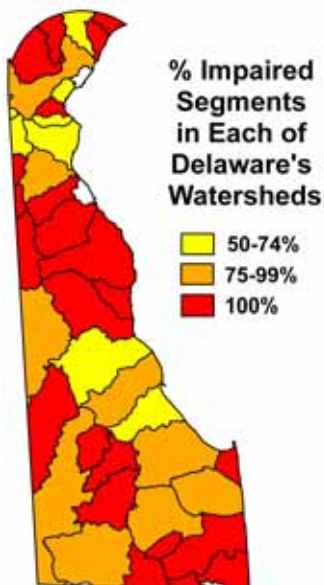




Delaware Water Quality

In the Fall 2002 issue of Delaware Water Resources Center (*DWRC*) WATER NEWS, we highlighted Delaware's Department of Natural Resources and Environmental Control's (*DNREC's*) goals and achievements promoting Delaware water quality. This issue presents an update on these and new projects over the past four years, as well as a variety of other programs and initiatives by other organizations underway to protect and improve water quality in Delaware.

Promoting Delaware Water Quality: DNREC Goals and Achievements Update



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To ensure that Delaware waters meet state, regional and national water quality requirements and goals, the State has one of the most extensive water quality monitoring networks in

the nation. Delaware water resources are regularly tested for biological and chemical parameters.

Acceptable standards for Delaware surface water quality measurements were revised and adopted effective July 11, 2004 by the Delaware Department of Natural Resources and Environmental Control (*DNREC*). These standards now protect swimmers better by making accepted bacteria levels consistent with U.S. Environmental Protection Agency guidance and 2000 federal Beaches Environmental Assessment and Coastal Health (BEACH) Act requirements.

Tracking long-term progress toward improving Delaware's water resources is possible thanks to the growing bank of water quality data. Trends and testing results are reported in even years in the State's 305 (b) report. Waters that do not meet water quality standards are listed in the State's 303 (d) list. Both are online at: <http://www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/305and303.htm>.

A federal court order addresses Delaware's non-attainment of Clean Water Act standards, as described in the 303 (d) list. The order requires the development of "total maximum daily load" (TMDL) regulations for nearly the entire state according to a schedule that stretches into 2010. TMDLs establish the maximum amount of pollutants a water body can receive daily without violating water quality standards, allowing the use of these waters for swimming, fishing, and drinking water supplies. TMDLs are being established for PCBs (polychlorinated biphenyls), toxics, nutrients, dissolved oxygen, and bacteria. In December 2003, TMDLs were finalized for PCBs in the Delaware Estuary in cooperation with the Delaware River Basin Commission. Information on this effort, including monitoring and plan implementation, is found at: http://www.state.nj.us/drbc/toxics_info.htm. (cont.)

In this Issue, on the web at: <http://ag.udel.edu/dwrc/news.html>

<i>DNREC</i> Water Quality Initiatives 2002 - present	1-3	A "Green" Home for the <i>Center for the Inland Bays</i>	5
Water Lectures & State Forum: Oct. and Nov. 2006	4	<i>DWRC</i> Announces Nine New 2006-2007 Interns	6-7
<i>USGS</i> Delaware Water Quality Programs	4	<i>DWRC</i> Advisory Panel Changes	7
<i>DNMC</i> Nutrient Management News	5	<i>DWRC</i> History, Goals, Advisory Panel, Contacts	8

TMDLs for nutrients, dissolved oxygen, and bacteria will be completed by 2007 in all affected watersheds. For completed TMDLs, see: <http://www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/tmdlinfo.htm>.

Pollution Control Strategies (PCSs) and Tributary Action Teams (TATs): Once TMDLs are in place, Pollution Control Strategies (PCSs) are developed to ensure continued compliance with the court order and to achieve water quality standards. A PCS addresses how, where, and when pollutant loads will be reduced to achieve TMDL levels. The PCSs generally offer voluntary and regulatory strategies for urban, suburban and agricultural land uses. They are developed through a public process based on recommendations by Tributary Action Teams (TATs), groups of stakeholders formed with the purpose of addressing water quality concerns.

