salinization Dynamics of Eastern Kent County (*in press*).

OPEN FILE REPORTS

OFR 57 Groundwater Monitoring Procedures Part 2: Equipment and Procedures for Collection of Water-Quality Samples from Monitoring Wells (*in press*).

GEOLOGIC MAPS

GM 29 Geologic Map of the Newark West, Newark East, and Wilmington South Quadrangles, Delaware.

EXTERNAL PUBLICATIONS BY DGS STAFF

Gardner, K. and **McLaughlin, P.P.**, 2023, Paleocene-Eocene Palynology and Stratigraphic Correlation Across a Nearshore-to-Offshore Transition in the Subsurface of Central Delaware (U.S. Mid-Atlantic Coastal Plain), Geological Society of America Abstracts with Programs, v. 55, no. 6, doi: 10.1130/abs/2023AM-392817.

McLaughlin, P.P., Browning, J.V., Miller, K.G., Nishi, F.Z., **Ramsey, K.W.**, Robinson, M.M., Self-Trail, J., **Tomlinson, J.L.**, and Utsunomiya, M., 2023, Paleogene-Neogene Stratigraphy of a New Continuously Cored Hole at Sandtown, Delaware, Geological Society of America Abstracts with Programs, v. 55, no. 6 doi: 10.1130/abs/2023AM-394187.

McQuiggan, R., Andres, A.S., Roros, A., Sturchio, N.C. and **Buell-Fleming, K.**, 2023, Road Salt Impacts Groundwater Quality and Recharge in Stormwater Management Areas, Geological Society of America Abstracts with Programs, v. 55, no. 6, doi.org/10.1130/abs/2023AM-395006.

Warner, D.L., **Ramsey, K.W.**, and **Wunsch, D.R.**, 2023, Assessing 21st Century Offshore Beach Sand Supply and Demand in Delaware and Maryland, Sterling VA: U.S. Department of the Interior, Bureau of Ocean Energy Management Cooperative Agreement M22A00001, 47 p.

Wunsch, D.R. and Schreiber, R.P., 2024, Calling All Groundwater Professionals: Support the National Groundwater Monitoring Network, Groundwater, May-June Issue, doi: 10.1111/gwat.13398.

PROFESSIONAL PRESENTATIONS

McKenna, T.E., Influence of Geology and Historical Mining and Ditching on the Flooding of an Estuarine Barrier at Slaughter Beach, Delaware, Geological Society of America Annual Meeting, Pittsburgh, Pennsylvania, October 15-18, 2023.

McLaughlin, P.P. Jr., Paleogene-Neogene Stratigraphy of a New Continuously Cored Hole at Sandtown, Delaware, Geological Society of America Annual Meeting, Pittsburgh, Pennsylvania, October 15-18, 2023.

McLaughlin, P.P. Jr. and Gardner, K., Paleocene-Eocene Palynology and Stratigraphic Correlation Across a Nearshore-to-Offshore Transition in the Subsurface of Central Delaware (U.S. Mid-Atlantic Coastal Plain), Geological Society of America Annual Meeting, Pittsburgh, Pennsylvania, October 15-18, 2023.

Warner, D.L., Mapping Elevation Levels in Delaware's Coastal Marshes, University of Delaware Ocean Currents Lecture Series, Lewes, Delaware, August 17, 2023.

Warner, D.L., Callahan, J.A., **McKenna, T.E.**, and Medlock, C., 2024, Reducing Vertical Bias in Delaware Coastal Wetland DEMs with Machine Learning, Delaware Wetlands Conference, Wilmington, Delaware, February 6-7, 2024.

Warner, D.L., **Ramsey, K.W.**, and **Wunsch, D.R.**, 2023, POSTER: Assessing 21st Century Offshore Beach Sand Supply and Demand in Delaware and Maryland, American Shore and Beach Preservation Association Annual Meeting, Providence, Rhode Island, October 10-13, 2023.

Warner, D.L., **Ramsey, K.W.**, and **Wunsch, D.R.**, 2024, Assessing 21st Century Offshore Beach Sand Supply and Demand in Delaware and Maryland, Association of American State Geologists Annual Meeting, Park City, Utah, June 1-6, 2024.

Wunsch, D.R., The Hydrogeology of Delaware, National Ground Water Association, Hydrology of the States Seminar Series, August 9, 2023.

Wunsch, D.R., Exploration Borehole to Determine the Feasibility of a Deep Injection Well in Delaware for the Disposal of PFAS Waste, Senator Chris Coons Office, Washington, D.C., February 27, 2024.