The first PCS in the State, developed to address the TMDLs in the Inland Bays, has been drafted and is anticipated to be final in the winter of 2007. Final

PCSs for the Nanticoke, Murderkill, and Appoquinimink watersheds are also expected to be developed in 2007. In the Inland Bays, Nanticoke, Murderkill, and Appoquinimink watersheds, the TAT process and the development of a draft PCS has taken up to seven years. However, an expedited process has been developed to shorten the PCS development process to 15-18 months in new watersheds where TATs are formed. Since 2005, new TATs have been formed in the Christina, St. Jones, Broadkill, Chester and Choptank watersheds to work on water quality strategies there. **DNREC** looks forward to recommendations from those teams by the end of 2007. Over the next several years, new teams are expected to be formed in the remaining Delaware impacted watersheds.

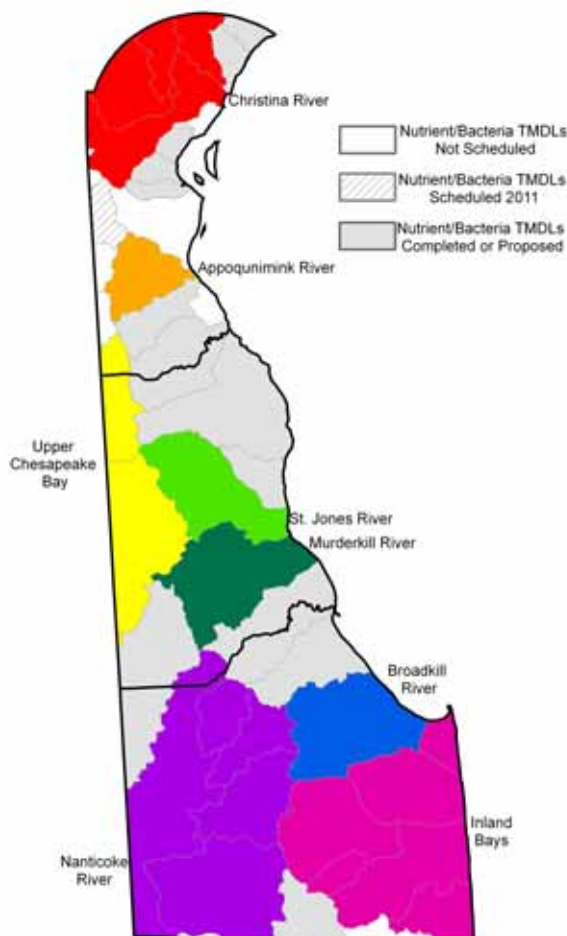
Watershed projects addressing water quality concerns require cooperation, not just in government interactions, but between members of Tributary Action Teams as well. The Center for Inland Bays, University of Delaware Cooperative Extension, the Sea Grant Program at the University of Delaware College of Marine Studies, University of Delaware Water Resources Agency, Delaware State Cooperative Extension, the Camden-Wyoming Rotary Club, the Delaware Nutrient Management Commission, New Castle, Kent and Sussex County governments, Sierra Club, the county conservation districts, USDA, other **DNREC** divisions and many others have been vital contributors and partners in the development of PCSs and TATs.

For information and progress of the Tributary Action Teams, please visit: <http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/>.

Other DNREC Water Quality Initiatives:

Sediment and Stormwater: Amended Sediment and Stormwater Regulations became effective in April 2005. The revised regulations require the use of "green technology" stormwater treatment practices to better address water quality concerns associated with site development. These practices may also include the use of conservation design principles in stormwater management plans. For details, see <http://www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/StormWater.htm>.

Non-point Source (NPS) Pollution: **DNREC** continues to reduce non-point source pollution through enhanced coordination of the Division of Soil and Water Conservation Cost Share Programs. These are implemented through the USEPA's NPS Management 319 Program, the National Oceanic and



Delaware Tributary Action Teams' Completed – Scheduled TMDLs

Atmospheric Association's (NOAA's) Coastal NPS Management 6217 program, a Delaware Department of Agriculture Nutrient Management Commission (DNMC) program, and more. The effort allows the Department to direct millions of dollars every year toward a comprehensive NPS program to reduce pollutant loads, restore streams and buffers, and install best management practices (BMPs). Example pollution-targeting practices are cover crops, nutrient management plans, manure storage structures, manure relocation, and also urban BMPs within impaired watersheds. More information on the NPS 319 program is available at:

<http://www.dnrec.state.de.us/dnrec2000/Divisions/Soil/NPS/index.htm>;

and information on Delaware's Coastal Management Program is available at:

<http://www.dnrec.state.de.us/dnrec2000/Divisions/Soil/dcmp/index.htm>.

Stream and Wetland Restoration: Rehabilitating stream corridors and wetlands, stabilizing stream banks, decreasing erosion, improving biological water quality and providing buffers along streams for riparian habitat are examples of the types of projects



Author Jennifer Campagnini while a DWRC undergraduate intern, 2000

DNREC has implemented to improve water quality in our watersheds. Projects completed in the last few years include Perkins Run in northern New Castle County, Mill Creek at the Three Little Bakers Theater in Pike Creek, and a wetlands restoration project at Christ Our Teacher Catholic School.

Onsite wastewater treatment (septic) systems:

Regulations for onsite wastewater treatment systems were revised in 2002 and again in April of 2005. Legislation was also recently passed creating a Class H Licensed Septic Inspector Program. Grant funds have been used during the last few years to implement septic system and holding tank pumpout and inspection programs in Sussex County. Both programs have been very successful in identifying failing systems and allowing **DNREC** to provide assistance to system owners in making repairs or replacements as needed. The Department has also been working with the wastewater community to develop new performance standards for onsite wastewater systems. See:

<http://www.dnrec.state.de.us/water2000/Sections/GrndWat/DWRGrndWat.htm>.

Source water assessment and protection: The **DNREC** Source Water Assessment and Protection Program (**SWAPP**) provides for the assessment and protection of all sources of public drinking water, both surface and ground water. Delaware SWAPP is a cooperative effort between **DNREC**, Delaware Division of Public Health, and the University of Delaware's Water Resources Agency. A citizen's advisory group (CTAC) was formed to assist **DNREC** in the development and implementation of the program and to ensure public involvement. SWAPP is a multi-phase program that is expected to be completed in the next few years. Assessment consists of three critical steps: first, delineation of source water areas; second, identification of existing and potential sources of contamination; and finally, assessment of the susceptibility of the source water area to contamination. The "Site Index Database" identifies the location and status of existing and potential sources of source water contamination within the State. Most potential point sources have been mapped and rated.

In 2004, the Source Water Protection Program developed a guidance manual for local governments. This document was updated in 2005. For more information on source water protection, please visit: <http://www.wr.udel.edu/swaphome/index.html>.

Cooperation is key: Cooperation among DNREC, residents, other agencies-state and federal, universities, county and municipal governments, conservation districts, and non-governmental organizations (NGOs) helps bring Delaware water goals to fruition. Finding a solution for cleaner water will require more innovative solutions, greater regulatory control, additional financial resources, and a willingness to make a change by everyone affecting Delaware's watersheds, as we are all part of the problem and we must work together to find a reasonable solution for all.

Fall 2006 DWRC Sponsored Events

*** Red Clay Creek Lecture Series ***

Tues. Oct. 10:

"Flood, Drought - Where's the Balance?"

Wed. Nov. 8:

"The Way to a Healthy Watershed"

Ashland Nature Center

*** 6th Annual State Delaware Water Forum ***

Mon. Oct. 16: "The Delaware: Challenges and Opportunities Affecting a Working and Environmental River"

UD Clayton Hall

Details TBA <http://ag.udel.edu/dwrc/>

USGS Delaware Water Quality Programs

By U.S. Geological Survey

Delaware State Office Director William Guertal and

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<http://md.water.usgs.gov/>

The U.S. Geological Survey (**USGS**) is a Bureau of the Department of the Interior. Since 1879, we have provided the Nation with reliable, impartial information to describe and understand the Earth. This information is used to minimize the loss of life and property from natural disasters; manage water, biological, energy and mineral resources; and enhance and protect the quality of life. To this end, we conduct ongoing studies that contribute to knowledge of how water and chemicals move naturally through the hydrologic system and how humans affect the natural system.