Wunsch, D.R., Water Resources: Science, Policy, and Ethics in the Changing World, Keynote Speaker at UD College of Earth, Ocean, and Environment School of Marine Policy Student Research Forum, Lewes, Delaware, May 17, 2024.



Group photo of the students and faculty who participated in the CEOE School of Marine Policy Student Research Forum at UD's Lewes Campus on May 17, 2024. DGS Director, David Wunsch, served as the Keynote Speaker for the event.

DGS staff produced:

- 2 new geologic maps
- 1 open file report
- 5 external publications
- 10 professional presentations

DGS Service to Professional Societies, Boards, and Committees

American Association of Petroleum Geologists Committee on Preservation of Geoscience Data	Delaware Water Supply Coordinating Council
American Geophysical Union	Delaware Water Well Licensing Board
American Geosciences Institute, Executive Committee	Directory of Public Repositories of Geological Materials Working Group
Association of American State Geologists	Federal Geologic Mapping Advisory Committee
Association of American State Geologists Foundation	Geological Society of America, Academic and Applied Geoscience Relations Committee
Bureau of Ocean Energy Management (BOEM) Central Atlantic Intergovernmental Renewable Energy Task Force	Geological Society of America, Hydrogeology Division, Liaison to AGI
Center for the Inland Bays, Hydrodynamic/Water Qual- ity Model Workgroup	International Continental Scientific Drilling Program
Chesapeake Bay Vertical Land Motion Project	National Association of State Boards of Geology
Center for the Inland Bays Scientific and Technical Advisory Committee	National Association of State Boards of Geology Council of Examiners
Cushman Foundation for Foraminiferal Research, Board of Directors	National Geologic Map Database, Geologic Map Schema Working Group
Cushman Foundation for Foraminiferal Research, Chairperson for Student Awards Committee	National Index of Borehole Information Working Group
Delaware Department of Natural Resources Source Water Protection Program Citizen and Technical Advisory Committee	New Castle County Resource Protection Area Technical Advisory Committee
Delaware Emergency Management Agency State Hazard Mitigation Council	New Castle County Water Supply Coordinating Council
Delaware Environmental Institute (DENIN) Internal Advisory Board	New Jersey-Delaware Tidal Marsh Working Group
Delaware Emergency Management Agency Technical Assessment Center Group	North American Cartographic Society
Delaware Geographic Data Committee	River Master Advisory Committee
Delaware Geologic Mapping Advisory Committee	River Master Decree Party Workgroup
Delaware River Basin Commission Regulated Flow Advisory Committee	University of Delaware Center for Environmental Mon- itoring and Analysis (CEMA) Advisory Board
Delaware State Board of Geologists	University of Delaware Engagement Council of Public Engagement
Delaware Water Resources Advisory Committee	University of Delaware Ph.D. and M.S. Student Committees
	U.S. Board on Geographic Names

**DGS staff served on 41
boards, task forces, and
committees.**

DGS Staffing and Performance Measures



Staff Directory



David R. Wunsch
Ph.D., P.G.
dwunsch@udel.edu
302-831-8258



Stefanie J. Baxter P.G.
steff@udel.edu
302-831-1576



Madeline R Belknap
mbelknap@udel.edu
302-831-1704



Isabelle M Bristol
ibristol@udel.edu
302-831-0397



Katherine Buell-Fleming
kbf@udel.edu
302-831-4872



Changming He
hchm@udel.edu
302-831-4917



Shayne M. Linzy
slinzy@udel.edu
302-831-0843



Paul "Steve"
McCreary
mccreary@udel.edu
302-831-8261

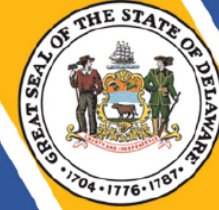
Expertise

- administration (2)
- coastal plain geology (3)
- data preservation (2)
- digital data (2)
- hydrogeology (8)
- modeling (2)
- publications (3)
- remote sensing (2)
- sedimentology (2)
- subsurface geology (6)
- technical (2)

Currently 17 full-time staff:

- Recent hire: Coastal Geologist (June 1 start date)
- One position being created: Scientific Applications Consultant II
- Typically, DGS hires several student workers throughout the year