The **USGS** has been involved in the study of Delaware's water resources for several decades—through cooperative studies with state partners such as the Delaware Geological Survey, Department of Natural Resources and Environmental Control, and Department of Transportation; and federal partners including the Department of Defense and U.S. Environmental Protection Agency.

The major ongoing USGS water-quality project in Delaware has been the National Water-Quality Assessment (**NAWQA**) Program, active on the Delmarva Peninsula since the mid-1980s. Studies of ground-water quality in Delaware — especially in the unconfined aquifer overlying most of the surface of



*Groundwater radon sampling:
USGS Technician Deb Bringman*

the state — is the primary focus. The surface aquifer supplies water to streams and for public use. It is vulnerable to contamination by human activities, as the sediments are often permeable sands and the water table is

relatively shallow in many places. NAWQA studies have found median nitrate concentrations in the surficial aquifer of about 5 mg/L Peninsula-wide, and greater than 10 mg/L, the Federal standard for drinking water, in about one-third of the wells sampled in the part of the aquifer used for domestic drinking water supply. These numbers indicate widespread effects of human activities, because nitrate concentrations under natural conditions are less than 1 mg/L. Nitrate concentrations were greater

than 3 mg/L in about half of the headwater streams on Delmarva. Watersheds having the highest percentage of agricultural land use and permeable, well-oxygenated sediments generally had the highest nitrate concentrations in streams. Low concentrations of pesticides, commonly detected in ground water and throughout the year in streams on the Peninsula, rarely exceed established standards for drinking water and aquatic life. For more NAWQA findings: <http://md.water.usgs.gov/nawqa/podl/podlhome.htm>

Four other USGS ongoing water projects:

- * Real-time hydro-logic monitoring, in collaboration with the State at 23 stream gages, 10 tidal gages, and one well for flood forecasting and drought tracking. The real-time data are available on **USGS's** Maryland / Delaware / DC District web site: <http://md.water.usgs.gov/>



*Brandywine Creek Gage 01481500
Wilmington, DE dates to 1946. Visit http://waterdata.usgs.gov/de/nwis/uv/?site_no=01481500&PARAMeter_cd=00065,00060*

- * Determining the source and extent of any elevated mercury concentrations within the Columbia Aquifer, an important source of drinking water for the Long Neck area of Sussex County. <http://md.water.usgs.gov/publications/sir-2006-5011/index.html>

- * Updating peak-flow frequency estimation techniques and implementing StreamStats (web tools at <http://water.usgs.gov/osw/streamstats/>) for the State of Delaware, providing Department of Transportation (DeIDOT) with information needed for hydrologic modeling.

- * Using LIDAR (*Laser Imaging Detection and Ranging*) data for improving elevation data for eastern Kent County. This improved vertical resolution (10 cm) will be useful for applications such as storm surge modeling, sea-level rise prediction, flood plain delineation, ditch inventory and mapping, and wetland delineation. Work is progressing to acquire LIDAR data for the entire state of Delaware. LIDAR data and hyperspatial imagery are also being used to identify and delineate stands of domestic and invasive *Phragmites* at the Prime Hook National Wildlife Refuge, working in conjunction with the US Fish and Wildlife Service (USFWS).