Delaware Geological Survey



Performance Measures

IPU	Performance Measure Name	Fiscal Year 2024 Actual	Fiscal Year 2025 Budget	Fiscal Year 2026 Governor's Recommended
90-01-02	<i>Delaware Geological Survey</i>			
	# of geologic mapping square miles (cumulative)	2,814	2,916	2,974
	# of DGS well records in database	60,463	62,075	63,686
	# of water level records in database (millions)	42.1	45.9	49.7
	# of water salinity observations to look for sea level rise & salt water intrusion (millions)	8.3	9.2	10.1
	# of stream gages	10	10	10
	# of tide gages	7	7	7
	# of website page views (annual)	170,000	173,400	173,400

Director Reflects on his Career at DGS

It's very likely that the Director's column in our next edition of the DGS Annual Report will be written by a new director as I am planning to retire in the late spring of 2025. I came to the DGS in November 2011, and it has been a distinct honor to serve as the State Geologist and Director of DGS over the past 13 years. I can't say enough about the hard-working and talented staff that I've had the pleasure of working with over the course of my tenure here. I have learned a lot from them, and I hope the experience has been mutual.

Soon after settling in as Director, one of the first initiatives we undertook was to conduct a survey of our stakeholders as part of a strategic approach to evaluate the quality and quantity of the programs, services, and geoscience information we provide. In addition, we also requested feedback with regard to future challenges and data needs to serve our stakeholders. This was a very valuable exercise, and I believe we have made significant progress based on the comments we received.

DGS has survived through statewide budget challenges, the Covid pandemic, and changes in leadership in our college and the university at large. Our state appropriation for our operational budget is a direct line in the state budget, so we've always been evaluated on our performance by the state Office of Management and Budget, and the State Legislature's Joint Finance Committee. During my tenure, I'm pleased to say that even with minor state budget cuts along the way, when you include our annual cost contingency appropriation to adjust for inflation, DGS has not received a net reduction in our budget. This is a great testament to the work and production of DGS staff, and the value and respect we have earned from state officials and sister state agencies. Relatedly, over the past decade DGS staff have been recognized by receiving several national awards for the quality and impact of our scientific reports and geologic maps, and several of our research scientists have achieved

fellowship in professional geoscience societies.

From a fiscal perspective, DGS has significantly increased the percentage of our total research budget provided by external grants and cooperative agreements from federal agencies such as the U.S. Geological Survey, Bureau of Ocean and Energy Management, the Department of Energy by way of the Battelle Institute, and the National Science Foundation. This has allowed us to broaden the scope of our research portfolio, which is highlighted in this Annual Report.

The health and safety of our staff and their work environment has always been paramount to me as director. And during my remaining time at DGS, my goal is to place the survey in the best possible position with regard to personnel and infrastructure to help ensure the next director's success.

To this end, we have experienced significant upgrades to our building over the past decade. For example, we have replaced our office furniture for ergonomic comfort and performance, improved our laboratories' lighting and safety infrastructure, and provided safety training for staff and purchased wall-mounted AED's, and insulated plumbing and added dehumidifiers to control the climate in our core repository. We also had a new roof installed on our building, and we are currently replacing all our exterior doors with added modern keyless entry technology. Through special appropriations from the legislature, were able to modernize our vehicle fleet, purchase a new, larger and safer boat for our coastal open-water work, and improve and modernize our IT infrastructure for performance and cybersecurity.

From a scientific and data collection perspective, we have upgraded our seismic instrumentation from 1960s vintage hardware to modern multi-



channel broadband seismometers. Working with state partners, we have significantly expanded the number of groundwater monitoring wells across the state. DGS developed excellent working relationship with the Delaware Department of Transportation (DelDOT), where they share their geologic cores and logs from Delaware construction projects with DGS for archiving, and we also started meeting annually with the Department of Natural Resources and Environmental Control (DNREC) during a professional retreat to learn more about their science and data needs that DGS can provide. And as the lead agency for contracts with the U.S. Geological Survey, we have managed programs to have statewide Q2 LiDAR data collected, which allowed DGS to produce 1-foot elevation contours; and currently, Q1 LiDAR and high-resolution hydrography data are being generated for the state.

In closing, it has been my honor and privilege to be a member of the University of Delaware community, and to serve the state as the Director of the DGS. I hope we have managed to secure your trust and belief in the scientific support we provide for the state. In some ways, it's hard for me to think about retirement when I've been active and working for most of my life, but I have a bucket list to keep myself busy. Best wishes to all!

David R. Wunsch

David R. Wunsch
Director and State Geologist



QUESTIONS?

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DGS Building
257 Academy Street
University of Delaware
Newark, DE 19716-7501
Phone: 302-831-2833
www.dgs.udel.edu