Nutrient Management News: An Update on Delaware's Nutrient Management Program

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www.state.de.us/deptagri/nutrients/index.shtml

The **Delaware Nutrient Management Commission's** Nutrient Management Program is designed to improve water quality in Delaware while preserving valuable agricultural industries. It meets these goals through education and certification of nutrient generators, handlers, planners, and consultants; cost-sharing programs; approval of alternative-use projects for excess manures; and more. In its April 2006 Annual Report to Governor Minner, the **DNMC** summarized progress toward its stated priority goals:

Nutrient Management Education and Certification:

Legislation passed in 1999 requires implementation of mandatory nutrient management education, planning, and management standards by any business operation that applies nutrients to greater than ten acres or manages 8,000 pounds of animals. By January 2003, the Commission had issued 2,170 three-year or one-year certifications to private and commercial nutrient handlers, generators and consultants. All certified individuals must also participate in ongoing continuing education programs to maintain their certification status. During 2005, 33 continuing education classes were offered at 17 locations by University of Delaware Cooperative Extension and **DNMC** staff, private agri-service companies, and other consultants.

Nutrient Management Planning: Nutrient management plans required by the 1999 state law are being phased in over a 5-year period and will be completely implemented by January 2007. Many nutrient management plans were voluntarily implemented ahead of these deadlines by early cooperators. In 2005, nutrient management plans were developed for 112,477 acres and, to date, 388,841 acres (85%) of agricultural crop land are now being managed under **DNMC** approved nutrient management practices.

Nutrient Management Implementation and the Nutrient Relocation Program (NRP): In addition to nutrient management plan development by individual program participants, a wide array of environmental protection and conservation measures are being implemented with Federal, State and local

funding. The U.S. Natural Resources Conservation Service (**NRCS**) and **DNREC** have supported manure handling structures, mortality management, and cover crops to protect surface and ground waters; **NRCS** additionally funds vegetative buffers to prevent nutrient runoff into streams. **DNMC's** Nutrient Relocation Program (**NRP**) provides state aid to farmers, brokers, or trucking businesses dealing with more manures than are needed on their farms to meet crop nutrient requirements. In 2005, the Commission reimbursed costs to relocate 35,770 tons of poultry litter from Delaware farms. Destinations are other peninsula area farms for land application or alternative use sites such as mushroom or fertilizer producers. Perdue's AgriRecycle pellet-fertilizer plant located in Blades, Delaware, processed a total of 56,600 tons and relocated another 5,052 raw tons for land application in 2005 without NRP cost assistance.

Other programs: **DNMC** implements a variety of strategies to meet the intent of Delaware Nutrient Management Law. These include creating a 2001 formal nutrient management agreement with poultry companies; restricting phosphorous applications to crop removal rate; encouraging use of phytase enzymes in poultry feed to reduce phosphorus excretions; recognizing small farm environmental stewards; and resolving law violation complaints. For additional information, please visit:

http://www.state.de.us/deptagri/nutrients/nm_anrpt.shtml

New "Green" Home for the Center for the Inland Bays



CIB's "recycled" Coast Guard barracks home, Delaware Seashore State Park, spring 2006.

Under consideration for a sustainable future:
*sealing doors, windows, ducts to cut energy loss;
making electricity with photovoltaic cells and wind turbine;
using alternative materials such as bamboo flooring and
recycled material countertops;
collecting / recycling roof runoff with rain barrels;
fitting a recycling station into kitchen casework; and
using water-conserving native landscaping.*

Nine *DWRC* Internship Winners for 2006 - 2007

Nine undergraduate students were selected in April 2006 for Delaware Water Resources Center (*DWRC*) internships for summer 2006 through February 2007. Applicants from the University of Delaware and Delaware State University teamed with faculty advisors to propose projects earning the students up to \$3500. The new internships bring to 69 the number of undergraduate projects funded by the *DWRC* to date in collaboration with ten co-sponsors: the Delaware State University (*DSU*), University of Delaware's (*UD's*) College of Arts and Sciences (*CA&S*), College of Agriculture and Natural Resources (*CANR*), College of Engineering (*CENG*), College of Marine Studies (*CMS*), Institute of Soil and Environmental Quality (*ISEQ*), Department of Plant and Soil Sciences (*PLSC*), and Water Resources Agency (*WRA*), and also the Delaware Geological Survey (*DGS*) and Delaware Division of Natural Resources and Environmental Control (*DNREC*).

UD third-year Environmental Science and International Relations double major **Jennifer Boutin** hopes to learn more about the impact of global climate change on the hydrological cycle, both globally and in the local Delmarva region. Her *DWRC / UD College of Arts and Science (CA&S)* - sponsored internship project "The Effect of Proposed Climatic Warming on the Hydrological Cycle" will be advised by Dr. David Legates of the *UD* Department of Geography. Jennifer will investigate contradictory studies of rate of change of the hydrological cycle. She will then compare regional flood, drought, and storm frequency and intensity data from the Delaware State Climate Office and Delaware Geological Survey to related global data.

Belinda Gao, a *UD* first-year Chemical Engineering major, will be researching "Enhanced Pollutant Biodegradation by Electrode Use" for her *DWRC / UD College of Engineering* co-sponsored project. Her internship advisor is Dr. Steven Dentel of *UD's* Department of Civil and Environmental Engineering. Belinda will study the practicality of using electrodes for water pollution treatment in situations where a lack of oxygen would otherwise inhibit microbial oxidation of organic material. She will build on the work of four prior *DWRC* engineering interns, all advised by Dentel. Aditya Sharma and Bret Stroger in 2002-2003, also advised by Dr. Pei Chiu of the same department, and Andrew Joslyn and Kate Schutte in 2003-2004, established that electricity is also generated as a by-product of the biodegradation of organic substances using the electrode method.



New *DWRC* intern Elizabeth Wolff extracting pressure readings from a monitoring well in Middletown, Delaware

Dr. Judith Hough-Goldstein of the *UD* Department of Entomology and Wildlife Ecology will serve as advisor for a *DWRC / UD College of Agriculture and Natural Resources (CANR)* co-sponsored internship research project "Predators of *Galerucella* Beetles, Biocontrol Agents of Purple Loosestrife", undertaken by *UD* fourth-year Entomology major **Jason Graham**. Jason, along with former *DWRC* intern Jamie Pool, has studied the effectiveness of beetles released at sites at Ashland Nature Center and Flat Pond near the C & D canal in controlling stands of a targeted invasive freshwater plant. Now he hopes to investigate to what extent potential predators such as praying mantids, ladybird beetles, arachnids, and assassin bugs are feeding on the biocontrol beetles, as a possible explanation for their failure to establish a colony in the Ashland location.

Garrett Peters, a *UD* third-year Civil Engineering major, will be working with advisors Dr. William Ullman and Dr. Douglas Miller of the *UD College of Marine Studies (CMS)* on his *DWRC / CMS* co-sponsored internship project, "Measuring Groundwater Discharge to the Inland Bays". Garrett will investigate the patterns and rates of groundwater seepage and any related ecological and environmental impacts to the coastal zone. He hopes to use new methods, such as water temperature, as an indicator of the rate of groundwater flow as well as more traditional methods that use salinity as an indicator of flow. The region of study will include the northern edge of the Indian River, locations in the Inland Bays, and marshy areas.

Dr. Diane Herson of the *UD* Department of Biology will advise another *DWRC / Institute of Soil and Environmental Quality (ISEQ)* co-sponsored project titled "Detection of *Salmonella* in Biosolids using PCR". Fourth-year *UD* Biology major **Samantha Smith** will build on her *DWRC*

internship research of last year, in which she compared the effectiveness of a combination of techniques versus a new method proposed by the EPA to detect and count *Salmonella* in treated biosolids. Samantha now aims to develop a short-term, effective procedure using PCR (polymerase chain reactions) that will decrease the length of time and cost of detection of these pathogens.

Container aquaculture of oysters is becoming a viable industry addressing oyster decline caused by overfishing, reef destruction, sedimentation, and disease. This practice may provide many of the same ecological services attributed to natural or restored reefs. Examining the benefits or detriments of oyster farms on macroinfauna, or animals living in aquatic sediments large enough to be seen with the naked eye, is the goal of **Le'Sasha Stewart's** project "*An Assessment of Macro-infauna Associated with Oyster (*Crassostrea Virginica*) Aquaculture, Indian River Bay, Delaware*". She hopes her research will shape the future fate and structure of shellfish aquaculture in Delaware and elsewhere. A first-year Delaware State University (**DSU**) Biology major, Le'Sasha will be advised by Dr. Gulnihal Ozbay of the **DSU** Department of Agriculture and Natural Resources for her **DWRC** - sponsored internship.

"*Sustainable Mosquito Control for Storm-water Ponds*" is the title of **Sarah Sturtz's** internship, co-sponsored by **DWRC / CANR** under the advisement of Dr. John Gingrich of the UD Department of Entomology and Wildlife Ecology. A fourth-year UD Biology major, Sarah will build on previous research by **DWRC** 2005-2006 intern Nancy McGehee Scott and 2003-2004 intern Megan Bielawa studying conditions promoting the breeding of West Nile virus vector mosquitoes in retention ponds. Sarah will investigate the success and cost-effectiveness of applications to retention ponds of aluminum sulfate with the goal of reducing mosquito-feeding nutrients with minimum effects on non-target organisms.

Jarvon Tobias, a UD fourth-year Animal Science pre-veterinary major, will be researching "*The Effects of Dietary Level and Source of Copper on Broiler Copper Excretion and Movement of Copper through Broiler Excreta-Amended Soils*" for her **DWRC / ISEQ** co-sponsored project. The advisor for this internship, which is a continuation of work done by 2005-2006 **DWRC** intern Carolyn Schnek, is Dr. William Saylor of UD's Department of Animal and Food Sciences. From her research on the effects of copper in poultry feed on the fate of copper in manures applied to cropland, Jarvon hopes to improve our understanding of how diets can be

formulated to optimize poultry health while protecting water quality.

The Columbia unconfined aquifer of Delaware's southern New Castle County is a water source for domestic, irrigation, and public well use, the source of all base flow in local streams, and a conduit to all ground water in deeper confined aquifers. Measuring the saturated hydraulic conductivity of this important aquifer is the goal of **Elizabeth Wolff's** project "*Hydraulic Properties of the Unconfined Aquifer in Southern New Castle County*". She hopes her research will then allow future quantitative analysis of water availability, sustainable pumping rates, and contaminant transport. A fourth-year UD Environmental Science major, Elizabeth will be advised by Mr. Scott Andres of the **Delaware Geological Survey (DGS)** for her **DWRC / DGS** co-sponsored internship.

The DWRC welcomes William Guertal, David Hansen, Paul Imhoff, Shreeram Inamdar, and Andrew Manus



U.S. Geological Survey
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Shreeram Inamdar of UD's Department of Bioresources Engineering (inamdar@udel.edu, (302) 831-8877), and
 The Nature Conservancy – Delaware's Director **Andrew Manus** (amanus@tnc.org, (302) 684-5351) will now represent these organizations on the **DWRC Advisory Panel**.

The DWRC thanks

Steven Dentel, UD Department of Civil and Environmental Engineering, **Judith Denver**, U.S. Geological Survey, **Ken Lomax**, UD Department of Bioresources Engineering, **Paul Petrichenko**, USDA Natural Resources & Conservation Service and **William Saylor**, UD Department of Animal and Food Science, **as they step down from our state Advisory Panel!**



Thank you all for your many years of energy and service forwarding the DWRC's water resources research mission in Delaware.

***The Delaware Water
Resources Center***

The Delaware Water Resources Center (DWRC), established in 1965, is part of a network of 54 Water Resources Research institutes throughout the nation. The DWRC receives funding through Section 104 of the Water Resources Research Act of 1984. The U.S. Geological Survey administers the provisions of the Act and provides oversight of the nation's Water Resources Centers. The primary goals of the DWRC are: to support research that will provide solutions to Delaware's priority water problems, to promote the training and education of future water scientists, engineers, and policymakers, and to disseminate research results to water managers and the public. For further information, visit our website:

<http://ag.udel.edu/dwrc/>

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WATER NEWS – SUMMER 2006

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